Journal of Biomedical Education

Nutrition Education for the Health Care Professions

Guest Editors: Martin Kohlmeier, Caryl A. Nowson, Rose Ann DiMaria-Ghalili, and Sumantra Ray

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Editorial Board

Contents

Nutrition Education for the Health Care Professions, Martin Kohlmeier, Caryl A. Nowson, Rose Ann DiMaria-Ghalili, and Sumantra Ray
Volume 2015, Article ID 380917, 2 pages

The Rationale, Feasibility, and Optimal Training of the Non-Physician Medical Nutrition Scientist, Susan E. Ettinger, Jennifer A. Nasser, Ellen S. Engelson, Jeanine B. Albu, Sami Hashim, and F. Xavier Pi-Sunyer
Volume 2015, Article ID 954808, 6 pages

Working with Individuals Who Provide Nursing Care to Educate Older Adults about Foodborne Illness Prevention: The *Food Safety Because You Care!* Intervention, Kelly C. Wohlgenant, Sandria L. Godwin, Sheryl C. Cates, and Richard Stone
Volume 2015, Article ID 513586, 5 pages

Hydration: Knowledge, Attitudes, and Practices of UK Dietitians, Pauline Douglas, Lauren Ball, Lynn McGuffin, Celia Laur, Jennifer Crowley, Minha Rajput-Ray, Joan Gandy, and Sumantra Ray
Volume 2015, Article ID 172020, 6 pages

The State of Nutrition Education at US Medical Schools, Kelly M. Adams, W. Scott Butsch, and Martin Kohlmeier
Volume 2015, Article ID 357627, 7 pages

A Survey of Medical Students' Use of Nutrition Resources and Perceived Competency in Providing Basic Nutrition Education, Rebecca Connor, Lynn Cialdella-Kam, and Stephanie R. Harris
Volume 2015, Article ID 181502, 7 pages

New Zealand Medical Students Have Positive Attitudes and Moderate Confidence in Providing Nutrition Care: A Cross-Sectional Survey, Jennifer Crowley, Lauren Ball, Dug Yeo Han, Bruce Arroll, Michael Leveritt, and Clare Wall
Volume 2015, Article ID 259653, 7 pages

Learner-Directed Nutrition Content for Medical Schools to Meet LCME Standards, Lisa A. Hark, Darwin D. Deen, and Gail Morrison
Volume 2015, Article ID 469351, 12 pages

Enabling Valuation of Nutrition Integration into MBBS Program, Niikee Schoendorfer and Jennifer Schafer
Volume 2015, Article ID 760104, 6 pages

Nutrition Knowledge, Attitudes, and Confidence of Australian General Practice Registrars, Caryl A. Nowson and Stella L. O'Connell
Volume 2015, Article ID 219198, 6 pages

Student Perceptions of Nutrition Education at Marshall University Joan C. Edwards School of Medicine: A Resource Challenged Institution, W. Elaine Hardman, Bobby L. Miller, and Darshana T. Shah
Volume 2015, Article ID 675197, 8 pages

Nutri One-on-One: The Assessment and Evaluation of a Brief One-on-One Nutritional Coaching in Patients Affected by Metabolic Syndrome, Jennifer King, Jeffrey E. Harris, David Kuo, and Farzaneh Daghigh
Volume 2015, Article ID 580287, 6 pages

University Education in Human Nutrition: The Italian Experience—A Position Paper of the Italian Society of Human Nutrition, Luca Scalfi, Furio Brighenti, Nino Carlo Battistini, Alessandra Bordoni, Alessandro Casini, Salvatore Ciappellano, Daniele Del Rio, Francesca Scazzina, Fabio Galvano, and Nicolò Merendino
Volume 2015, Article ID 143083, 8 pages

Developing Research Competence in Undergraduate Students through Hands on Learning, Zoe E. Davidson and Claire Palermo
Volume 2015, Article ID 306380, 9 pages

Making an IMPACT: The Story of a Medical Student-Designed, Peer-Led Healthy Eating and Physical Activity Curriculum, Avik Chatterjee, Thomas N. Rusher, Julia Nugent, Kenneth W. Herring, Lindsey M. Rose, Dean Nehama, and Natalie D. Muth
Volume 2015, Article ID 358021, 5 pages

A Novel Method of Increasing Medical Student Nutrition Awareness and Education, Cynthia L. Schoettler, Jennifer N. Lee, Kathy A. Ireland, and Carine M. Lenders
Volume 2015, Article ID 784042, 8 pages

Analysis of Nutrition Education in Osteopathic Medical Schools, Kathaleen Briggs Early, Kelly M. Adams, and Martin Kohlmeier
Volume 2015, Article ID 376041, 6 pages

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Editorial

Nutrition Education for the Health Care Professions

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Nutrition and related lifestyle factors greatly impact well-being in health and disease. The World Health Organization defines nutrition as "the intake of food, considered in relation to the body's dietary needs. Good nutrition—an adequate, well balanced diet combined with regular physical activity—is a cornerstone of good health. Poor nutrition can lead to reduced immunity, increased susceptibility to disease, impaired physical and mental development, and reduced productivity" (http://www.who.int/topics/nutrition/en/). At the level of the population, we are grappling with the challenges of the double burden of both over- and undernutrition. Despite the profound impact good nutrition has on health and wellness, the science of nutrition and its application to health care are not fully integrated in most health professions training programs. This gap is further compounded by the fact that patients and the public remain confused about the correct nutritional advice to follow given the widespread media interest attracted by diet and the disparity in nutrition-related health messages that are in circulation. While dietitians are recognized as the health care professionals with nutrition expertise, all health care professionals need to be knowledgeable and competent in nutrition as it applies to health promotion and prevention, as well as treating acute and chronic diseases. Fewer than 100,000 registered dietitians and other state-licensed nutrition professionals practice in the USA. This modest number is eclipsed by the more than 3 million physicians, physician assistants, nurses, pharmacists, dentists, and many other groups of US health care professionals. The distribution is similar in many other countries. For example, in Australia there are 2,831 dietitians: 0.03 per 1,000 compared to the ratio of physicians (3 per 1,000). In the UK, the number of dietitians to doctors in the health service is 3 per 100. Even in the presence of robust referral mechanisms between doctors and dietitians there still needs to be effective nutritional screening and triage by doctors in order to provide specialist input to the most appropriate patients. As a result, most of the non-nutritionist health care providers have to deal with nutrition-related conditions and diseases on a daily basis, but few are adequately prepared to recognize key diagnostic signs and then assist their patients and clients with effective interventions. This need for adequate nutritional training has global relevance because there is no region or country without significant impact of nutrition on health outcomes. Health care providers in developing countries often have to worry about different nutrition problems in their patients, but their need for adequate nutrition training is just as great as that of their colleagues in more affluent regions and is also often unmet. Recent exchanges between a number of countries have highlighted the fact that there is much in common with the nature of the problems relating to gaps

in medical and health care nutrition education worldwide. Potential solutions may also rely on common denominators.

The evidence base for practical use of nutrition-based preventive and curative interventions is rapidly growing and implementation research steadily improves delivery of best practices. There is little doubt that health professionals can be more effective in their daily practice when they draw on current nutrition knowledge and effective clinical skills. The challenge is to fit a core set of this nutrition information, based on synthesis of enduring evidence, into current undergraduate and postgraduate health care training schedules that are already bursting at the seams. In response to this challenge, the current issue focuses on nutrition education for the health care professions. The articles in this issue focus on 4 themes: current status of nutrition content in osteopathic and medical schools in the USA, innovative programs for integration of nutrition content in medical and osteopathic schools in the USA and Australia, knowledge gaps of practicing health care professionals in Australia, the UK and more widely, and translating nutrition research from the bench to the bedside in the USA and Australia.

An important question is how much nutrition education for future health care providers is enough. Thirty years ago, a panel commissioned by the Institute of Medicine in the USA mandated a minimum of 25–30 content hours of nutrition for medical school curricula [1]. In a recent survey of all US medical schools, K. M. Adams et al. found that most medical schools are not meeting this recommendation. Even more alarming is that the first ever survey conducted by K. B. Early et al. on nutrition content in osteopathic schools in the USA also follows a similar trend. This is concerning since osteopathic training by its nature is more holistic with the assumption that nutrition content would be more fully integrated in osteopathic schools than the traditional medical schools.

Even though most medical and osteopathic schools fall short of the required 25 hours of content, medical and osteopathic school faculty continue to implement innovative educational programs to integrate nutrition into existing curriculum. L. A. Hark et al. provide examples of how readily available resources can be integrated into medical schools to meet the LCME standards. A. Chatterjee et al., S. E. Ettinger et al., and J. King et al. provide examples of how to involve medical students in university or community-based nutrition programs to gain valuable experience by integrating nutrition knowledge in practice.

N. Schoendorfer and J. Schafer, R. Connor et al., J. Crowley et al., and W. E. Hardman et al. discuss how nutrition is integrated in their respective medical school curriculum in the USA and Australia. L. Scalfi et al. explain the structures of curricula for nutritionists in Italy. A common finding among these papers is that medical students recognize the importance of nutrition in chronic disease prevention and also acknowledge the need for more nutrition content in their programs early on.

A logical conclusion is that if health professionals do not receive adequate nutrition content during their training programs, this would lead to a knowledge gap when in practice. C. A. Nowson and S. L. O'Connell discuss the nutrition knowledge gap of Australian general practitioners and P. Douglas et al. discuss the knowledge and practice gaps related to dietitian-led hydration management in the UK. This also reflects the fact that some areas of nutritional management, such as hydration, are overlooked more than others. Ray et al. explore nutrition knowledge in a snapshot of doctors and dietitians in a region of India and whilst there are similarities with Western paradigms, there are also key differences. These papers clearly demonstrate the need for continued education in nutrition-related topics for all health care professionals.

The last set of papers in this special issue focus on translating nutrition research into practice across the health care professions. K. C. Wohlgenant et al. describe an innovative program delivered by nurses on food safety prevention in older adults in the USA. Z. E. Davidson and C. Palermo highlight the development of a research competency for undergraduate nutrition students in Australia. S. E. Ettinger et al. discuss a unique postgraduate fellowship program to prepare the nonphysician nutrition scientist for clinical nutrition research—moving discoveries from bench to bedside.

Reading across the piece, on one hand there is a need to position the nutrition education of health care professions such that it is informed by current research and high quality evidence whilst on the other hand continuing research into the clinical effectiveness of new educational initiatives. This is not a new concept but simply reflects the "Knowledge to Action" approach that connects research, education, and practice in many other disciplines. It is time that we consider its application to nutrition.

What our joint efforts underscore is the need for a forum where investigators and practitioners can share insights on the state of nutrition education for health care professionals and innovative instructional practices for improving their nutrition competencies.

We hope these articles will inspire nutrition educators and instructional investigators across the globe to further develop new programs or replicate existing ones, to enable nutrition into the curriculum of health professions education at the undergraduate and graduate levels.

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Caryl A. Nowson
Rose Ann DiMaria-Ghalili
Sumantra Ray

References

[1] Committee on Nutrition in Medical Education, Food and Nutrition Board, Commission on Life Sciences, and National Research Council, *Nutrition Education in U.S. Medical Schools*, The National Academies Press, Washington, DC, USA, 1985.

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Research Article

The Rationale, Feasibility, and Optimal Training of the Non-Physician Medical Nutrition Scientist

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Dietary components have potential to arrest or modify chronic disease processes including obesity, cancer, and comorbidities. However, clinical research to translate mechanistic nutrition data into clinical interventions is needed. We have developed a one-year transitional postdoctoral curriculum to prepare nutrition scientists in the language and practice of medicine and in clinical research methodology before undertaking independent research. Candidates with an earned doctorate in nutrition science receive intensive, didactic training at the interface of nutrition and medicine, participate in supervised medical observerships, and join ongoing clinical research. To date, we have trained four postdoctoral fellows. Formative evaluation revealed several learning barriers to this training, including deficits in prior medical science knowledge and diverse perceptions of the role of the translational nutrition scientist. Several innovative techniques to address these barriers are discussed. We propose the fact that this "train the trainer" approach has potential to create a new translational nutrition researcher competent to identify clinical problems, collaborate with clinicians and researchers, and incorporate nutrition science across disciplines from "bench to bedside." We also expect the translational nutrition scientist to serve as an expert resource to the medical team in use of nutrition as adjuvant therapy for the prevention and management of chronic disease.

1. Introduction

The ideal training and scope of practice of nutrition professionals has been a bone of contention for as long as medicine has existed. No less a physician than Hippocrates [1] wrote over 2400 years ago, "Let food be thy medicine and medicine be thy food." This recommendation has been supported by abundant evidence suggesting that specific components in food can ameliorate deleterious effects of metabolic derangements [2], inflammation [3], and organ dysfunction in humans and animals [4, 5]. Despite this suggestive evidence, and even in the face of widespread chronic disease and soaring medical costs, translation of these experimental findings into clinical trials to guide patient care has been limited [6].

Several questions must be addressed in clinical trials before targeted diet guidelines for humans can be established [7–9]. Areas in need of clarification include alteration in food composition due to production and processing methods, optimal nutrient dosage, bioavailability, interactions with other dietary components, and possible toxicity. Translation to actual patient care is further complicated by individual genetic profiles, differences in normal and transformed cell and tissue response to food components as a function of tissue specific receptors, and pathophysiologic changes due to concomitant diseases and chronological age. An additional layer of complexity results from the impact of food components on the vast microbiota in the gut, with multiple potential impacts on risk for cancer and chronic disease [10]. These concerns underscore the need to train a new nutrition professional with an understanding of the language and practice of medicine, competent to develop a nutrition-focused biological plausibility [11, 12], to solve clinical questions and to translate data into targeted nutrition guidelines for clinical care.

Theoretically, translational clinical research in medical nutrition could be accomplished by the physician with specialized postgraduate training. In 1995, the Committee on Clinical Practice Issues in Health and Disease of the American Society for Clinical Nutrition proposed that the American Board of Nutrition certify the physician nutrition specialist (PNS) [13]. The PNS was envisioned as functioning in all facets of nutrition services, from complex clinical nutrition support issues to community health promotion programs, and was expected to be especially valuable in the academic setting as a role model and educator. An Intersociety Professional Nutrition Education Consortium (IPNEC) was founded to establish educational standards and a unified mechanism for PNS certification. Actual nutrition training required for the PNS is largely clinical. Candidates complete as little as 6 months of mentored clinical nutrition experience and formal instruction, either as a block or as an equivalent amount of time (~1000 hours) integrated among other clinical duties over a longer time period. Approximately one-half of applicants indicated that they had completed some fellowship training in nutrition, either as stand-alone nutrition fellowships or combined with other subspecialties. As a result, in 2009, most of the 368 PNS diplomats surveyed indicated a career focus in clinical medicine, with few reporting a focus in clinical research [14]. The dearth of physicians who function as "pure" clinical nutritionists was described over 40 years ago by van Itallie [15] and continues to be of concern [16]. While PNS training creates physicians competent to provide medical nutrition care, it does not effectively create an academic professional whose primary focus is to identify a clinical problem, devise a mechanistic hypothesis to test the efficacy of targeted diet modification as adjuvant medical therapy, and conduct substantive translational clinical research.

McLaren [17] proposed that leadership in nutrition education and clinical research would be more effectively accomplished through collaboration between the PNS and a nutrition scientist who understands the language and practice of clinical medicine. Although the registered dietitian has been proposed as the ideal collaborator with the PNS [18], McLaren identified a clear distinction between nutrition and dietetics. He proposed that nutrition is an integral part of biology that deals with the physiological roles of food components, while the goal of dietetics is social: "to maintain or improve health through optimal feeding practices" [19]. We propose that the ideal collaborator must be a doctoral level nutrition scientist, cross-trained in the language and practice of medicine and competent to conduct clinical research. The Medical Nutrition Scientist (MNS) would also function as an educator and researcher and be in an ideal position to liaise with the physician and basic scientist to design targeted clinical studies to improve patient care.

2. Methods

Theoretically, the candidate for MNS training must have doctoral level expertise in food and nutrition science as set forth by the American Society for Nutrition [20]. This knowledge base encompasses clear understanding of food as a source of nutrients, bioavailability of nutrients and nonnutrient food components, risk from toxins and carcinogens in the diet, and the impact of food processing methods that modify diet components. The MNS must have a working knowledge of dietary factors that regulate whole body nutrient homeostasis and the composition and function of the gut microbiota. In addition, the MNS must have expert knowledge of the actions of the nutrients at the cellular and molecular levels.

Doctoral training in nutrition science is based on undergraduate prerequisites similar to those required for medical training: one year of physics, one year of biology, one year of English, and two years of chemistry through organic chemistry (prerequisites as specified by the Association of American Medical Colleges https://www.aamc.org/students/applying/requirements/). Expertise in nutrition science is achieved through graduate courses that focus on the molecular and cellular biochemistry of foods and nutrients, their relationship to human physiology, and mechanisms of homeostatic regulation. Building on expertise developed in doctoral training, MNS training must integrate nutrition and medicine to develop understanding of (1) mechanisms of disease etiology, pathology, and morphologic signs and symptoms together with nutrient actions that target these processes, (2) current medical techniques for diagnostic screening, treatment, and prophylactic strategies, and (3) potential molecular targets for diet modification as adjuvant therapy to prevent and/or control disease. Finally, the MNS must develop the capacity to conduct independent clinical research. The MNS must be mentored to identify nutritionally relevant clinical problems and to devise testable solutions using clinical research methodology. To our knowledge, few, if any, training programs combine knowledge of food and nutrition science with elements of medical science and practice and with clinical research methodology to create a true translational medical nutrition scientist.

2.1. Pilot Curriculum to Train the Non-Physician Medical Nutrition Scientist. Given the dearth of doctoral programs to train the MNS and the pressing need for these professionals to liaise with physicians and researchers, we hypothesized that candidates with doctoral training in nutrition could be trained in the language and practice of medicine and in clinical research methodology at the postdoctoral level. Using R25 funds from the National Institute of Diabetes and Digestive Diseases (NIDDK), we developed and tested an eleven-month transitional curriculum comprising intensive didactic independent study, guided exposure to clinical medicine, and mentored experience with clinical research strategy and grant writing. Limited training duration precluded the opportunity to conduct research and generate pilot data. However, the Fellows were advised to write up a research proposal that would be appropriate and compatible with the resources of their home institutions. Fellows were also encouraged to undertake subsequent traditional postdoctoral fellowships or to develop collaboration with faculty mentors and conduct the research in their home academic institutions. The basic curriculum created for the NIDDK award focused on obesity

Table 1: Case modules for nutrition, obesity, and comorbidities.

Critical care	Obese patient with abdominal gunshot wounds and sepsis
Endocrinology	Type 1 diabetes, celiac disease, and anemia of chronic disease
Metabolic	Type II diabetes, obesity, neuropathy, gout, and sarcopenia
Neoplasia	Postmenopausal uterine cancer
Gastroenterology	Intestinal permeability in inflammatory bowel disease
Liver disease	Nonalcoholic hepatosteatosis (NASH) and metabolic syndrome
Cardiology	Atherosclerosis, cardiomyopathy, and congestive heart failure
Pulmonary disease	Asthma in an obese young adult
Nephrology	Diabetes, arterial calcification, and osteodystrophy in kidney failure
Neurology	Alzheimer's disease in a formerly obese man
Bone disease	Osteoporosis in a formerly lean elderly man
Bariatric surgery	Neurological complications following bariatric surgery

Case modules have been developed to illustrate complications of metabolic dysregulations associated with obesity and metabolic syndrome. Patient information with results of imaging and diagnostic testing is presented, followed by a series of questions on the actions of dietary components in the pathophysiology. Resources include an extensive review of the literature linking nutrients with disease pathophysiology, prevention, and treatment.

and its comorbidities. Based on the results of our curriculum development, we propose that this basic curriculum can be modified as a model for specialized medical nutrition training in other specialties, including cancer.

To enhance the candidate's existing knowledge and skills and to remediate any deficits, we instituted the following strategies.

(i) Pathology Based Case Modules. Case modules were integrated into a guided nutritional pathophysiology tutorial that extended throughout the 11-month fellowship. Each module consisted of a two-page scenario describing the patient, complete with relevant laboratory and imaging data, medical and diet history, and results of the physical examination assessment. The scenarios were based on actual or published complex cases and describe not only the presenting symptoms, but also comorbidities and complications. Each case scenario was followed by a literature review setting forth disease processes and potential mechanisms through which nutrients can modify disease pathways. Links were provided to original research reports as well as meta-analyses and consensus reports that evaluated the strength of the evidence currently available. The case modules served two purposes. They served as a nutritional pathophysiology text to supplement the basic pathology text and as links to current medical nutrition therapy recommendations. This information prompted the candidate to develop biological plausibility relating dietary components to the disease processes. Modules served as an evaluation tool to test the candidate's understanding of the material and also revealed unanswered mechanistic questions that the candidate could test in a clinical protocol. Candidates worked through each module independently and presented it to program faculty prior to undertaking the relevant clinical observership. A list of case modules created for the NIDDK award is found in Table 1.

(ii) Introduction to Medicine. Introduction to medical practice was provided in two venues. Initially, candidates reviewed an online tutorial on the rationale and methodology for medical diagnosis and treatment. This resource provided information on diagnostic paradigms and current treatment modalities in an organ system format. Following completion of the tutorial, candidates entered the initial Endocrinology Observership where they received "Hands-on" introduction to medical diagnosis and treatment provided by program faculty. Fellows were also trained in selected use of the online institutional medical records system. A current textbook of medicine complete with supplemental online material was provided to each candidate for detailed discussion of medical considerations and procedures.

(iii) Clinical Observerships. Fellows completed a series of 4- to 6-week rotations in selected medical disciplines at the level of a third-year medical student. Clinical mentors provided a "hands on" introduction to patient care in their discipline and supervised candidates throughout the observership. Fellows observed physical, laboratory, and imaging diagnostic methods used in each discipline. Trainees had access to patient information, participated in staff rounds and seminars, and observed selected consults and procedures during their rotation. In the course of each observership, candidates presented actual, nutritionally informative cases to the clinical staff in rounds and seminar settings and discussed diet modification appropriate to each patient. Candidates were asked to respond to staff questions on both the biological plausibility and clinical applicability of a proposed targeted modification. Observerships were evaluated by program faculty using interim and exit interviews with the candidate and review of the candidate's journal, containing data on patients seen, procedures observed, rounds attended, and the like. Each mentor was asked to comment on the fellowship and to assess candidate performance in the observership; see typical observership schedules in Table 2.

(iv) Clinical Research Mentoring. At the onset of training and prior to undertaking clinical observerships, candidates were required to complete online training in responsible conduct of clinical research. Over the course of the clinical observerships, candidates were expected to identify

Table 2: Observership sites.

Endocrinology and nutrition support
Gastroenterology
General medicine
Geriatrics
Endocrinology
Cardiology
Pulmonary and intensive care
Nephrology
Bariatric surgery

Fellows participate in rotations for four to six weeks, depending on the site. Mentors in each site have agreed to supervise Fellows at the level of the third-year medical student. Fellows attend rounds and conferences, observe procedures, participate in case discussions, and identify clinical problems with nutritional implications. The Fellow selects one or more of these problems for development as a clinical research protocol.

nutritionally related clinical problems, develop a biological plausibility for a selected study, explore appropriate clinical and/or basic research methodology, and develop a protocol suitable for submission to a funding agency. To facilitate these activities, candidates met with multiple clinical and basic research mentors to discuss ongoing projects and become familiar with research methodology used by the mentor. The candidate was encouraged to develop collaborations with mentors in his/her area of interest. It is expected that the network of mentor collaborations developed will extend past the fellowship duration and help develop the candidate's research career.

3. Results and Discussion

To date, we have trained four postdoctoral fellows, all of whom hold university faculty positions in nutrition. Extensive formative evaluation of candidate progress through the curriculum revealed several barriers; we have identified and addressed barriers as follows.

(i) Prior Training. All candidates completed undergraduate science prerequisites and graduate nutrition science training. While they had designed and conducted independent doctoral research, several of their research topics were narrowly focused in some area of bench nutrition science. None of the candidates had taken a formal course in pathology. Some candidates (3 of 4) were credentialed as registered dietitians; however, neither doctoral training nor clinical knowledge required for dietetic credentialing includes comprehensive study of nutritional pathophysiology or clinical medicine. None of the candidates had undertaken an observership in clinical medicine. Candidates indicated that their greatest difficulty was in following the medical considerations and rationale for treatment of specific patients.

To address this barrier, we formalized the nutritional pathophysiology course to extend through the duration of the fellowship. In response to formative evaluation, we now require candidates to complete and present the corresponding case module prior to undertaking the clinical observership. We have also required that the online introduction to medicine be completed prior to entering the Endocrinology Observership with its "hands on" introduction to medicine segments. Because we found that the medical terminology and abbreviations posed a challenge to some candidates, we introduced weekly interactive sessions for the candidate with faculty mentors; these sessions have significantly enhanced the Fellow's learning.

(ii) Candidate Recruitment. R25E funds are awarded for program development, not trainee support. Although trainees receive a stipend to defray part of their living expenses, this award does not constitute a salary as does the traditional postdoctoral fellowship. Thus, although we received applications from a number of highly qualified and enthusiastic newly minted Ph.D. applicants, all found the stipend insufficient and declined to participate in the training. Our short-term solution to this problem was to recruit candidates from nutrition faculty supported by their institutions during their sabbatical year. Prospective candidates were recruited from members of the Academy of Nutrition and Dietetics, specifically from the dietetic educators practice group. This solution posed further problems as delineated below.

(iii) Recency of Research. Of the four candidates trained, two candidates had undertaken heavy teaching and administrative duties for several years after doctorate. Because these responsibilities had prevented the candidates from keeping abreast of ongoing research in nutrition and medicine, the heavy focus on nutrition pathology, medicine, and clinical research in our curriculum presented a challenge. This barrier appears to have been surmounted by our final candidate who obtained her academic appointment prior to completing her doctoral research. This permitted her to take a sabbatical immediately after obtaining her doctorate. Although she had some of the knowledge gaps indicated above, her research skills were more current and her progress both in the clinical observerships and clinical research development appeared to be much more productive than her predecessors. This final candidate was able to identify several clinical problems in need of research; she is presently developing one of these problems with a faculty mentor and will use it for her grant proposal. These observations support the necessity of full-time candidate funding for the one-year transition postdoctoral fellowship.

(iv) Candidate Credentialing. A major barrier for some candidates appeared to be a functional dichotomy between the scope of practice of a registered dietitian and the requirements of the MNS curriculum. Candidates, who were credentialed as registered dietitians (RD) and had spent several years teaching dietetics, attempted to apply existing medical nutrition guidelines to a clinical problem. In contrast, the goal of MNS training is to train the Fellow to identify a nutrition-related clinical problem and develop a testable protocol to generate new knowledge. The final candidate also struggled with this dichotomy, but because she had recently completed

her doctorate, she was better able to identify potential research questions in the clinical observerships. It should be noted that clinical mentors were very happy to access the dietetic knowledge and skills of the Ph.D., RD Fellows.

(v) Short Duration of Training. Most traditional postdoctoral fellowships are at least two years in duration, during which the candidate is required to devise a research project and generate pilot data for further research. While the one-year duration of our transition training paradigm could be considered a barrier, we have determined it is a unique solution. By designating the fellowship as "transitional," we reinforce the concept that this first postdoctoral year could almost be considered an extension of doctoral training. The MNS training provides clinical knowledge and experiences not generally available in doctoral nutrition programs. We expect that completion of the transitional year will ideally position the candidate to seek a traditional research fellowship or academic position in which he/she will conduct substantive translational research.

4. Conclusions

From these pilot data we conclude that it is possible to efficiently train a MNS candidate with the competencies delineated above. It is critical that candidates have completed solid basic science coursework at the undergraduate level, have undertaken doctoral level nutrition and medical science training, and have obtained a working knowledge of all aspects of food and nutrition. During the transitional year, the candidates must have access to expert mentors in medical nutrition, medical specialties, and clinical research. Candidates must be funded with a living salary to assure that highly motivated, recent Ph.D. graduates will apply. With these elements in place, we propose that our intensive one-year postdoctoral fellowship curriculum can provide didactic training and clinical experiences sufficient to transition the candidate into translational clinical research. We expect that, following MNS training, graduates will function as translational researchers, educators, and expert consultants to the medical, research, and public health communities.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

Authors' Contribution

Drs. Ettinger, Nasser, Engelson, Albu, Hashim, and Pi-Sunyer made major contributions to the overall research plan and project oversight; Dr. Ettinger wrote the paper and Dr. Pi-Sunyer had primary responsibility for the final content.

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References

[1] Hippocrates, On Ancient Medicine—Part 14, 400 BC.

[2] J. A. Baur, K. J. Pearson, N. L. Price et al., "Resveratrol improves health and survival of mice on a high-calorie diet," *Nature*, vol. 444, no. 7117, pp. 337–342, 2006.

[3] S. P. Weisberg, R. Leibel, and D. V. Tortoriello, "Dietary curcumin significantly improves obesity-associated inflammation and diabetes in mouse models of diabesity," *Endocrinology*, vol. 149, no. 7, pp. 3549–3558, 2008.

[4] J. F. Leikert, T. R. Räthel, P. Wohlfart, V. Cheynier, A. M. Vollmar, and V. M. Dirsch, "Red wine polyphenols enhance endothelial nitric oxide synthase expression and subsequent nitric oxide release from endothelial cells," *Circulation*, vol. 106, no. 13, pp. 1614–1617, 2002.

[5] H. Schroeter, C. Heiss, J. Balzer et al., "(−)-epicatechin mediates beneficial effects of flavanol-rich cocoa on vascular function in humans," *Proceedings of the National Academy of Sciences of the United States of America*, vol. 103, no. 4, pp. 1024–1029, 2006.

[6] J. A. Milner, "Incorporating basic nutrition science into health interventions for cancer prevention," *Journal of Nutrition*, vol. 133, no. 11, pp. 3820S–3826S, 2003.

[7] J. W. Finley, "Proposed criteria for assessing the efficacy of cancer reduction by plant foods enriched in carotenoids, glucosinolates, polyphenols and selenocompounds," *Annals of Botany*, vol. 95, no. 7, pp. 1075–1096, 2005.

[8] S. Egert and G. Rimbach, "Which sources of flavonoids: complex diets or dietary supplements?" *Advances in Nutrition*, vol. 2, no. 1, pp. 8–14, 2011.

[9] K. M. Munir, S. Chandrasekaran, F. Gao, and M. J. Quon, "Mechanisms for food polyphenols to ameliorate insulin resistance and endothelial dysfunction: therapeutic implications for diabetes and its cardiovascular complications," *American Journal of Physiology: Endocrinology and Metabolism*, vol. 305, no. 6, pp. E679–E686, 2013.

[10] I. Sekirov, S. L. Russell, L. C. M. Antunes, and B. B. Finlay, "Gut microbiota in health and disease," *Physiological Reviews*, vol. 90, no. 3, pp. 859–904, 2010.

[11] V. L. W. Go, R. R. Butrum, and D. A. Wong, "Diet, nutrition, and cancer prevention: the postgenomic era," *Journal of Nutrition*, vol. 133, no. 11, supplement 1, pp. 3830S–3836S, 2003.

[12] J. B. German, M. A. Roberts, L. Fay, and S. M. Watkins, "Metabolomics and individual metabolic assessment: the next great challenge for nutrition," *Journal of Nutrition*, vol. 132, no. 9, pp. 2486–2487, 2002.

[13] D. C. Heimburger, "Training and certifying Physician Nutrition Specialists: the American Board of Physician Nutrition Specialists (ABPNS)," *The American Journal of Clinical Nutrition*, vol. 83, no. 4, pp. 985S–987S, 2006.

[14] D. C. Heimburger, S. A. McClave, L. M. Gramlich, and R. Merritt, "The intersociety professional nutrition education consortium and American board of physician nutrition specialists: what have we learned?" *Journal of Parenteral and Enteral Nutrition*, vol. 34, no. 6, supplement, pp. 21S–29S, 2010.

[15] T. B. van Itallie, "The 'pure' clinical nutritionist: an endangered species," *The American Journal of Clinical Nutrition*, vol. 30, no. 12, pp. 1929–1934, 1977.

[16] S. A. McClave, J. I. Mechanick, B. Bistrian et al., "What is the significance of a physician shortage in nutrition medicine?" *Journal of Parenteral and Enteral Nutrition*, vol. 34, no. 6, supplement, pp. 7S–20S, 2010.

[17] D. S. McLaren, "Nutrition in medical schools: a case of mistaken identity," *The American Journal of Clinical Nutrition*, vol. 59, no. 5, pp. 960–963, 1994.

[18] M. E. Shils, "National dairy council award for excellence in medical and dental nutrition education lecture, 1994: nutrition education in medical schools—the prospect before us," *American Journal of Clinical Nutrition*, vol. 60, no. 4, pp. 631–638, 1994.

[19] D. S. McLaren, "The need for physician nutrition specialists," *American Journal of Clinical Nutrition*, vol. 62, no. 2, pp. 446–447, 1995.

[20] L. H. Allen, M. E. Bentley, S. M. Donovan, D. M. Ney, and P. J. Stover, "Securing the future of nutritional sciences through integrative graduate education," *Journal of Nutrition*, vol. 132, no. 4, pp. 779–784, 2002.

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Research Article

Working with Individuals Who Provide Nursing Care to Educate Older Adults about Foodborne Illness Prevention: The *Food Safety Because You Care!* Intervention

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Older adults are more susceptible to foodborne infections than younger adults and many older adults do not follow recommended food safety practices. This study implemented the *Food Safety Because You Care*! program with 88 individuals in the United States who provide nursing care to older adult patients and subsequently surveyed them. The majority of respondents had favorable opinions of the program. Following program exposure, many of the respondents advised their older adult patients about food safety. The findings from this study suggest that the program is a useful tool that can assist those who provide nursing care as they interact with their older patients and lead them to positively influence older adults' food safety practices. However, more research is needed to examine changes in providers' behaviors as a result of program exposure and the accompanying effect on older adults' food safety practices.

1. Introduction

To build healthy eating patterns, the 2010 *Dietary Guidelines for Americans* recommends that all people follow food safety recommendations when preparing and eating foods to reduce the risk of foodborne illnesses [1]. Older adults are at a greater risk for developing serious complications from foodborne infections compared with younger adults [2–5]. Factors such as decreased stomach acid production, intestinal motility, malnutrition, immobility, chronic diseases, living in a nursing home environment, and increased use of antibiotics cause older adults to be more susceptible to foodborne infections [5, 6]. This is evidenced by a recent multistate outbreak of *Listeria monocytogenes* that most likely originated from contaminated cantaloupes. According to the Centers for Disease Control and Prevention, among the 72 ill persons affected by the outbreak most were aged 60 or older or had weakened immune systems [7].

Although foodborne illnesses are an imminent health concern for older adults, experts have identified practices that can help mitigate the risk of acquiring foodborne illnesses [8–10]. These practices include avoiding foods that are more likely to be contaminated with pathogens such as raw or undercooked eggs; raw or undercooked meat, poultry, or seafood; hot dogs and deli meats that have not been reheated to steaming hot; soft cheeses made from unpasteurized milk; raw sprouts; and unpasteurized milk and juices; using an appliance thermometer to ensure the refrigerator's ambient temperature is 40°F or less; using a food thermometer to check the internal temperature of meat and poultry dishes; refrigerating food promptly; and other practices. However, research suggests that many older adults may not be following recommended food safety practices [11–14].

A nationally representative survey of older adults [11] and a study conducted by Boone and colleagues [12] revealed that seniors would prefer to learn about food safety from their health care providers. Focus groups with several types of health care professionals found that nurses were receptive to providing food safety information to their senior patients [15]. A few resources have been developed to communicate

Table 1: Booklet sections.

Section	Topics covered
(1) Learn about Foodborne Illness	Reasons older adults are susceptible to foodborne infections, symptoms associated with foodborne illness, and caring for someone with foodborne illness
(2) Foods Seniors Outgrow	Foods older adults should avoid eating to prevent foodborne illness
(3) Food Storage 101	Recommended storage times for foods and how to safely store leftovers
(4) The Right Tools for a Spotless Kitchen	Tools needed to maintain a sanitary kitchen and tips such as using an appliance thermometer to ensure the refrigerator's temperature is 40°F or below
(5) Keeping Food Clean and Safe to Eat	Safe hand washing, sanitation, and food hygiene practices (e.g., washing produce or methods for preventing cross contamination)
(6) How to Get Rid of Those Hidden Germs	Kitchen sanitation
(7) Safe Cooking and Cooling Temperatures	Recommended lethality temperatures for cooking raw meats and how to safely thaw food
(8) What to Do If a Food Product Is Recalled	Responding to food recalls and identifying signs of product tampering

foodborne illness management and food safety information to health care professionals [16, 17]. However, to our knowledge, none have specifically been tailored to nurse-older adult patient communications about food safety.

The aim of this study was to implement the *Food Safety Because You Care!* Intervention, a program developed for those who provide nursing care for older adult patients and to assess participants' response to the program. The intervention was an educational booklet developed by Tennessee State University that provided information tailored to nurse-older adult patient communications about foodborne illnesses and how to prevent them. This study examined participants' opinions of the booklet and whether the booklet motivated them to share the booklet with others or provide food safety information to their older adult patients.

2. Materials and Methods

2.1. Intervention. The *Food Safety Because You Care!* Intervention is a 47-page educational booklet that includes food safety tips and quizzes intended for older adults and those who care for them. The food safety tips are based on expert recommendations for preventing foodborne illness and are in line with the USDA's and FDA's food safety recommendations. Table 1 describes each section of the food safety booklet. The booklet uses a large font size, large colorful graphics, and nontechnical language so that older adults with failing eyesight or decreased cognitive functioning can easily read and understand it. The booklet is currently accessible online at http://fnic.nal.usda.gov/nal_web/fsrio/fseddb/fsed-dbsearchdetails.php?id=1922.

2.2. Survey Design and Participant Recruitment. To assess response to the intervention, we conducted a post-only retrospective survey without a control or comparison group. Using convenience sampling, we recruited study participants from June to December 2011 using the following methods: (1) placing advertisements in the American Nurses Association e-newsletters, (2) posting study recruitment announcements on Craigslist, and (3) using Zoomerang's Web panel of nurses. Additionally, we disseminated booklets and recruited individuals for the study at local conferences, including the Tennessee Nurse's Association and Tennessee Association of Student Nurses Joint Convention and the Tennessee Public Health Association's Annual Education Conference. Study participants were required to care for patients aged 60 or older and be a nurse practitioner, registered nurse, licensed practical nurse, or certified nursing assistant.

2.3. Study Procedures and Questionnaire. One to three weeks after the booklets were disseminated, we administered the survey via the participant's preferred method: Web or traditional pen-and-paper method. Participants who received hard copy booklets either in person at the conferences or by request in the mail were sent a reminder to read the booklet 1 week before we fielded the paper or Web-based survey. Other participants who expressed interest in our study and were provided digital copies of the booklets via e-mail were told they would be contacted again about a week after receiving the booklet and provided with the survey Web link. The Web-based survey was hosted by SurveyMonkey (Palo Alto, CA). To increase the response rate, all participants were sent reminders to complete the survey 1 week after it was fielded.

The survey collected information on participants' opinions of the booklet, current food safety knowledge, and any changes made following exposure to the intervention. All study procedures were approved by RTI International's Institutional Review Board, and all study participants were financially compensated for completing the survey.

3. Results

3.1. Study Population Characteristics. A total of 88 individuals from across the United States completed the survey. For 77% of the respondents, more than 50% of their patients were aged 60 or older. Fifty-five percent of the respondents were registered nurses, and 43% of the respondents specialized in geriatrics. The majority of the respondents worked in long-term

Table 2: Respondents' opinions of the booklet ($n = 88$).

Statement	% strongly agree	% agree	% neither agree nor disagree	% disagree	% strongly disagree	% do not remember/no answer
After reading the booklet I now feel better prepared to advise older adults and/or their caregivers to safely prepare food.	54.6	36.4	4.6	1.1	1.1	2.3
The information in this booklet was easy to understand.	60.2	29.6	3.4	0	1.1	5.7
Reading this booklet made me more aware of food safety.	56.8	35.2	2.3	2.3	2.3	1.1
I learned at least one new thing regarding food safety after reading the booklet.	58.0	29.6	6.8	1.1	1.1	3.4
Reading this booklet has shown me that I do not know enough about properly preparing food for older adults.	21.6	33.0	23.9	15.9	4.6	1.1
There was too much information to read.	5.7	18.2	22.7	34.1	17.1	2.3
I thought the information was interesting.	47.7	43.2	5.7	0	1.1	2.3
The booklet was tailored to older adults.	23.9	40.9	20.5	11.4	2.3	1.1
I found the information to be credible.	48.9	42.1	4.6	0	2.3	2.3
Adults aged 60 or older are at an increased risk of getting food poisoning or foodborne illness.	56.8	29.6	6.8	3.4	2.3	1.1

care/rehabilitation facilities (27%) or hospital settings (26%); thus their patients required ongoing nursing care, whereas the patients of respondents who worked in other settings (e.g., doctor's offices) were not receiving ongoing nursing care.

3.2. Opinions of the Booklet. Table 2 describes respondents' impressions of the booklet. Seventy-three percent of the respondents found it to be very informative, and 68% found it to be very useful. Seventy-four percent reported that they did all or most of the quizzes in the booklet. Ninety percent of respondents agreed that the information provided in the booklet was easy to understand, interesting, and credible. Over 90% of respondents agreed that after reading the booklet they were better prepared to advise older adults and/or their caregivers to safely prepare food and that they were more aware of food safety. More than half of respondents agreed that the booklet showed them that they did not know enough about properly preparing food for older adults, and 24% of respondents agreed that the booklet was too lengthy.

Respondents indicated that they would be likely to refer back to the booklet and share it with others. Forty-four percent of respondents reported that they filed the booklet or put it somewhere so that they could refer to it again in the future, 39% shared it with a colleague, and 24% shared it with an older adult and/or their caregiver. Nearly two-thirds of respondents reported that they would be very likely to share the booklet.

3.3. Current Practices. Ninety-one percent of respondents ($n = 80$) provided food safety information to their older adult patients before participating in the study. Of those respondents, 40% reported that they frequently or very frequently provide food safety information to their older adult patients. The most common topics were foods to avoid eating and recommended practices for handling and preparing food safely at home.

3.4. Reported Changes in Behavior following Exposure. After reading the booklet, 57% of respondents reported that they advised their patients not to eat certain foods because of concerns about food safety, and 57% of respondents reported that they gave their patients recommendations on how to safely store, handle, or prepare food at home. Respondents who reported providing these recommendations to their patients were then asked via unaided, open-ended questions to specifically describe the dietary and/or food storage/handling recommendations they gave their patients. Responses to the opened-ended questions are provided in Table 3.

Among those who responded to the follow-up question and described dietary recommendations they had given to their patients ($n = 41$) (nine respondents skipped the

Table 3: Respondents' recommendations to their patients as a result of reading the booklet.

What foods have you advised your patients aged 60 or older not to eat based on what you learned in the booklet? ($n = 41$)*	%
Foods containing raw or undercooked eggs	26.8
Raw or undercooked meat or poultry	24.4
Mold-ripened, blue veined, or soft cheeses	19.5
Deli meats eaten without reheating	14.6
Food stored at improper temperatures	14.6
Hot dogs eaten without reheating	7.3
Raw or undercooked fish or seafood	9.8
Raw, unpasteurized milk	9.8
Raw sprouts	7.3
Unpasteurized juices, cider, or honey	2.4
Expired food	4.9
Food stored in can that is dented, leaking, or swollen	4.9
Describe recommendations you have given to your patients and/or their caregivers since reading the booklet ($n = 41$)*	**%**
Proper storage time for refrigerated foods	31.7
Other storage practices, nec	29.3
Proper kitchen hygiene	14.6
Refrigerate perishable food promptly (not more than 2 hours at room temperature)	12.3
Other food-handling practices, nec	12.2
Check refrigerator temperature	9.8
Use food thermometer for cooking meat, poultry, seafood, and eggs	9.8
Other cooking practices, nec	7.3
Proper personal hygiene (hand washing)	7.3
Washing produce	7.3
Procedures for preventing cross contamination	4.9
Reheating deli meats	4.9

*Nine respondents skipped question or did not provide a legible response.
nec = not elsewhere classified.

question or did not provide a legible response), respondents recommended that their older adult patients avoid eating the following foods as indicated in the booklet: foods containing raw or undercooked eggs (27%); raw or undercooked meat or poultry (24%); and mold-ripened, blue veined, or soft cheeses (20%). Among respondents who described recommendations they had given their patients for safe food storage, handling, or preparation ($n = 41$) (nine respondents skipped the question or did not provide a legible response), almost a third recommended proper storage times for refrigerator foods or recommended other storage practices not already specified, including storing pantry items in closed containers, setting the freezer at the proper temperature, or storing frozen foods for the proper amount of time.

The booklet recommends that older adults use an appliance thermometer to monitor their refrigerator's temperature and a food thermometer to check meat and poultry dishes for doneness. After reading the booklet, 40% of respondents reported that they advised patients aged 60 or older and/or their caregivers to put appliance thermometers in their refrigerator, and 56% of respondents advised their patients to use a food thermometer. The booklet also recommends that older adults cook eggs until they are firm. After reading the booklet, 48% of respondents reported that they advised their patients to change the way they prepare fried eggs.

4. Discussion/Conclusions

The nurses and other care providers surveyed had favorable impressions of the booklet and believed that it better prepared them to advise older adults and/or their caregivers on recommended food safety practices. Based on the results of the survey, the booklet appeared to motivate respondents to educate older adult patients about food safety. Education consisted of advising older adult patients not to eat certain "risky" foods or advising patients on how to safely store, handle, or prepare food when cooking at home. The booklet also led some respondents to recommend that patients use appliance thermometers to ensure that perishable foods are stored at 40°F or below or recommend that patients use food thermometers to check the internal temperature of meat and poultry dishes for doneness.

Overall the program appeared to increase respondents' comfort level with making food safety recommendations to patients. This is important because, as discussed by Kendall and colleagues [8], older adults rely on health care providers

as a trusted and desired source for receiving health information, and studies suggest that older adults would prefer to receive food safety information from their health care provider [11, 12]. Unique features of this booklet are that the information is presented in an easy-to-use and interactive format that was interesting for nurses/care providers to read but could also be shared with patients who may have decreased eyesight or cognitive functioning. It offered suggestions for how older adults might change some of their behaviors to help prevent foodborne illness. Thus, the design of the booklet followed several of Higgins and Barkley [18] recommendations for promoting behavior change among older adults. These recommendations include keep program content practical and relevant and to structure the program to increase retention by using familiar terminology and simplifying concepts.

This study had some limitations. First, the sample was not probability based and a relatively small number of individuals who provide nursing care to older adults were surveyed; thus the results of these individuals cannot be generalizable to the US population. Second, the study was retrospective and did not include a counterfactual condition in order to establish causality of program impacts. Additional research is needed to examine whether the behaviors of nurses and those who provide nursing care are changed over the long term as a result of program exposure and whether the information provided leads older adult patients to improve their food safety practices.

In summary, this study found that respondents had favorable opinions of the *Food Safety Because You Care!* program and were motivated to share food safety information with their older adult patients. This suggests that the program may serve as a useful tool in helping older adults improve their food safety practices. However, more research is needed to examine changes in older adults' behaviors as a result of the program.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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References

[1] U.S. Department of Agriculture and U.S. Department of Health and Human Services, *Dietary guidelines for Americans*, 2010, http://www.health.gov/dietaryguidelines/dga2010/DietaryGuidelines2010.pdf.

[2] J. C. Buzby, "Older adults at risk of complications from microbial foodborne illness," *Food Review*, vol. 25, no. 2, pp. 30–35, 2002.

[3] C. P. Gerba, J. B. Rose, and C. N. Haas, "Sensitive populations: who is at the greatest risk?" *International Journal of Food Microbiology*, vol. 30, no. 1-2, pp. 113–123, 1996.

[4] K. C. Klontz, W. H. Adler, and M. Potter, "Age-dependent resistance factors in the pathogenesis of foodborne infectious disease," *Aging Clinical and Experimental Research*, vol. 9, no. 5, pp. 320–326, 1997.

[5] J. L. Smith, "Review: foodborne illness in the elderly," *Journal of Food Protection*, vol. 61, no. 9, pp. 1229–1239, 1998.

[6] P. A. Kendall, V. V. Hillers, and L. C. Medeiros, "Food safety guidance for older adults," *Clinical Infectious Diseases*, vol. 42, no. 9, pp. 1298–1304, 2006.

[7] Centers for Disease Control and Prevention, *Investigation Update: Multistate Outbreak of Listeriosis Linked to Whole Cantaloupes from Jensen Farms, Colorado*, 2011, http://www.cdc.gov/listeria/outbreaks/cantaloupes-jensen-farms/092711/index.html.

[8] P. Kendall, L. C. Medeiros, V. Hillers, G. Chen, and S. Dimascola, "Food handling behaviors of special importance for pregnant women, infants and young children, the elderly, and immune-compromised people," *Journal of the American Dietetic Association*, vol. 103, no. 12, pp. 1646–1649, 2003.

[9] P. K. Yen, "Preventing harm form food-borne illness," *Geriatric Nursing*, vol. 24, no. 6, pp. 376–377, 2003.

[10] Food and Drug Administration [FDA] and U.S. Department of Agriculture [USDA], "To Your Health! Food Safety for Seniors," http://www.fda.gov/downloads/Food/ResourcesForYou/Consumers/Seniors/UCM182784.pdf.

[11] S. C. Cates, K. M. Kosa, S. Karns et al., "Food safety knowledge and practices among older adults: identifying causes and solutions for risky behaviors," *Journal of Nutrition for the Elderly*, vol. 28, no. 2, pp. 112–126, 2009.

[12] K. Boone, K. Penner, J. C. Gordon, V. Remig, L. Harvey, and T. Clark, "Common themes of safe food-handling behavior among mature adults," *Food Protection Trends*, vol. 25, no. 9, pp. 706–711, 2005.

[13] M. A. Gettings and N. E. Kiernan, "Practices and perceptions of food safety among seniors who prepare meals at home," *Journal of Nutrition Education and Behavior*, vol. 33, no. 3, pp. 148–154, 2001.

[14] J. Lenhart, P. Kendall, L. Medeiros, J. Doorn, M. Schroeder, and J. Sofos, "Consumer assessment of safety and date labeling statements on ready-to-eat meat and poultry products designed to minimize risk of listeriosis," *Journal of Food Protection*, vol. 71, no. 1, pp. 70–76, 2008.

[15] K. C. Wohlgenant, S. C. Cates, S. L. Godwin, and L. Speller-Henderson, "The role of healthcare providers and caregivers in educating older adults about foodborne illness prevention," *Educational Gerontology*, vol. 38, no. 11, pp. 753–762, 2012.

[16] The Ohio State University, "Food Safety for High Risk Populations," 2012, http://www.csrees.usda.gov/funding/integrated/pdfs/food_safety.pdf.

[17] Centers for Disease Control and Prevention, *Diagnosis and Management of Foodborne Illnesses: A Primer for Physicians*, 2001, http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5002a1.htm.

[18] M. Higgins and M. Barkley, "Tailoring nutrition education intervention programs to meet needs and interests of older adults," *Journal of Nutrition for the Elderly*, vol. 23, no. 1, pp. 59–79, 2003.

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Research Article

Hydration: Knowledge, Attitudes, and Practices of UK Dietitians

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Aim. The aim of this study was to investigate dietitians' knowledge, attitudes, and practices (KAP) regarding hydration and patient care. *Methods*. A cross-sectional online survey was administered to UK dietitians via the British Dietetic Association monthly newsletter and included 18 items on hydration knowledge ($n = 8$), attitudes ($n = 4$), and practices ($n = 6$). KAP scores were calculated by adding the total number of correct knowledge responses and by ranking attitude and practice responses on a Likert scale. *Results*. 97 dietitians completed the online survey and displayed varying levels of KAP regarding hydration and patient care. The mean unweighted scores were knowledge 5.0 (±1.3) out of 8; attitude 13.9 (±1.3) out of 16; practice 14.9 (±2.6) out of 24. Dietitians appeared to be guided by clinical reasoning and priorities for nutrition care. *Conclusions*. There may be scope to further assess and potentially enhance the KAP of dietitians regarding hydration and patient care. Innovative approaches to hydration promotion are warranted and may include focusing on dietitians' personal hydration status, increasing communication with other healthcare professionals, and partnering with patients to take a proactive role in hydration monitoring.

1. Introduction

Hydration is a recognised determinant of health status for all population groups [1]. Mild dehydration can have negative health effects such as impaired physical function and cognitive decline [2]. There is limited understanding of the extent to which the hydration status of population groups increases health-related costs. There is, however, a growing evidence base of the use of health economics models for specific disease modalities [3, 4]. Dehydration is recognized as a component of malnutrition, for which the United Kingdom (UK) health-related costs are estimated to be at least £13bn annually [5]. As a result, national guidance widely encourages optimal hydration in UK hospital and community settings [6, 7].

Guidance exists for the promotion of hydration in UK hospitals [8]. The guidance provides practical advice for health care staff in England and Wales on how to minimise the risk and potential harm that dehydration can cause and offers solutions to improve the provision of fluids to patients in hospitals. Despite this guidance, it has been reported that patients continue to lack access to fresh drinking water and continued efforts to promote optimal hydration are needed [9]. Furthermore, over 90% of malnourished patients are cared for in community settings [10], suggesting that continued efforts for hydration promotion should occur in both hospital and community settings.

Healthcare professionals (HCPs) are expected to engage in best-practice care to address nutrition-related conditions in a multidisciplinary manner [11]. Registered dietitians are

HCPs who assess, diagnose, and treat nutritional problems for individuals in the UK [12]. It is recommended that dietitians take a coordinated and integrated approach to addressing the nutritional care of patients, including promotion of optimal hydration, and lead on relevant knowledge transfer to other HCPs [13]. Dietitians should be competent in assessing patients' hydration requirements, developing strategies to meet hydration needs, and providing user outcome focussed services in all care settings as part of a holistic integrated package of care [14]. However, the competence of UK dietitians regarding hydration and patient care has not been studied.

The knowledge, attitudes, and practices (KAP) of HCPs have been widely investigated as indicators of behaviours [15–17]. Investigating the KAP of UK dietitians regarding hydration will inform strategies to support optimal hydration of patients in hospital and community settings. These strategies are important due to the recognised influence of hydration status on health outcomes [1] and will contribute to a reduction in health-related costs [18]. The aim of this study, therefore, was to investigate dietitians' KAP regarding hydration and patient care.

2. Methods

2.1. Overview. This study utilised a cross-sectional online survey to describe dietitians' KAP regarding hydration and patient care. The survey was conducted before the British Dietetic Association fluid factsheet was released in 2014. The study was undertaken as part of a larger project on hydration education in health care, and was exempt from ethical approval due to the nonsensitive, anonymous, educational nature of the survey.

2.2. Survey Instrument. A cross-sectional online survey (SurveyMonkeyPro) was developed following a review of relevant scientific literature (developed into evidence tables), published texts, "grey" literature, and expert opinion from dietitians, doctors, and hydration experts. Topics requiring investigation were categorised into key areas: facts regarding hydration, dehydration and fluid intake, kidney function and associated conditions, cognitive function, vulnerable groups regarding hydration (e.g., dysphagia and older adults), hydration assessment and advice in practice, personal and clinical attitudes towards hydration, and perceived importance of hydration training.

The survey was piloted on a range of HCPs at various levels including medical students, junior doctors, and GPs and reviewed by GPs, GP trainers, dietitians, scientists, and hydration experts for feedback on the interpretation and understanding of survey items. Recommendations to survey content, wording, and layout were completed prior to data collection. The finalised survey included 18 items on knowledge ($n = 8$), attitudes ($n = 4$), and practices ($n = 6$), and each practice question also included an open ended textbox for respondents to justify their response. The survey was intended to take approximately five minutes to complete following recommendations by the GP reviewers that a short survey would promote participant completion. The survey was only available in English.

Table 1: Dietitians' knowledge of hydration and patient care ($n = 97$).

Knowledge area	Proportion of participants answering correctly n (%)
Definition of dehydration	74 (76)
Physical signs of dehydration	89 (92)
Impact on performance tasks	91 (94)
Fluid requirements for adults	39 (40)
Fluid requirements for older adults	59 (61)
Water content of foods and drinks	34 (35)
Water content of the human body	44 (45)
Recommended water intake	53 (55)

2.3. Participant Sampling. The potential participant pool was dietitians working in the UK who were registered with the British Dietetic Association in February 2014. Information about the survey was included in the monthly newsletter for February 2014, including a brief description of the study, assurance of confidentiality, link to complete the survey, and contact details of the research team.

2.4. Data Analysis. Data analysis was conducted using the SPSS statistical software package version 22. Frequency distributions were calculated for each survey item, as well as mean and range for participants' years of experience. Knowledge scores were calculated for each participant by adding up the total number of correct answers for the knowledge questions. Attitudes and practice scores were calculated for each participant by ranking each response on a scale from 1 to 4 where 1 indicated low attitude or infrequent practice and 4 indicated high attitude or frequent practice. Data are presented as mean (±standard deviation).

3. Results

A total of 126 dietitians accessed the survey during the data collection period, and 97 (77%) completed the survey. Participants were from a combination of hospital and community settings and had been working as a dietitian for a mean of 6 years (range of 0–40 years). More than one third ($n = 39$; 40%) of participants reported being in their current post for ≤2 years, 28% ($n = 27$) for 3–5 years, 11% ($n = 11$) for 6–9 years, and 21% ($n = 20$) for 10+ years.

3.1. Knowledge. Table 1 outlines the hydration knowledge of participating dietitians. The mean number of questions correctly answered was 5.0 (±1.3) out of 8. Most dietitians were able to recognise the physical signs of dehydration (92% correct) and knew the impact that dehydration has on performance tasks (94% correct). However, fewer dietitians knew the water content of the human body (45% correct),

Table 2: Dietitians' attitudes towards hydration in patient care ($n = 97$).

Attitude area	Response	Proportion of participants' responses n (%)
Person responsible for managing hydration intake of patients	Dietitian	0 (0)
	Doctor	0 (0)
	Patient	0 (0)
	All of the above	97 (100)
Risk of excess water consumption on health	No risk	0 (0)
	Minimal risk	25 (26)
	Moderate risk	59 (61)
	Significant risk	13 (13)
Importance of hydration for kidney stones	Very important	65 (67)
	Somewhat Important	24 (25)
	Unimportant	0 (0)
	Very unimportant	8 (8)
Importance of hydration education for dietitians	Very important	61 (63)
	Somewhat Important	32 (33)
	Unimportant	3 (3)
	Very unimportant	1 (1)

fluid requirements for adults (40% correct), and the water content of foods and drinks (35% correct).

3.2. Attitudes. Table 2 outlines the hydration attitudes of participating dietitians. The mean attitudes score was 14.0 (±1.3) out of a maximum score of 16. All dietitians (100%) reported that hydration management is the combined responsibility of HCPs and patients and recognised some degree of risk in consuming excess water. Nearly all participants (96%) reported that hydration education for dietitians is important.

3.3. Self-Reported Practices. Table 3 outlines the hydration practices of participating dietitians. The mean practice score was 14.9 (±2.6) out of a maximum score of 24. Most dietitians (91%) promoted hydration in standard care by encouraging intake of water and other beverages and reported wide variation in time spent promoting hydration to patients. Variations in practices were also apparent for promoting hydration to stroke patients and assessing urine colour. The majority of dietitians (58%) rated their personal hydration practices as bad or average but reported using water dispensing facilities at their place of work.

Dietitians reported that it is important to promote liberal intakes of all fluids to facilitate compliance and maximise the likelihood of patients reaching optimal hydration status. The amount of time dietitians spent on hydration promotion was dependent on the nutritional priorities of patients. Free text responses from dietitians who never promoted hydration to stroke patients reported that it was either not applicable to their current post ($n = 20$) or that cognitive impairments of patients hindered communication ($n = 1$; $n = 2$ did not comment). Self-reported urine colour was deemed to be a practical and valid indicator of hydration status. The main barrier to dietitians consuming adequate fluids at work was lack of time and not remembering to drink.

4. Discussion

This study investigated the KAP of dietitians in the UK regarding hydration and patient care. This is important as dietitians are ideally placed to advise and educate on the benefits of appropriate hydration alongside nutrition [14, 19]. The dietitians in the current study displayed approaches to hydration and patient care that are realistic to practice settings. However, there were noted opportunities for improved hydration KAP.

The hydration knowledge of dietitians in this study appeared to be lacking. Whilst dietitians displayed very good understanding of physical signs of dehydration and its impact on cognitive performance, fewer dietitians provided correct answers to other knowledge questions, such as recommended water intakes and water content of food, drinks, and the human body. It is important to note that the evidence relating to specific hydration issues such as water content of foods and hydration requirements of patients is evolving [20, 21]. Based on the EFSA fluid intake from beverages recommendations, the most recent hydration guidelines promoted 8–10 glasses (200 mL glass) per day [22] which is higher than the previous guidelines of 6–8 glasses per day [23]. As a result, dietitians may have variable understanding of specific hydration issues and require further education to maintain clinical relevancy.

Participants appeared to recognise the need for improved hydration knowledge given that only 4% of participants regarded hydration education as unimportant. As a registered dietitian in the UK, it is a requirement to remain competent to practice [14, 24, 25], thus requiring a need for career-long learning to maintain evidence-based knowledge and skills

Table 3: Dietitians' self-reported practices regarding hydration in patient care ($n = 97$).

Practice area	Response	Proportion of participants' responses n (%)
Usual method of promoting hydration in standard care	Not part of care	7 (7)
	Encourage reduced caffeine intake	1 (1)
	Encourage water intake only	1 (1)
	Encourage water and other beverages	88 (91)
Average time spent providing hydration advice in a 4-hour clinical session	0 minutes	4 (4)
	Between 0 and 10 minutes	30 (31)
	Greater than 10 minutes	32 (33)
	Unable to quantify	31 (32)
Frequency of promoting hydration to stroke patients	Never	23 (24)
	Occasionally	17 (18)
	Regularly	22 (22)
	Always	35 (36)
Frequency of assessing patients' self-reported urine colour	Never	6 (6)
	Occasionally	36 (37)
	Regularly	38 (39)
	Always	17 (18)
Personal rating of hydration status at work	Bad	14 (14)
	Average	43 (44)
	Good	26 (27)
	Excellent	14 (14)
Workplace access and use of water dispensing facilities	Yes, and I use it	64 (66)
	Yes, but I do not use it	10 (10)
	No, but I would use if available	22 (23)
	No, I would not use it	1 (1)

[26, 27]. While the dietitians in this study recognized that nutrition and hydration are integral to optimise patient outcomes, the dietetics curriculum framework does not specifically mention hydration [14]. It has been said that water is the forgotten nutrient [8] and it could be suggested that it is important to be explicit in documentation to state nutrition and hydration together.

Dietitians in this study displayed positive attitudes towards hydration and its impact on prevention and patient care. They recognised the importance of a multidisciplinary approach to hydration promotion, particularly for at-risk patient groups and for dietitians to be well educated on hydration. However, it has been previously established that UK HCPs place less importance on hydration compared with counterparts in Mediterranean countries, which may be due to variations in climate [19]. Strategies to enhance a multidisciplinary approach to hydration care may lower the gap between UK HCPs and other countries by, for example, increased focus on the NHS nutrition and hydration awareness weeks [6].

Qualitative responses from free text boxes indicated that self-reported hydration practice was influenced by higher nutrition priorities for their patients. Therefore, despite the participants having a good attitude towards hydration care, this may not always translate into patient care. Less than half of the dietitians in this study reported good personal hydration while at work, with 24% indicating that this was due to lack of access to water dispensing facilities in their workplace. This is particularly pertinent for health care professionals working in a community setting and carrying out domiciliary visits where there will be a lack of access to water dispensing and bathroom facilities. The impact of dietitians' personal habits on their counselling practices has not been investigated; however, doctors with healthy personal habits or a desire to improve their own health are more likely to counsel patients [28–30]. Similarly, interventions that focus on medical students' personal nutrition behaviours have been shown to improve the frequency of nutrition counselling [31]. These studies suggest that emphasis should be given to dietitians' workplace hydration practices to facilitate improvements in their own hydration status and the hydration-related care provided to patients.

As previously mentioned, in some hospitals and practice settings there were no water dispensing facilities available for staff. This has been related to guidance on preventing legionella and pseudomonas outbreaks in care settings, leading to infection control guidance, strict use and service maintenance records, or withdrawal of dispensers [32, 33]. HCPs should be cognisant of sourcing water throughout the day which could be supported if the substantive evidence of

how to maintain water dispensing facilities is appropriately applied [32–34].

Innovative approaches to promoting adequate fluid intake are required in UK hospitals and community settings [7]. One approach that has experienced positive outcomes is enhancing patients' participation in their health and medical care [35–37]. These studies report that patients are receptive to taking a proactive role in health care, which suggests that there are similar opportunities for hydration promotion initiatives utilising patient-participation. For example, initiatives could facilitate patients to self-monitor fluid balance, in order to reach targets set in collaboration with dietitians. A similar approach has been successfully trialled in Australia to enhance patients' protein and energy intake [38] and warrants further consideration.

Key limitations of the present study should be noted. Firstly, the strategy used to recruit participants may have resulted in some selection bias [39]. It is likely that those agreeing to participate may have had a particular interest in hydration and therefore may have resulted in an overestimation of dietitians' KAP. Secondly, a response rate could not be calculated as it is unknown how many dietitians read the newsletter/advertisements and chose not to participate. Similarly, questions relating to demographic characteristics were not included in the survey, which limited investigations into the representativeness of the participating dietitians in relation to the overall UK dietetic workforce. Finally, the self-reported nature of the survey may have resulted in participants providing more clinically desirable responses than a true reflection of their attitudes and practices.

There may be scope to further assess and potentially enhance the KAP of dietitians regarding hydration and patient care. The dietitians in the current study appear to be guided by clinical reasoning and priorities for nutrition care. There is also a potential opportunity to follow up this sample of dietitians to investigate whether release of the British Dietetic Association's fluid factsheet has influenced KAP regarding hydration. The current study suggests that promotion of optimal hydration for patients requires a broader focus involving patients and other HCPs. The NNEdPro Group is currently examining the KAP in relation to the hydration education of medical doctors and will continue this work with other HCPs to determine their need for further training. Innovative approaches to hydration promotion are warranted and may include focusing on dietitians' personal hydration status and their leadership role in educating other HCPs and partnering with patients to take a proactive role in hydration monitoring.

Conflict of Interests

Joan Gandy works as a consultant for Danone Waters.

Authors' Contribution

Pauline Douglas, Lynn McGuffin, Celia Laur, Minha Rajput-Ray, Joan Gandy, and Sumantra Ray contributed to the conception and design of the project. Pauline Douglas, Celia Laur, Lynn McGuffin, and Sumantra Ray designed the survey instrument. Lauren Ball and Jennifer Crowley conducted the data analysis and drafted the paper. All authors participated in finalisation of the paper.

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References

[1] B. M. Popkin, K. E. D'Anci, and I. H. Rosenberg, "Water, hydration, and health," *Nutrition Reviews*, vol. 68, no. 8, pp. 439–458, 2010.

[2] H. Gibson-Moore, "Hydration and health," *Nutrition Bulletin*, vol. 39, no. 1, pp. 4–8, 2014.

[3] Y. Lotan, I. B. Jiménez, I. Lenoir-Wijnkoop et al., "Primary prevention of nephrolithiasis is costeffective for a national healthcare system," *BJU International*, vol. 110, no. 11, pp. E1060–E1067, 2012.

[4] Y. Lotan, I. Buendia Jiménez, I. Lenoir-Wijnkoop et al., "Increased water intake as a prevention strategy for recurrent urolithiasis: major impact of compliance on cost-effectiveness," *Journal of Urology*, vol. 189, no. 3, pp. 935–939, 2013.

[5] M. Elia and C. Russell, *Combating Malnutrition: Recommendations for Action*, BAPEN, Redditch, UK, 2009.

[6] British Association for Enteral and Parenteral Nutrition (BAPEN), Nutrition and hydration week, 2014, http://www.bapen.org.uk/news-and-media/news/nutrition-and-hydration-week-2014.

[7] British Dietetic Association, *The Nutrition and Hydration Digest: Improving Outcomes Through Food and Beverage Services*, British Dietetic Association, Birmingham, UK, 2012.

[8] Royal College Nursing and National Patient Safety Agency, *Water for Health: Hydration Best Practice Toolkit for Hospitals and Healthcare*, Royal College Nursing, London, UK, 2009.

[9] Parliamentary and Health Service Ombudsman, "Care and compassion?" Report of the Health Service Ombudsman on 10 Investigations into NHS Care of Older People, Parliamentary and Health Service Ombudsman, London, UK, 2011.

[10] R. M. Leach, A. Brotherton, M. Stroud, and R. Thompson, "Nutrition and fluid balance must be taken seriously," *British Medical Journal*, vol. 346, article f801, 2013.

[11] P. M. Kris-Etherton, S. R. Akabas, C. W. Bales et al., "The need to advance nutrition education in the training of health care professionals and recommended research to evaluate implementation and effectiveness," *The American Journal of Clinical Nutrition*, vol. 99, no. 5, pp. 1153S–1166S, 2014.

[12] British Dietetic Association, *Dietitian, Nutritionist, Nutritional Therapist or Diet Expert? A Comprehensive Guide to Roles and Functions*, British Dietetic Association, Birmingham, UK, 2014.

[13] British Dietetic Association, *The Care of Nutritionally Vulnerable Adults in Community and All Health and Care Settings*, British Dietetic Association, Birmingham, UK, 2012.

[14] British Dietetic Association, "A curriculum framework for the pre-registration education and training of dietitians," Birmingham, UK, 2013.

[15] K. L. Delucchi, B. Tajima, and J. Guydish, "Development of the smoking knowledge, attitudes, and practices (S-KAP) instrument," *Journal of Drug Issues*, vol. 39, no. 2, pp. 347–364, 2009.

[16] L. S. Eller, E. Kleber, and S. L. Wang, "Research knowledge, attitudes and practices of health professionals," *Nursing Outlook*, vol. 51, no. 4, pp. 165–170, 2003.

[17] T. Saleem, U. Khalid, S. Ishaque, and A. Zafar, "Knowledge, attitudes and practices of medical students regarding needle stick injuries," *Journal of the Pakistan Medical Association*, vol. 60, no. 2, pp. 151–156, 2010.

[18] National Institute for Health and Clinical Excellence, *Nutrition Support for Adults. Clinical Guideline 32*, London, UK, 2006.

[19] J. E. Holdsworth, "The importance of human hydration: perceptions among healthcare professionals across Europe," *Nutrition Bulletin*, vol. 37, no. 1, pp. 16–24, 2012.

[20] European Food Safety Authority (EFSA), "Scientific opinion on dietary reference values for water," *EFSA Journal*, vol. 8, no. 3, p. 1459, 2010.

[21] R. L. Sharp, "Role of whole foods in promoting hydration after exercise in humans," *Journal of the American College of Nutrition*, vol. 26, no. 5, supplement, 2007.

[22] British Nutrition Foundation, *Healthy Hydration Guide*, 2010, http://www.nutrition.org.uk/healthyliving/hydration/healthy-hydration-guide.

[23] Food Standards Agency, *Drinking Enough?*, 2010, http://tna.europarchive.org/20100929190231/http://www.eatwell.gov.uk/healthydiet/nutritionessentials/drinks/drinkingenough/.

[24] British Dietetic Association, *Code of Professional Conduct*, British Dietetic Association, Birmingham, UK, 2008.

[25] Health and Care Professions Council, *Standards of Proficiency*, Dietitians, London, UK, 2013.

[26] Health and Care Professions Council, *Continuing Professional Development and Your Registration*, Health and Care Professions Council, London, UK, 2012, (updated 2014).

[27] Thematic Network for Dietetics, "DIETS: dietitians ensuring education teaching and professional quality (2010–2013)," in *Guide to Lifelong Learning for Dietitians in Europe. How to Develop Your Professional Competence*, A. D. Looy, Ed., Thematic Network for Dietetics, Plymouth, UK, 2013.

[28] E. Frank, J. Breyan, and L. Elon, "Physician disclosure of healthy personal behaviors improves credibility and ability to motivate," *Archives of Family Medicine*, vol. 9, no. 3, pp. 287–290, 2000.

[29] O. Hung, N. L. Keenan, and J. Fang, "Healthier personal habits of primary care physicians increase the likelihood of their recommending lifestyle modifications for their hypertensive patients that are consistent with the national guidelines," *Circulation*, vol. 125, abstract P136, 2012.

[30] K. B. Wells, C. E. Lewis, B. Leake, and J. E. Ware Jr., "Do physicians preach what they practice? A study of physicians' health habits and counseling practices," *The Journal of the American Medical Association*, vol. 252, no. 20, pp. 2846–2848, 1984.

[31] E. Frank, J. S. Carrera, L. Elon, and V. S. Hertzberg, "Predictors of US medical students' prevention counseling practices," *Preventive Medicine*, vol. 44, no. 1, pp. 76–81, 2007.

[32] Department of Health, "Water Systems: Health Technical Memorandum 04-01, Addendum: Pseudomonas aeruginosa—advice for augmented care units," Quarry Hill, UK, 2013.

[33] World Health Organization, *Water Safety in Buildings*, World Health Organization, Geneva, Switzerland, 2011.

[34] Public Health England, *Draft Draft Guidelines for Collection and Interpretation of Results from Microbiological Examination of Food, Water and Environmental Samples from the Hospital Environment*, Public Health England, London, UK, 2010.

[35] M. J. Crawford, D. Rutter, C. Manley et al., "Systematic review of involving patients in the planning and development of health care," *British Medical Journal*, vol. 325, no. 7375, pp. 1263–1265, 2002.

[36] S. Latimer, W. Chaboyer, and B. Gillespie, "Patient participation in pressure injury prevention: giving patient's a voice," *Scandinavian Journal of Caring Sciences*, vol. 28, no. 4, pp. 648–656, 2014.

[37] C. Mockford, S. Staniszewska, F. Griffiths, and S. Herron-Marx, "The impact of patient and public involvement on UK NHS health care: a systematic review," *International Journal for Quality in Health Care*, vol. 24, no. 1, pp. 28–38, 2012.

[38] S. Roberts, B. Desbrow, and W. Chaboyer, "Feasibility of a patient-centred nutrition intervention to improve oral intakes of patients at risk of pressure ulcer: a pilot randomised control trial," *Scandinavian Journal of Caring Sciences*, Under Review.

[39] L. Neuman, *Social Research Methods: Qualitative and Quantitative Approaches*, Pearson International Edition, 6th edition, 2006.

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Research Article

The State of Nutrition Education at US Medical Schools

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Purpose. To assess the state of nutrition education at US medical schools and compare it with recommended instructional targets. *Method*. We surveyed all 133 US medical schools with a four-year curriculum about the extent and type of required nutrition education during the 2012/13 academic year. *Results*. Responses came from 121 institutions (91% response rate). Most US medical schools (86/121, 71%) fail to provide the recommended minimum 25 hours of nutrition education; 43 (36%) provide less than half that much. Nutrition instruction is still largely confined to preclinical courses, with an average of 14.3 hours occurring in this context. Less than half of all schools report teaching any nutrition in clinical practice; practice accounts for an average of only 4.7 hours overall. Seven of the 8 schools reporting at least 40 hours of nutrition instruction provided integrated courses together with clinical practice sessions. *Conclusions*. Many US medical schools still fail to prepare future physicians for everyday nutrition challenges in clinical practice. It cannot be a realistic expectation for physicians to effectively address obesity, diabetes, metabolic syndrome, hospital malnutrition, and many other conditions as long as they are not taught during medical school and residency training how to recognize and treat the nutritional root causes.

1. Introduction

Poor nutrition contributes to the development of most chronic diseases and even some acute conditions. The ongoing obesity epidemic demands urgent attention from physicians, and they can make a difference in their daily clinical practice without compromising the delivery of their usual services [1–3]. There is an increasing recognition that malnutrition is common in hospitalized patients, that it promotes the development of pressure ulcers and prolongs hospitalization stays, and that it is a major contributor to poor outcomes with many medical procedures. Timely nutritional assessment of at-risk patients and initiation of determined countermeasures are often effective and save costs [4]. Ill-advised overfeeding, on the other hand, can put malnourished patients at acute risk due to refeeding syndrome [5]. In fact, there are few areas of medical practice that are completely isolated from nutritional links or influences.

Physicians must be prepared for the many diverse situations when solid nutrition knowledge and clinical nutrition skills can improve the likelihood of optimal health outcomes. Physicians shape clinical practice patterns, direct other healthcare staff, and allocate resources. They must be able to recognize the importance of nutritional problems and take the initiative to make nutrition a key part of their daily practice, such as routinely including nutrition assessment during history-taking and physical examination. Physicians are the ones who routinely see patients when they need nutritional guidance the most; they must be able to recognize the need for a nutrition consultation, set the stage by explaining the importance of action to the patient, and then refer the patient to the appropriate professionals, such as a registered dietitian nutritionist.

Physicians in the US are largely on their own when it comes to learning how to look for signs of nutrition problems, how to explain the significance of nutrition-related conditions and appropriate interventions, and how to refer patients

to nutrition professionals. The Association of American Medical Colleges (AAMC) has recently declined to incorporate nutrition into their new blueprint for medical competencies [6]. Furthermore, we have conducted three prior nutrition education surveys at four-year intervals since 2000 [7, 8] and consistently found that most medical schools do not even come close the recommendation of the National Research Council [9] to include at least 25–30 hours of nutrition education in the undergraduate medical curriculum.

The purpose of this study was to assess the state of nutrition education at US medical schools and compare it with recommended instructional targets. To this end, we conducted a nutrition education survey of the 2012/2013 academic year to examine the amount of and context for medical nutrition education in US medical schools. We also sought to compare the results with survey results from previous years.

2. Methods

As part of our work with the Nutrition in Medicine Project (NIM) at the University of North Carolina at Chapel Hill described elsewhere, we have well-developed contacts at nearly all US medical schools [10]. In most cases, this is the instructor who is actually providing nutrition education to medical students. Occasionally, it is a nutrition coordinator who oversees the nutrition content of the curriculum or an administrator with knowledge of the nutrition offerings. In all cases, we seek to identify the person with the most knowledge of the entire nutrition curriculum. We targeted US medical schools accredited by the Licensing Council for Medical Education (LCME) for inclusion in our survey if they had completed a full four-year cycle by the end of the 2012/13 academic year. The list of accredited US medical schools and their enrollment numbers was drawn from the tables published online by the AAMC [11]. Beginning in November 2012, we contacted by email the 133 schools fitting this criterion and asked them to complete an online survey to report the hours of nutrition education, the distribution across the four-year curriculum, and inclusion within specific disciplines, emphasizing the time period of the survey being the 2012/13 academic year. At schools where we did not have an established contact person, we asked the dean's office who was responsible for nutrition education at that school and sought to obtain a survey from him/her. We sent out periodic reminders with the option of responding to the questions by reply email through February 2014. Surveys that were submitted via email were entered into the web-based form by the authors. We made additional contacts by telephone, email, and in person until the response rate had exceeded our predetermined minimum response target of 86%. Participation in our survey was voluntary. The Institutional Review Board at the University of North Carolina at Chapel Hill made the determination that this project was exempt from requiring ethical approval.

We retained the key questions that were in the previous quadrennial surveys by our project since 2000. The survey items included a core of questions used in identical form during the three previous survey campaigns for academic years 2000/2001, 2004/2005, and 2008/2009. In brief, the questions asked respondents to indicate the required nutrition instruction hours during the preclinical and clinical phases of the four-year medical school curriculum, specify the total nutrition instruction hours, and account for the location of these hours in specific instructional context (nutrition, physiology/pathology/pathophysiology, biochemistry, clinical practice sessions, integrated courses, and other contexts). We asked participants to identify the number of first-year medical students at their institutions and to indicate overall whether nutrition was required, optional, or not offered. We left these questions and the overall methodology unchanged since our initial survey to allow for comparisons over time. We also questioned respondents about their perceptions of the adequacy of nutrition instruction and asked whether they utilized the Nutrition in Medicine online curriculum. In performing our calculations, we specified zero hours of required nutrition instruction at any school which indicated only optional nutrition education. If a submitted survey used a range of hours (e.g., 20–25 hours), we used the midpoint of the range in our calculations (e.g., 22.5 hours). When respondents provided partial information, we performed simple calculations wherever possible, such as totaling the amount of nutrition education over four years. As we did in previous surveys, we placed no limits on what defines a "nutrition course" or what constitutes "nutrition education." Respondents themselves determined whether their schools provided nutrition in the various course categories.

We converted the dataset from the survey responses into a spreadsheet software program (Excel 2013; Microsoft Corp., Seattle, WA) to perform the calculations. We calculated means and standard deviations from the 2012/13 survey data and compared them to those from all previous survey years, using the same criteria and procedure. The statistical significance of contrasts was determined with Student's t-test for individual data pairs and with a Chi-square test for serial comparisons.

3. Results

During the 2012/13 academic year 141 US medical schools were fully or provisionally accredited by the LCME. Only information about the 133 schools with a fully operational four-year curriculum at the time of the survey is included in this report. A total of 121 (91%) medical schools responded to the survey. Required questions pertained to the total amount of required nutrition across the four years, and thus all respondents completed this part of the survey. A vast majority of schools that required nutrition education answered the part of the survey asking where the required nutrition instruction occurs in the curriculum (103/109 or 95%).

3.1. How Much Is Taught? The responding medical schools reported that they provide on average 19.0 hours of nutrition education with a standard deviation (SD) of 13.7 hours and a median of 17 hours. Over a third of the responding medical schools (43/121, 36%) reported requiring 12 or fewer hours of nutrition instruction; twelve of those institutions (9%)

Table 1: Nutrition instruction hours in various contexts at US medical schools that taught nutrition during the 2012/2013 academic year*.

Course/context	Nutrition	Integrated	Biochemistry	Physiology	Clinical practice
Number of schools	22	82	45	35	55
Number of hours of nutrition instruction in this context, average (SD)	13.8 (7.3)	12.6 (10.4)	6.4 (6.0)	4.2 (3.2)	6.4 (6.6)
Total 4-year nutrition curriculum hours at schools using nutrition instruction in this form, average (SD)	22.2 (8.6)	22.1 (13.7)	21.7 (11.4)	23.1 (11.7)	24.2 (14.8)
Percent of total instruction provided in that course/context, average (SD)	66.7 (27.5)	60.3 (31.3)	31.8 (27.6)	24.3 (25.6)	25.1 (14.4)

*121/133 US medical schools responded to a survey that began in 2012. Most schools that provided nutrition education did so in more than one type of course or context. SD indicates standard deviation.

required none. Less than a third (35 of 121, 29%) of the responding medical schools reported that they provide at least 25 hours of nutrition education across the four-year curriculum. In terms of enrollment, this means that 24.6% of all medical students get the minimum of 25 hours, while 16.1% of all US medical students (those enrolled at 24 schools) get 30 hours or more. Eight of these schools reported that they provide between 40 and 75 hours of nutrition education.

3.2. In What Context Is Nutrition Taught? Most reported nutrition education takes place during preclinical training, adding up to an average of 14.3 (SD 10.5) hours of instruction. The instructional hours of nutrition education are lower during clinical training with an average number of 4.7 (SD 6.2) required hours. This number of hours does not include various electives, seminars with voluntary attendance, or student-organized activities.

Table 1 shows in what specific kind of instructional setting medical students get their nutrition knowledge and practice skills. Most nutrition instruction occurs in the context of integrated courses or in stand-alone nutrition courses. At schools that teach nutrition in an integrated or dedicated nutrition course context, most of the nutrition instruction is provided in either one or the other context. Teaching nutrition as part of a basic science course or clinical practice session is usually only a smaller part of the total. Fewer than half of all responders (55/121, 45%) reported any nutrition education defined as clinical practice. Respondents from 13 medical schools (11%) reported that at least 10 hours of clinical nutrition practice activities were included in the curriculum. Shadowing of nutrition consults or mentored training of patient assessment and counseling were listed specifically by 3 of the surveyed medical schools (2%).

Eighteen percent of schools (22 of 121) reported that their required curriculum includes a dedicated nutrition course (Table 1). We allowed respondents to self-determine what they considered a "nutrition course." At all but two schools who reported a nutrition course, this format provided at least 5 hours in total across the four-year curriculum.

Looking at the eight schools with 40 or more hours of total nutrition instruction, we found that none of them offer a dedicated nutrition course. In contrast, all but one of these schools provide substantial clinical practice components, accounting for 20.6 (SD 8.0, range 10–30) hours of their combined 56.4 hours of nutrition instruction.

3.3. The Impact of NIM Online Instruction. Respondents from a third (44/121) of all responding US medical schools indicated that they were actively using our NIM online instruction materials. These active users reported more nutrition instruction hours than the other schools (22.1 versus 17.4 hours, $P < 0.04$). An additional 18/121 stated that the NIM materials were available to students as a resource. Overall, respondents from 32 schools reported that the availability of the NIM online modules helped to add nutrition instruction hours, 47 schools found that it improved the quality of nutrition education, and 37 indicated that it increased student awareness of nutrition.

3.4. Changes in the Amount and Delivery of Nutrition Instruction. Because our core questions and methodology remained unchanged since 2000, we were able to examine data from 113 medical schools for which total course hours were available in the current survey and also in at least one of our previous surveys. We found that there were 12 more schools with a reported decrease of required nutrition hours than schools with a reported increase ($P < 0.05$, Chi-square test). The percentage of schools that did not meet the 25-hour nutrition instruction minimum recommendation was 71% (86/121); in our 2008 survey that percentage was 73% [8].

Table 2 shows that the number of medical schools with a required nutrition course declined progressively since the 2000 survey (Table 2). A correspondingly larger percentage of nutrition is now taught as a part of integrated courses. We had observed in our previous surveys [7, 8] that schools with dedicated nutrition instruction provided more nutrition instruction overall. This does not seem to be the case anymore. We now find very similar numbers of total nutrition instruction in schools teaching nutrition in the various modalities (Table 1). In particular, schools using integrated courses report total nutrition hours right in the middle of values among the different instructional contexts.

4. Discussion

4.1. Need for Better Nutrition Education. The quantity of nutrition education offerings in medical school curricula

Table 2: Required nutrition education hours at US medical schools over time*.

	2000	2004	2008	2012
Average hours of required nutrition education (SD)*	20.4 (13.6)	22.3 (15.3)	19.5 (13.5)	19.0 (13.7)
Median hours of required nutrition education	18	20	16	17
Schools with a required nutrition course, number/total (%)	39/112 (35%)	32/106 (30%)	26/105 (25%)	22/121 (18%)
Response rates, number/total (%)	100/112 (89%)	89/106 (84%)	90/105 (86%)	121/133 (91%)

* All US medical schools were surveyed using identically worded core questions during four academic years: 2000/2001, 2004/2005, 2008/2009, and 2012/2013. SD indicates standard deviation.

has shown no sign of improvement during the last decade, according to our surveys. Ever-expanding medical information and a growing set of needed clinical skills continue to fuel a fierce competition for curriculum time and attention of medical students. At the same time, fourth-year interviews for residency programs have compressed the curriculum to significantly less than the full four years. Our survey data suggest a steady erosion of nutrition education in medical schools, with median total nutrition instruction remaining at or under 20 hours since 2000. A few medical schools manage to exceed the recommended number of nutrition education hours and provide their students with a blend of integrated courses and clinical practice sessions, providing evidence that it can be done and giving a blueprint for ways other schools might increase their nutrition content. When we began our surveys in 2000, we were closely focused on whether or not a school had a designated, required nutrition course as one sign of successful implementation of a nutrition curriculum. Since that time, the face of medical education has changed dramatically, with didactic lectures being deemphasized while problem-based learning has gained ground. We fully expected respondents to attempt to quantify the nutrition portion of any independent research or group work related to any required activity, allowing us to continue to compare total nutrition content hours over time. Although the hours may be provided in a different manner than they were almost three decades ago, the material must still be mastered. Many medical schools have already or are in the process of transitioning to a fully integrated curriculum. We also expected our surveys to reflect the nutrition portion of any integrated activities, realizing that this required the respondent familiar with the curriculum to make some estimations.

It is important to emphasize that our surveys only counted required nutrition education. Many medical schools offer nutrition electives and other optional opportunities to engage in nutrition-related learning activities and practices. Students also often seek out instruction on their own initiative, particularly from the Internet. None of these very important activities are captured in our survey data. But it is always a small minority of students who have the initiative and take the extra time to use such opportunities [12]. Exceptional efforts and achievements of the motivated few will do little to ensure that all physicians are ready to serve the health needs of their patients.

It is hard to see how a medical school can fulfill its core mission and prepare future physicians with an average of just 19.0 hours of nutrition instruction. Experienced medical nutrition educators (the Curriculum Committee for the Nutrition Academic Awards) have put together a catalog of nutrition knowledge and skills that medical students need to master upon graduation [13]. Exactly what content needs to be mastered will always be subject to considerable debate and the efficiency of medical instruction will always vary. But even a cursory review of the 51 pages listing specific items across the full spectrum of typical clinical practice areas makes it obvious that this diverse and extensive content cannot be taught in a few hours. The 25–30 hours of required nutrition instruction recommended by the 1985 Report of the National Research Council's Committee on Nutrition in Medical Education [9] should be considered a minimum estimate, developed at a time when the scope of medically relevant nutrition knowledge was only a fraction of what it is today. In fact, in 1989, The American Society for Clinical Nutrition surveyed medical school curriculum administrators and medical nutrition educators separately about the number of hours and the scope of nutrition course work that medical schools should provide [14]. They found close agreement among these two groups (37 hours versus 44 hours, resp.). Considering the rapid advancement of nutrition knowledge and the understanding of the role of nutrition in disease prevention and treatment in the past 25 years, it seems likely that if these groups were surveyed again today, the minimum "benchmark" of 25 hours in our analysis would be much higher.

Significant gaps in medical nutrition instruction often remain unfilled due to a dearth of qualified instructors. The limited expertise of faculty without a background in nutrition has been identified as a significant barrier for teaching effective intervention techniques to the next generation of physicians [15]. A major reason for this lack of competent nutrition educators is the fact that only a handful of medical schools have full nutrition departments; less than a third of them have divisions or other academic units with at least a partial focus on nutrition. This means in practice that nutrition education is commonly delegated to faculty without professional training or other formal qualifications in nutrition, much less to faculty members who engage in nutrition practice and research on a regular basis. While many nonspecialist educators tasked with nutrition instruction

have managed to build credible nutrition curricula, such outcomes are by no means ensured. Furthermore, earlier research has found that medical students and residents rarely have first-hand opportunity to observe and learn best nutrition practices from physicians with expertise in nutrition or from other licensed nutrition professionals [16, 17]. The common absence of clinical nutrition role models for medical students is reflected in the limited time (6.4 hours on average) allotted to practice at the minority (55 out of 121) of schools that require any clinical nutrition practice sessions.

4.2. Impact on Physician Competence. Current medical nutrition education must still be considered inadequate at all levels of professional training [18–20], and this is evident in the published literature showing that many physicians do not feel confident in their clinical nutrition skills, particularly when it comes to dealing with overweight and obese patients [21]. The few pieces of available objective data on clinical nutrition competencies of recently graduated physicians indicate that medical schools do not prepare their students adequately for the typical challenges of everyday practice. One survey of medical residents in a highly rated and competitive program found that only a small minority (14%) felt prepared to provide competent nutrition guidance to their patients [22]. A detailed knowledge test demonstrated that the bleak self-assessment of these residents was well founded. There is no indication that ill-prepared medical school graduates usually make up for deficits in their medical school education later on through extensive additional nutrition instruction and skill building opportunities [23, 24].

A review of patient records indicated that fewer than 10% of primary care providers (PCPs) in the US provide weight-loss counseling to their patients [25]. It is not because over 90% of PCPs think that such counseling is unimportant. A recent survey indicated that most primary practice physicians want to be better prepared for obesity care and overwhelmingly call for additional training in nutrition counseling and other effective interventions [26]. There are certainly many obstacles that prevent implementing proper weight assessment and interventions into busy practices. We have to assume that a lack of nutritional knowledge, engrained assessment procedures, and counseling skills contribute significantly to existing barriers.

4.3. What Can Be Done to Improve Nutrition Education? The eight medical schools with 40–75 hours of nutrition education are noteworthy because they demonstrate that medical school curricula can accommodate extensive coverage. These medical schools prepare their students for clinical practice by integrating nutrition content into preclinical subjects (25 hours on average). Most of them are then following up with extensive nutrition activities during their various clinical rotations (24 hours on average). This approach avoids the addition of even more hours to an already overcrowded curriculum. At the same time, it offers considerable advantages by addressing nutrition assessment and interventions in the context of organ- and disease-related instruction and typical clinical practice. Reviews of nutrition-related disease processes do not have to be duplicated, and various modes of disease prevention and treatment can be put into proper perspective, for example, by comparing efficacy and outcome expected with nutrition interventions to medication or surgical interventions and discussing how different modalities may be combined. It is obvious that meshing nutrition content with other clinical instructions requires strong nutrition education leadership and careful planning if the nutrition component of the integrated course is not to be a facile label without substance. Spreading instruction across the full curriculum also helps students to build on their preclinical instruction and connect nutrition theory to actual case management during their clinical rotations. Unfortunately, there are only few medical schools where all students are required to learn how to interview and counsel patients about their nutrition options in a mentored setting [27]. Students at a significant number of medical schools have responded to the perceived lack of nutrition instruction by organizing supplemental offerings on their own [28]. The Nutrition in Medicine (NIM) project is frequently contacted directly by such medical students about the availability of our online materials, and in a number of instances we were able to coordinate with school administrators and help them get nutrition instruction started.

4.4. Strengths. A major strength of our survey is the high response rate (91%), which gives us confidence that we have captured the current state of nutrition education across the entire country and not just in a specific region or type of medical school. Particular strengths of the survey are the use of our consistent methodology and identical questions since 2000, allowing us to compare 4 time points over 12 years. Our previous quadrennial surveys had similarly high response rates of 84–89%. Our survey instrument asks the respondent to specify the total hours of required nutrition education over the 4 years of medical school, as well as to indicate the number of hours in each specific course or curriculum type. Phrasing the same questions two different ways should prompt careful consideration on the part of the respondent and allowed us a chance to ask for clarification when the reported totals did not match. Our survey methodology targets the many instructors with whom we have developed relationships over the years, so we are confident that they are knowledgeable about the nutrition teaching they report.

4.5. Limitations. We acknowledge the inherent difficulty in characterizing something as complex and wide-ranging as nutrition instruction across a four-year curriculum. We realize that we are asking respondents to quantify something that may be more easily described in narrative form; however, a full curriculum review at all medical schools is not feasible with currently available resources. We are dependent on the reliability of our respondents, who may not always be fully informed of current curriculum scope and formats; however, as mentioned previously, we have long-standing relationships with many of our respondents and we have taken great pains to ensure that we are surveying the person most knowledgeable about the nutrition offerings at that school. We have always left the interpretation of what constitutes "nutrition education" to the individual respondent, so it

is possible that there are varying interpretations from one respondent to the next. Finally, we recognize that the raw number of curriculum hours does not necessarily predict the sufficiency of nutrition education across the medical school curriculum. We know that many instructors outside the dedicated nutrition courses are self-taught in the area of nutrition and do not have a strong background in clinical nutrition service or nutrition research. It is possible that a school might report a large number of hours, but the quality of education is lacking. On the other hand, it is unlikely that a school with a low number of required nutrition education hours is adequately covering the nutrition knowledge and skills that are needed. This makes it possible that the state of nutrition education at many medical schools may be even worse than the already inadequate number of curriculum hours suggest.

5. Conclusions

Many US medical schools still fail to prepare future physicians for everyday nutrition challenges in clinical practice. Nutrition is a dominant contributor to most chronic diseases and a key determinant of poor treatment outcomes. It cannot be a realistic expectation for physicians to effectively address obesity, diabetes, metabolic syndrome, hospital malnutrition, and many other conditions as long as they are not taught during medical school how to recognize and treat the nutritional root causes.

A few medical schools demonstrate that an alternative model with extensive nutrition education is compatible with the constraints of a crowded four-year medical curriculum. What we urgently need is the will to weave nutrition content credibly into other basic science and clinical topics, to offer such integrated learning sessions from the beginning to the end of undergraduate medical education and beyond, and to add a generous dose of nutrition practice opportunities. Instructors, curriculum committees, and medical school administrators need to be held accountable by licensing boards, and ultimately the general public, to meet generally recognized instructional standards. It is unacceptable that we keep finding the same systemic instructional failures decade after decade and still just hope for the best. What counts in the end is the readiness and ability of physicians to recognize and effectively address nutrition-related challenges in their patients. The reported educational deficits of medical school curricula go a long way to explain why many physicians miss opportunities to use nutrition as an effective healthcare tool.

Ethical Approval

The Institutional Review Board of the University of North Carolina at Chapel Hill made the determination that this project was exempt.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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References

[1] J. G. Thundiyil, D. Christiano-Smith, S. Greenberger, K. Cramm, J. Latimer-Pierson, and R. F. Modica, "Trimming the fat: identification of risk factors associated with obesity in a pediatric emergency department," *Pediatric Emergency Care*, vol. 26, no. 10, pp. 709–715, 2010.

[2] K. A. Shaw, A. B. Caughey, and A. B. Edelman, "Obesity epidemic: how to make a difference in a busy OB/GYN practice," *Obstetrical & Gynecological Survey*, vol. 67, no. 6, pp. 365–373, 2012.

[3] M. R. Jay, C. C. Gillespie, S. L. Schlair et al., "The impact of primary care resident physician training on patient weight loss at 12 months," *Obesity*, vol. 21, no. 1, pp. 45–50, 2013.

[4] A. Vivanti, E. Isenring, S. Baumann et al., "Emergency department malnutrition screening and support model improves outcomes in a pilot randomised controlled trial," *Emergency Medicine Journal*, 2013.

[5] J. A. Palesty and S. J. Dudrick, "Cachexia, malnutrition, the refeeding syndrome, and lessons from Goldilocks," *Surgical Clinics of North America*, vol. 91, no. 3, pp. 653–673, 2011.

[6] R. Englander, T. Cameron, A. J. Ballard, J. Dodge, J. Bull, and C. A. Aschenbrener, "Toward a common taxonomy of competency domains for the health professions and competencies for physicians," *Academic Medicine*, vol. 88, no. 8, pp. 1088–1094, 2013.

[7] K. M. Adams, K. C. Lindell, M. Kohlmeier, and S. H. Zeisel, "Status of nutrition education in medical schools," *American Journal of Clinical Nutrition*, vol. 83, no. 4, pp. 941S–944S, 2006.

[8] K. M. Adams, M. Kohlmeier, and S. H. Zeisel, "Nutrition education in U.S. medical schools: latest update of a national survey," *Academic Medicine*, vol. 85, no. 9, pp. 1537–1542, 2010.

[9] Committee on Nutrition in Medical Education FaNB, Commission on Life Sciences, and National Research Council, *Nutrition Education in U.S. Medical Schools*, The National Academies Press, Washington, DC, USA, 1985.

[10] K. M. Adams, M. Kohlmeier, M. Powell, and S. H. Zeisel, "Invited Review: Nutrition in medicine: nutrition education for medical students and residents," *Nutrition in Clinical Practice*, vol. 25, no. 5, pp. 471–480, 2010.

[11] Total Enrollment by U.S. Medical School and Sex, 2009–2013 (table 26), Association of American Medical Colleges Web site, 2012, https://www.aamc.org/data/facts/enrollmentgraduate/158808/total-enrollment-by-medical-school-by-sex.html.

[12] R. L. Weinsier, J. R. Boker, E. B. Feldman, M. S. Read, and C. M. Brooks, "Nutrition knowledge of senior medical students: a collaborative study of southeastern medical schools," *American Journal of Clinical Nutrition*, vol. 43, no. 6, pp. 959–968, 1986.

[13] Curriculum Committee of the Nutrition Academic Award Program, *Nutrition Curriculum Guide for Training Physicians*, 2002, http://www.nhlbi.nih.gov/research/training/naa/products/curr_gde/index.htm.

[14] R. L. Weinsier, J. R. Boker, C. M. Brooks et al., "Priorities for nutrition content in a medical school curriculum: a national consensus of medical educators," *American Journal of Clinical Nutrition*, vol. 50, no. 4, pp. 707–712, 1989.

[15] S. L. Goff, E. S. Holmboe, and L. Curry, "Barriers to obesity training for pediatric residents: a qualitative exploration of residency director perspectives," *Teaching and Learning in Medicine*, vol. 18, no. 4, pp. 348–355, 2006.

[16] R. L. Weinsier, J. R. Boker, C. M. Brooks et al., "Nutrition training in graduate medical (residency) education: a survey of selected training programs," *American Journal of Clinical Nutrition*, vol. 54, no. 6, pp. 957–962, 1991.

[17] D. Deen, E. Spencer, and K. Kolasa, "Nutrition education in family practice residency programs," *Family Medicine*, vol. 35, no. 2, pp. 105–111, 2003.

[18] R. A. Dimaria-Ghalili, M. Edwards, G. Friedman et al., "Capacity building in nutrition science: revisiting the curricula for medical professionals," *Annals of the New York Academy of Sciences*, vol. 1306, no. 1, pp. 21–40, 2013.

[19] R. F. Kushner, L. Van Horn, C. L. Rock et al., "Nutrition education in medical school: a time of opportunity," *The American Journal of Clinical Nutrition*, vol. 99, no. 5, supplement, pp. 1167S–1173S, 2014.

[20] C. M. Lenders, D. D. Deen, B. Bistrian et al., "Residency and specialties training in nutrition: a call for action," *American Journal of Clinical Nutrition*, vol. 99, no. 5, pp. 1174S–1183S, 2014.

[21] M. Jay, C. Gillespie, T. Ark et al., "Do internists, pediatricians, and psychiatrists feel competent in obesity care? Using a needs assessment to drive curriculum design," *Journal of General Internal Medicine*, vol. 23, no. 7, pp. 1066–1070, 2008.

[22] M. L. Vetter, S. J. Herring, M. Sood, N. R. Shah, and A. L. Kalet, "What do resident physicians know about nutrition? An evaluation of attitudes, self-perceived proficiency and knowledge," *Journal of the American College of Nutrition*, vol. 27, no. 2, pp. 287–298, 2008.

[23] M. Raman, C. Violato, and S. Coderre, "How much do gastroenterology fellows know about nutrition?" *Journal of Clinical Gastroenterology*, vol. 43, no. 6, pp. 559–564, 2009.

[24] J. S. Scolapio, A. L. Buchman, and M. Floch, "Education of gastroenterology trainees: first annual fellows' nutrition course," *Journal of Clinical Gastroenterology*, vol. 42, no. 2, pp. 122–127, 2008.

[25] J. L. Kraschnewski, C. N. Sciamanna, K. I. Pollak, H. L. Stuckey, and N. E. Sherwood, "The epidemiology of weight counseling for adults in the United States: a case of positive deviance," *International Journal of Obesity*, vol. 37, no. 5, pp. 751–753, 2013.

[26] S. N. Bleich, W. L. Bennett, K. A. Gudzune, and L. A. Cooper, "National survey of US primary care physicians' perspectives about causes of obesity and solutions to improve care," *BMJ Open*, vol. 2, no. 6, Article ID e001871, 2012.

[27] *Nutrition in the Medical School Curriculum: What and Where Nutrition Topics are Taught by NAA Faculty*, Nutrition Academic Awards Program, National Institute of Heart, Blood, and Lung Disease, 2013, http://www.nhlbi.nih.gov/funding/training/naa/products.htm.

[28] N. Agrawal, S. A. Ostrosky, and D. Henzi, "The introduction of nutrition education into the medical school curriculum: using an elective course to teach students the fundamentals, the science, and the clinical implications of food," *Medical Science Educator*, vol. 23, no. 2, pp. 225–232, 2013.

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Research Article

A Survey of Medical Students' Use of Nutrition Resources and Perceived Competency in Providing Basic Nutrition Education

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Purpose. The aims of this study were to assess where medical students obtain their nutrition information and their self-perceived level of competency in providing basic nutrition education to patients. *Methods.* A survey was distributed to all first through fourth year medical students at Case Western Reserve University ($n = 657$). For statistical analysis, data was expressed as percentages of total responses and binomial regression was used to answer the study hypotheses. *Results.* The survey response rate was 47%. Forty-two percent of respondents selected a majority of professional nutrition resources ($n = 132$) as their most commonly used nutrition resources, 38% selected a majority of consumer resources ($n = 119$), and 20% selected "I do not use nutrition resources" ($n = 61$). The most popular nutrition resource selected was consumer websites. Seventy percent of respondents reported feeling competent in their ability to provide basic nutrition education to patients ($n = 219$). *Conclusion.* Medical students seem to feel competent in their ability to give basic nutrition education to patients, but they may be obtaining nutrition information from unreliable consumer-based resources. To help increase the provision of sound nutritional guidance, medical students should be taught to use reliable nutrition resources, as well as the value of referring patients to registered dietitians.

1. Introduction

Nutrition-related chronic diseases are growing in prevalence in the USA; 35.9% of adults are obese, 8.1% have diagnosed diabetes, and 24% of deaths are caused by heart disease [1]. Physicians are often the first line of defense against chronic disease, as they are the first to communicate with patients about disease risk factors and prevention. Referring patients with nutrition-related health problems to registered dietitians (RDs) is often the best decision for a patient. However, it remains important that physicians feel competent in their ability to provide basic nutrition education and that they obtain nutrition information from reliable sources.

The American Academy of Family Physicians established nutrition competencies that medical residents should have at the end of training. One is to "be able to counsel patients regarding nutritional recommendations in a culturally-sensitive manner" [2]. Healthy People 2020 includes an objective to increase the number of patients receiving nutritional counseling and education from physicians [3]. In 2007, 12.2% of patients received nutritional counseling during physician visits. By 2020, the goal is that this percentage will increase to 15.2% [3].

Reports have found that physicians agree on nutrition being an important component of their practice but feel incompetent in their ability to provide nutritional counseling to patients [4–8]. Surveyed physicians have identified barriers to providing nutritional counseling. One is a lack of nutrition training in medical school. In 2005, 51.1% of US medical school graduates reported in the Association of American Medical Colleges Medical School Graduation Questionnaire that they received insufficient nutrition education during undergraduate medical school education [9, 10]. More recent questionnaires have not asked graduates about their nutrition education. From 1999 to 2009, 62–73% of US medical schools were not meeting the minimum suggested 25 hours of nutrition education recommended by the National Academy of Sciences [4, 11–13]. The National Academy of Sciences

also reported that the average number of nutrition education hours in medical school had dropped from 21 hours in 1985 to 19.6 hours in 2009 [4, 14].

Direct observations of 8000 patient visits with family physicians in 2002 and 2004 indicated that as few as 24% of primary care physicians (PCPs) provide nutritional counseling [15, 16]. In addition, in 2006, only one-third of Americans reported receiving nutrition information from physicians in the past [17, 18]. Physicians are often viewed as the most trusted source of nutrition information by surveyed consumers, and more than 25% of PCP visits involve a nutrition-related reason [17]. Furthermore, many physicians believe nutrition education is their responsibility, but few are actually giving nutrition education, and when they do, time is extremely limited [5, 8, 15, 16, 19].

Because physicians report receiving insufficient nutrition education during medical school, it makes sense to assume that they would turn to other sources for their nutrition information to gain knowledge. In 1995, a survey was sent to a representative random sample of active US physicians practicing in general practice, internal medicine, or pediatrics. The survey asked them to identify what sources they used to obtain nutrition information. Sixty-nine percent reported acquiring nutrition information from medical journals, 58% from dietitians, 46% from seminars and conferences, and 16% from nutrition journals, nutrition texts, and popular magazines [8]. In a more recent 2008 Dutch study, 61% of surveyed physicians reported searching the Internet for nutrition information, although the websites used were unspecified [20]. It is important that physicians choose professional, reliable nutrition resources so that the information they provide to patients is accurate.

To the best of our knowledge, few studies have assessed what nutrition resources medical students utilize or their feelings of preparedness toward providing basic nutrition education to patients. All research about the latter topics appears to be related to physicians. However, it is important to assess medical students because medical school is usually where physicians first receive nutrition education. During this time, students begin to develop habits regarding what nutrition resources will be their most frequently used sources of information. In addition, medical school is likely where many students are first exposed to the nutrition-related topics they will commonly have to discuss with patients. Thus, if medical students feel adequately prepared to give basic nutrition education and are taught to use reliable nutrition resources, they will be much more likely to provide sound nutritional guidance to patients once they become practicing physicians.

Medical students at Case Western Reserve University (CWRU) in Cleveland, Ohio, receive nutrition education in the classroom during their first year of medical school [21]. During their third year, they participate in various clinical rotations, in which they likely encounter patients with nutritional concerns and work on interdisciplinary teams that include RDs [21]. However, whether the latter exposure to nutrition provides them with the ability to identify reliable sources of nutrition information and promotes feelings of competency in providing basic nutrition education to patients is unknown. The objectives of this study were to assess where CWRU medical students get their nutrition information and their perceived competency in providing basic nutrition education to patients according to the 2010 Dietary Guidelines for Americans (DGAs). The DGAs were chosen as a reference for basic nutrition education topics because they represent a professional nutrition resource readily available to physicians. In addition, the DGAs include recommendations for the general population that emphasize an overall healthy diet [22]. The study hypotheses were that (i) a majority of medical students at CWRU who responded to the survey would identify consumer and not professional nutrition resources as their top sources of nutrition information, (ii) a majority of these medical students would not feel competent to provide basic nutrition education according to the DGAs, and (iii) self-perceived level of competency in providing basic nutrition education would increase as year in medical school increases.

2. Methods

A survey was developed asking medical students to provide information about their year in medical school, gender, top three sources for nutrition information, and perceived competency in providing basic nutrition education to patients. The survey was distributed in February 2013 via Research Electronic Data Capture (REDCap) version 5.1.1, which is a secure, web-based application for building and managing online surveys and was designed to support data capture for research studies [23]. REDCap provides audit trails for tracking data manipulation and user activity, as well as automated export procedures for data downloads to common statistical analysis software programs [23]. All current first-, second-, third-, and fourth-year medical students in the University Track Medical Degree program at CWRU (n = 657) received the survey via email using REDCap. Medical students were given two weeks to complete and submit the survey online. No inclusion or exclusion criteria existed, except that participants were current medical students at CWRU. The study was deemed exempt by the CWRU Institutional Review Board under federal regulation 45 CFR §46.101(b).

Respondents were asked to select their top three sources of nutrition information from a provided list (see Table 1). Government health agencies, peer-reviewed journals of nutrition and medicine, professional nutrition and health organizations, and RDs were considered "professional" resources. Consumer magazines and websites, phone apps, and television shows were considered "consumer" resources. Respondents had the option of selecting "other" and typing in a resource. In addition, they could select "I do not use nutrition resources." Respondents were determined to have chosen a majority of consumer resources if two or more selections were consumer. If they only selected two resources, one professional and one consumer, they were determined to have chosen a majority of consumer resources. If they selected "I do not use nutrition resources" but also selected one or more resources, they were determined to have chosen a majority of consumer resources if one or more of these

Table 1: Nutrition resources included in the survey that respondents could select as being their top sources of nutrition information.

Professional resources	Consumer resources
Government health agencies For example, http://usda.gov/, http://hhs.gov/, http://health.gov/, http://www.choosemyplate.gov/	Consumer magazines For example, Prevention, Men's/Women's Health, Muscle Fitness, Self
Peer-reviewed journals of nutrition For example, American Journal of Clinical Nutrition, Journal of the Academy of Nutrition and Dietetics, Nutrition Reviews	Consumer websites For example, http://WebMD.com/, http://MayoClinic.com/
Peer-reviewed journals of medicine For example, Journal of the American Medical Association, New England Journal of Medicine, American Journal of Preventative Medicine	Phone apps For example, MyFitnessPal
Professional nutrition organizations For example, http://nutrition.org/, http://eatright.org/, http://nutritioncare.org/	Television shows For example, Dr. Oz, The Doctors
Professional health organizations For example, http://diabetes.org/, http://cancer.org/, http://americanheart.org/, http://ama-aasn.org	
Registered dietitians	

Table 2: Nutrition topics (based on the DGAs) included in the survey for which respondents were asked to report feelings of competency.

(1) Preventing and/or reducing overweight and obesity through improved eating and physical activity behaviors
(2) Reducing sodium intake and recommendations for daily intake
(3) Replacing unhealthy fats with healthier fats
(4) Choosing whole over refined grains
(5) Limiting alcohol consumption
(6) Selecting healthier protein foods
(7) Increasing vegetable intake
(8) Increasing potassium intake
(9) Increasing dietary fiber intake
(10) Increasing calcium and vitamin D intake

resources were consumer. If their only selection was "I do not use nutrition resources," it could not be determined if they had chosen a majority of consumer resources. These respondents were placed into a separate category with others who responded the same. If respondents selected "other," they were required to provide further explanation; based on the information provided, it was determined whether this "other" resource was consumer or not (and these "other" resources are provided in the Results section).

Respondents were given a list of ten nutrition-related topics based on the DGAs (see Table 2). They were asked to respond "yes" to each topic if they felt competent to provide basic nutrition education about it to patients, "no" if they did not feel competent, and "unable to assess" if they felt unable to assess their competency level. Respondents were determined to feel competent to provide basic nutrition education according to the DGAs if they answered "yes" for at least seven of the ten topics.

The data collected in REDCap was exported to JMP Pro (Version 10.0.1, 2012, SAS Institute Inc., Cary, NC) for statistical analysis. Data was expressed as percentages of total responses. Binomial regression was performed to determine (1) if a majority of respondents chose consumer resources and (2) if a majority of respondents reported feelings of competency and (3) to evaluate differences in regard to gender and medical school year. A P value of <0.05 was considered significant.

3. Results

The survey was distributed to all current first-, second-, third-, and fourth-year medical students in the University Track Medical Degree Program at CWRU ($n = 657$). Of the 657 medical students who received the survey, 308 fully completed it. Four completed it without specifying gender. These partially completed surveys were included in data analysis, giving a 47% response rate ($n = 312$).

Gender and medical school year distributions were fairly even. Fifty-two percent of respondents were female ($n = 161$); 48% were male ($n = 147$). In comparison, the gender distribution of all medical school students at CWRU was 45% female and 55% male ($n = 657$). In addition, thirty percent of respondents were first-year medical students ($n = 95$), 24% were second-year medical students ($n = 74$), 21% were third-year medical students ($n = 66$), and 25% were fourth-year medical students ($n = 77$).

Respondents selected professional nutrition resources more often than they selected consumer nutrition resources. Of all the nutrition resource selections made, 371 were professional, and 296 were consumer. Figure 1 demonstrates the percentage of total respondents who reported using each of the nutrition resources listed in the survey. The most popular individual choice selected out of all of the resource options was consumer websites, followed by government health agencies. The third most popular individual choice was "I do not use nutrition resources." Thirty respondents

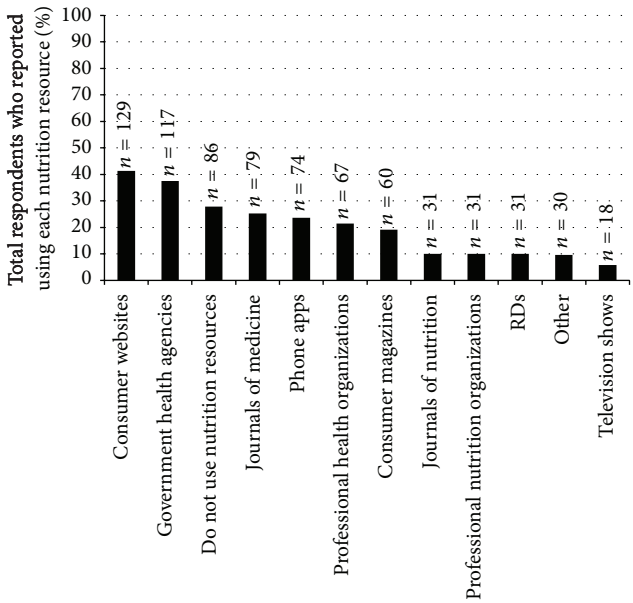

Figure 1: CWRU medical students' reported use of nutrition resources.

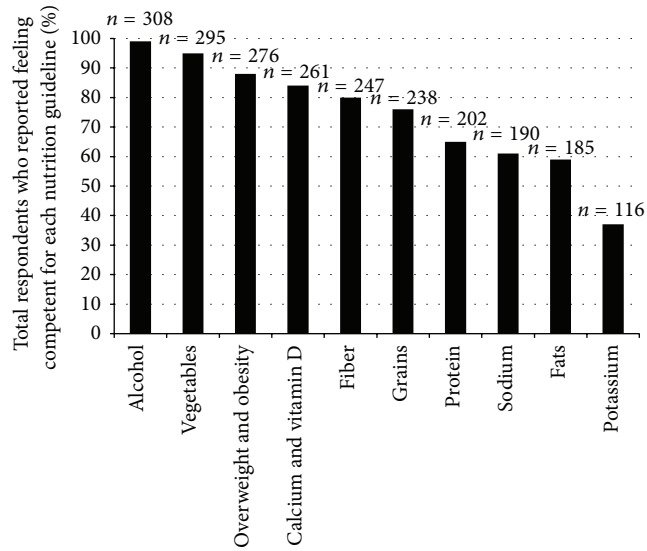

Figure 2: CWRU medical students' reported feelings of competency in providing basic education to patients about nutrition guidelines (according to the DGAs).

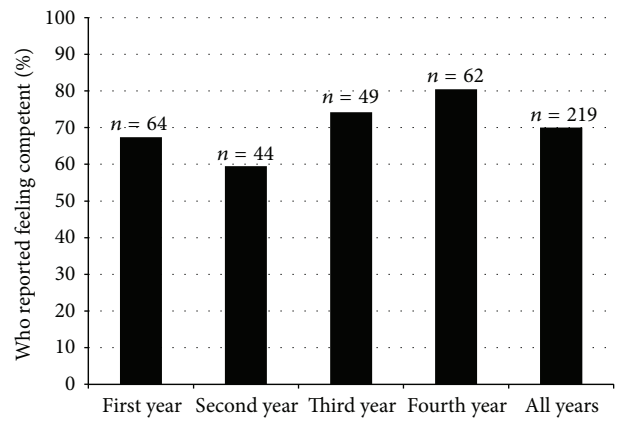

Figure 3: CWRU medical students' reported feelings of competency in providing basic nutrition education related to their year in medical school.

selected "other"; explanations provided included consumer books such as In Defense of Food, undergraduate classes, textbooks, friends, PCPs, the news, blogs, and websites including Wikipedia, UpToDate, and Reddit.

Selection of resources did not vary greatly between genders (data not shown), except for the following significant differences. Males were significantly more likely than females to use journals of medicine ($P = 0.01$) and nutrition ($P = 0.02$) and to select "other" ($P < 0.05$). Females were significantly more likely to use government health agencies ($P = 0.04$) and phone apps ($P = 0.01$).

No specific pattern existed for medical school year distribution and choice of nutrition resources (data not shown). First-year medical students were significantly less likely than fourth-year medical students to select journals of medicine ($P = 0.01$) and were significantly more likely to select phone apps ($P = 0.02$) and television shows ($P < 0.01$). Second-year medical students were significantly less likely than fourth-year medical students to select phone apps ($P = 0.01$) and significantly more likely to select "I do not use nutrition resources" ($P = 0.02$) and "other" ($P = 0.02$). Third-year medical students were significantly more likely than fourth-year medical students to select "other" ($P = 0.05$).

The data did not support the hypothesis that a majority of medical students would identify consumer over professional resources as their top sources of nutrition information. Forty-two percent of respondents selected a majority of professional resources ($n = 132$), 38% selected a majority of consumer resources ($n = 119$), and 20% selected "I do not use nutrition resources" and did not select any resources ($n = 61$).

Figure 2 illustrates medical students' reported feelings of competency in providing basic nutrition education to patients about nutrition guidelines (according to the DGAs). Over half of respondents reported feeling competent to give education for 9 of the 10 nutrition guidelines. Almost every respondent reported feeling competent to give education about limiting alcohol intake, and 95% reported feeling competent to provide education about increasing vegetable intake. The one guideline for which less than half of respondents reported feeling competent about was increasing potassium intake.

Only a few significant differences existed between genders and year in medical school (data not shown). Females were significantly more likely than males to feel competent to give education about grains ($P = 0.04$). Overall, fourth-year medical students felt the most competent to provide basic nutrition education (80.5%), followed by third-year medical students (74.2%), and then first-year medical students (67.4%). Second-year medical students felt the least competent (59.5%) (see Figure 3). First-year medical students were

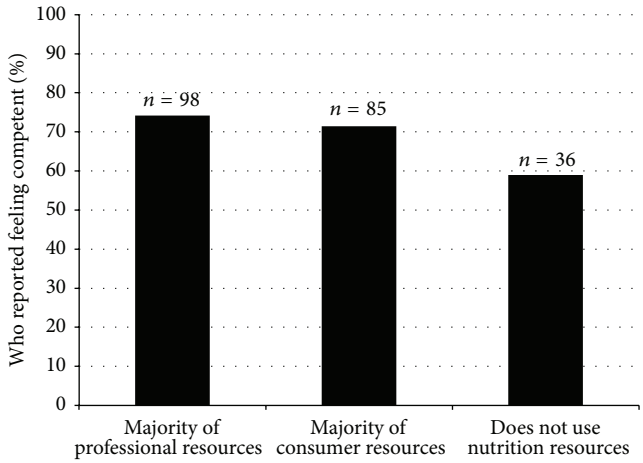

Figure 4: CWRU medical students' reported feelings of competency in providing basic nutrition education related to types of nutrition resources used.

significantly less likely than fourth-year medical students to feel competent to provide education about sodium ($P = 0.01$). Second-year medical students were significantly less likely than fourth-year medical students to feel competent to provide education about overweight and obesity ($P = 0.04$), potassium ($P < 0.01$), and fiber ($P < 0.01$).

Data also contradicted the hypothesis that a majority of medical students would not feel competent to provide basic nutrition education according to the DGAs. Seventy percent reported feeling competent in their ability to provide nutrition education for at least seven of the ten dietary guidelines ($n = 219$). However, the data supported the hypothesis that self-perceived level of competency increased with year in medical school, with the exception of second-year medical students feeling less competent than first-year medical students.

The data indicated that reported feelings of competency in providing basic nutrition education were similar for respondents who reported using a majority of consumer resources and those who reported using a majority of professional resources (see Figure 4). Of respondents who chose a majority of professional resources, 74.2% ($n = 98$) reported feeling competent; 71.4% ($n = 85$) who chose a majority of consumer resources reported feeling competent. However, only 59% ($n = 36$) of respondents who reported not using any nutrition resources also reported feeling competent, making these respondents significantly less likely to feel competent to provide basic nutrition education ($P = 0.04$) than other respondents.

4. Discussion

The survey had a fairly high response rate of 47%. Medical students who chose not to respond to the survey may have had a lack of interest in nutrition or may have felt that nutrition is insignificant to their medical specialty of interest. As already discussed, physicians appear to recognize the importance of nutrition education in their practice. However, some medical students may not yet understand or value this relationship. Another potential deterrence could have been the time required to complete the survey, but it is unlikely that time was a major factor in participants' decision to respond because they were notified that the survey took less than two minutes to complete.

A slightly greater percentage of medical students chose a majority of professional nutrition resources over consumer resources, as their top sources of nutrition information, 42% versus 38%, respectively. Overall, more individual selections of professional resources were made. However, the most commonly selected individual resource was consumer websites. Also, a large percentage of respondents (20%) reported not using any nutrition resources. Therefore, many of the medical students who responded to the survey may be getting nutrition information from unreliable sources.

Results showed that first-year medical students were significantly less likely to use journals of nutrition and significantly more likely to use phone apps and television shows as nutrition resources than were fourth-year medical students. Perhaps as medical students progress through their medical education, they gain more knowledge about which nutrition resources are reliable and hence are better choices. However, results also indicated that first-year medical students were more likely to use journals of nutrition and professional nutrition organizations and less likely to use consumer magazines than fourth-year medical students, although these results were not significant. Therefore, it is difficult to conclude if medical students develop habits of choosing more reliable nutrition resources as they advance through medical school.

More than half of respondents reported feeling competent to provide basic nutrition education to patients about all of the nutrition-related topics (according to the DGAs), except the one regarding potassium. Interestingly, medical students' perceived level of competency in providing basic nutrition education appeared to increase as they advanced through medical school. The one exception to this pattern was that second-year medical students reported feeling less competent than first-year medical students. Perhaps students tend to enter medical school feeling as if they know more than they actually do. As they get further into their medical education, maybe they begin to realize the amount of information they have yet to learn. When they reach their third and fourth years, their level of competency likely increases as they gain more knowledge about nutrition-related topics, especially during their exposure to patients and RDs during clinical rotations. In addition, it is interesting to note that second-year medical students were significantly more likely to select "I do not use nutrition resources" than fourth-year medical students. The data indicated that students who were not using nutrition resources were significantly less likely to feel competent to provide nutrition education. Perhaps part of the reason that second-year medical students felt the least competent was because they were significantly more likely not to use any nutrition resources.

Because many medical students are getting nutrition information from consumer resources or not using nutrition resources at all, it is possible that their nutrition information is unreliable. It is important to note that respondents who selected a majority of consumer resources were equally as

likely to feel competent to provide basic nutrition education as those choosing a majority of professional resources. Thus, while medical students may feel competent to provide basic nutrition education, those using consumer resources could be passing along inaccurate information to patients.

A literature review showed that physicians are not frequently providing nutrition education to patients. Although this study did not assess actual competency, the data show that CWRU medical students appear to feel competent in their ability to give basic nutrition education. Therefore, lacking feelings of competency may not be the primary barrier hindering physicians from providing basic nutrition education to patients. Other barriers likely exist. Time is probably a key barrier in hindering physicians from speaking with patients about nutritional concerns. An average visit with a PCP is 10–20 minutes [15, 24]. The maximum amount of time that physicians usually spend on nutritional counseling is five minutes [8, 25]. Even if physicians are willing to give nutrition education, time constraints could keep them from providing it.

Although physicians are an important source of nutrition information for patients, they may not be the best source unless they have also completed the education and training required of an RD. In a 2012 study surveying 500 general practitioners, family practitioners, and general internists in the USA, 41–48% of respondents reported that RDs were most qualified to be successful in helping obese patients [26]. Physicians likely have similar feelings about RDs being the most qualified in educating patients about other nutrition-related topics. It is important that physicians refer patients to RDs who are considered the experts in the field of nutrition, especially when patients require beyond-basic nutrition education. It is also important that medical students learn about the role of RDs in interdisciplinary healthcare teams, so they have a general idea of what RDs do and when referrals are most appropriate.

The information gained from this study could be helpful in creating the best medical education for the 21st century. Perhaps curriculum should include teaching medical students about how to choose and locate reliable, professional nutrition resources to help increase the likelihood of basic education with more accurate nutrition information. The resources medical students use during their training will likely become the same resources used when they are practicing physicians. In addition, it would be extremely beneficial to ensure that medical students are taught about the value of referring patients to RDs, who have much more education/training in nutrition and have more time available to spend educating patients about nutrition issues. It is certainly important that physicians are able to give accurate basic nutrition information to patients, but their decision to refer a patient to an RD could be the more valuable choice for many patients.

Limitations of this study include those that go along with using a survey. All responses were self-reported and were potentially inaccurate. The sample size was fairly small, only including 312 medical students. Also, results from this study at CWRU cannot be generalized to medical students at other universities, nor can they be translated into how these medical students will behave as practicing physicians. Only respondents' perceived level of competency in giving basic nutrition education to patients could be assessed, rather than their actual ability to give accurate nutrition education. Since perceived competency does not necessarily translate into actual ability, future research studies that explore the correlation between feelings of competency and actual competence would be enlightening. In addition, although the DGAs include many basic nutrition topics, medical students will likely have to educate patients about additional basic nutrition topics not included in the DGAs. Therefore, perceived competency in providing basic nutrition education may not be completely assessed using only the topics included in the survey. Last, respondents were asked to select their top three nutrition resources, but many selected only one or two, affecting data analysis. In addition, selection of "I do not use nutrition resources" and then selection of one or more resources also affected data analysis.

5. Conclusions

Many medical students at CWRU are getting nutrition information from consumer resources or not using nutrition resources at all. However, most of these medical students reported feeling competent to provide basic nutrition education to patients about a variety of topics. Because most medical students will become practicing physicians and will be responsible for providing sound nutrition education and guidance to patients, it is important that they learn how to differentiate between professional nutrition resources and unreliable, consumer-based resources. Referring patients to RDs is also a wise option to ensure that patients receive accurate nutrition education. Thus, medical school educators may benefit from expanding their nutrition curriculums to incorporate information about identifying reliable nutrition resources and the importance of referrals to RDs. The latter may help to promote the distribution of accurate nutrition information and increase the likelihood that patients receive evidence-based nutrition recommendations.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

References

[1] National Center for Health Statistics, "Health, United States, 2012," Centers for Disease Control and Prevention, May 2013, http://www.cdc.gov/nchs/data/hus/hus12.pdf.

[2] American Academy of Family Physicians, *Recommended Curriculum Guidelines for Family Medicine Residents: Nutrition*, American Academy of Family Physicians, 2008, http://www.aafp.org/dam/AAFP/documents/medical_education_residency/program_directors/Reprint275_Nutrition.pdf.

[3] United States Department of Health and Human Services. Nutrition and weight status, http://healthypeople.gov/2020/topicsobjectives2020/objectiveslist.aspx?topicId=29.

[4] K. M. Adams, M. Kohlmeier, M. Powell, and S. H. Zeisel, "Invited Review: Nutrition in medicine: nutrition education for medical students and residents," *Nutrition in Clinical Practice*, vol. 25, no. 5, pp. 471–480, 2010.

[5] B. S. Levine, M. M. Wigren, D. S. Chapman, J. F. Kerner, R. L. Bergman, and R. S. Rivlin, "A national survey of attitudes and practices of primary-care physicians relating to nutrition: strategies for enhancing the use of clinical nutrition in medical practice," *The American Journal of Clinical Nutrition*, vol. 57, no. 2, pp. 115–119, 1993.

[6] K. S. Soltesz, J. H. Price, L. W. Johnson, and S. K. Tellijohann, "Family physicians' views of the preventive services task force recommendations regarding nutritional counseling.," *Archives of family medicine*, vol. 4, no. 7, pp. 589–593, 1995.

[7] J. A. Cimino, "Why can't we educate doctors to practice preventive medicine?" *Preventive Medicine*, vol. 25, no. 1, pp. 63–65, 1996.

[8] R. F. Kushner, "Barriers to providing nutrition counseling by physicians: a survey of primary care practitioners," *Preventive Medicine*, vol. 24, no. 6, pp. 546–552, 1995.

[9] M. L. Vetter, S. J. Herring, M. Sood, N. R. Shah, and A. L. Kalet, "What do resident physicians know about nutrition? An evaluation of attitudes, self-perceived proficiency and knowledge," *Journal of the American College of Nutrition*, vol. 27, no. 2, pp. 287–298, 2008.

[10] Association of American Medical Colleges, "2005 GQ All schools summary report [data set]," Obtained by special permission, September 2005.

[11] F. Torti, K. Adams, L. Edwards, K. Lindell, and S. Zeisel, "Survey of nutrition education in U.S. medical schools—an instructor-based analysis," *Medical Education Online*, vol. 6, p. 8, 2001, http://med-ed-online.net/index.php/meo/article/view/4526.

[12] K. M. Adams, K. C. Lindell, M. Kohlmeier, and S. H. Zeisel, "Status of nutrition education in medical schools," *American Journal of Clinical Nutrition*, vol. 83, no. 4, pp. 941S–944S, 2006.

[13] K. M. Adams, M. Kohlmeier, and S. H. Zeisel, "Nutrition education in U.S. medical schools: latest update of a national survey," *Academic Medicine*, vol. 85, no. 9, pp. 1537–1542, 2010.

[14] National Research Council (U.S.) and Committee on Nutrition in Medical Education, *Nutrition Education in U.S. Medical Schools*, National Academy Press, Washington, DC, USA, 1985.

[15] C. B. Eaton, M. A. Goodwin, and K. C. Stange, "Direct observation of nutrition counseling in community family practice," *American Journal of Preventive Medicine*, vol. 23, no. 3, pp. 174–179, 2002.

[16] N. A. Anis, R. E. Lee, E. F. Ellerbeck, N. Nazir, K. A. Greiner, and J. S. Ahluwalia, "Direct observation of physician counseling on dietary habits and exercise: patient, physician, and office correlates," *Preventive Medicine*, vol. 38, no. 2, pp. 198–202, 2004.

[17] K. M. Kolasa and K. Rickett, "Barriers to providing nutrition counseling cited by physicians: a survey of primary care practitioners," *Nutrition in Clinical Practice*, vol. 25, no. 5, pp. 502–509, 2010.

[18] J. Tillotson, "Who's the average Joe eater to believe?" *Nutrition Today*, vol. 41, no. 3, pp. 112–114, 2006.

[19] K. M. Kolasa, ""Images" of nutrition in medical education and primary care," *The American Journal of Clinical Nutrition*, vol. 73, no. 6, pp. 1006–1009, 2001.

[20] S. M. E. van Dillen and G. J. Hiddink, "A comparison of Dutch family doctors' and patients' perspectives on nutrition communication," *Family Practice*, vol. 25, supplement 1, pp. i87–i92, 2008.

[21] Case Western Reserve University School of Medicine, *The Western Reserve 2 Curriculum: Reuniting Health and Medicine*, Case Western Reserve University School of Medicine, 2013, http://casemed.case.edu/admissions/docs/Curriculum%2011-12.pdf.

[22] United States Department of Agriculture and United States Department of Health and Human Services, *Dietary Guidelines for Americans, 2010 Executive Summary*, United States Department of Agriculture Center for Nutrition Policy and Promotion Website, 2010, http://www.cnpp.usda.gov/sites/default/files/dietary_guidelines_for_americans/ExecSumm.pdf.

[23] P. A. Harris, R. Taylor, R. Thielke, J. Payne, N. Gonzalez, and J. G. Conde, "Research electronic data capture (REDCap): a metadata-driven methodology and workflow process for providing translational research informatics support," *Journal of Biomedical Informatics*, vol. 42, no. 2, pp. 377–381, 2009.

[24] D. Mechanic, D. D. Mcalpine, and M. Rosenthal, "Are patients' office visits with physicians getting shorter?" *The New England Journal of Medicine*, vol. 344, no. 3, pp. 198–204, 2001.

[25] L. G. Nicholas, C. D. Pond, and D. C. K. Roberts, "Dietitian-general practitioner interface: a pilot study on what influences the provision of effective nutrition management," *The American Journal of Clinical Nutrition*, vol. 77, no. 4, pp. 1039S–1042S, 2003.

[26] S. N. Bleich, W. L. Bennett, K. A. Gudzune, and L. A. Cooper, "National survey of US primary care physicians' perspectives about causes of obesity and solutions to improve care," *British Medical Journal*, vol. 2, no. 6, Article ID e001871, 2012.

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Research Article

New Zealand Medical Students Have Positive Attitudes and Moderate Confidence in Providing Nutrition Care: A Cross-Sectional Survey

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Throughout the world, medical students and doctors report inadequate nutrition education and subsequently lack of knowledge, attitude, and skills to include nutrition in patient care. This study described New Zealand's students' attitudes to and self-perceived skills in providing nutrition care in practice as well as perceived quantity and quality of nutrition education received in training. 183 medical students from New Zealand's largest medical school (response rate 52%) completed a 65-item questionnaire, partially validated, using 5-point Likert scales. Students believed incorporating nutrition care into practice is important, yet they were less confident patients improve nutrition behaviours after receiving this care. Students were confident in skills related to nutrition in health and disease but less confident in skills related to general food knowledge. Greater quantity and quality of nutrition education received was associated with greater self-perceived skills in providing nutrition care to patients but not with attitudes towards incorporating nutrition care into practice. This cohort of New Zealand medical students places similarly high importance on nutrition care as students and doctors from other countries. Further investigations beyond graduation are required to inform whether additional nutrition education is warranted for these doctors.

1. Introduction

The incidence of chronic disease in New Zealand is growing [1]. The role of nutrition in the prevention and management of chronic disease is well recognised [2, 3]. It is a priority target of the New Zealand Health Strategy to improve the dietary behaviour of individuals [1]. Primary health care has been identified as an ideal setting to provide nutrition care to patients with chronic disease [1, 4]. In this setting, nutrition care refers to any practice conducted by a health professional that aims to improve the nutrition behaviour and subsequent health of patients [5].

Approximately thirty percent of New Zealand medical students express a strong interest in becoming general practitioners (GPs) when leaving medical school [6]. General practitioners have the potential to make a significant contribution to the prevention and management of chronic disease in New Zealand by providing nutrition care for three reasons. First, GPs are often the initial contact point for health care of individuals with chronic disease [7]. Second, over three

Table 1: Description of each section of the questionnaire.

Section	Description of questions
Attitudes towards incorporating nutrition care into practice[a]	33 questions exploring the perceived importance of nutrition care, implementation of nutrition care, doctor-patient relationship in nutrition, and efficacy of doctors in providing nutrition care.
Self-perceived skills in providing nutrition care[b]	30 questions exploring confidence in skills relevant to nutrition care.
Nutrition education	Two questions exploring perceived quantity and quality of nutrition education received during medical training.

[a]Adapted from McGaghie et al. (2001) [22].
[b]Adapted from Mihalynuk et al. (2003) [23].

quarters (78%) of the adult New Zealand population consult a GP at least once each year [1]. Third, GPs are one of the most trusted providers of nutrition care [8–11].

There is evidence that GPs can provide effective nutrition care that results in improvements in patients' nutrition behaviour [12–14]. However, the competence of GPs in providing nutrition care has previously been questioned, and it is reported that GPs receive insufficient nutrition education during medical training [10, 15, 16]. As a result, GPs perceive that they are inadequately prepared to provide nutrition care to patients and report low self-efficacy in this area [17–20]. However, it is unclear whether the findings reported in international literature extend to the New Zealand primary care context [21]. In New Zealand's largest medical school, undergraduate training is taught using a systems-based curriculum. Nutrition education does not have a dedicated domain and is taught within the preclinical systems curriculum (years 2 and 3) and in clinical years (years 4, 5, and 6). Students receive approximately twenty hours of nutrition teaching, similar to the United States national average of 19.6 hours [16]. The teaching is predominantly didactic, taught by a dietitian in collaboration with other medical educators and includes one three-hour nutrition laboratory.

Competence refers to an individual's ability to perform a task and includes three components: *knowledge* of a task, *skill* to perform a task, and *attitude* that enables task performance [24]. The investigation of self-perceived skills and attitudes in medical students is an accepted indicator of competence when objectives are clearly specified [23, 25]. As prospective GPs, medical students in the final stages of their university training are an ideal group to investigate skills and attitudes towards incorporating nutrition care into practice. It is presently unclear whether self-perceived skills and attitudes are mediated by the perceived quantity and/or quality of nutrition education received during medical training. Investigating this relationship will assist in understanding if additional nutrition education is required during medical training and will inform strategies to support future GPs to increase competence in nutrition care.

This study described New Zealand medical students' (i) attitudes towards incorporating nutrition care into practice, (ii) self-perceived skills in providing nutrition care, and (iii) perceived quantity and quality of nutrition education received during medical training.

2. Materials and Methods

This study utilised a cross-sectional design and was approved by the relevant institutional human research ethics committee (reference number 7785).

Potential participants were students enrolled in two consecutive cohorts from the largest of one of two New Zealand medical schools. The students had finished their coursework and placements and were eligible to graduate ($n = 351$). In 2012, there were one hundred and sixty two graduate students and, in 2013, one hundred and eighty nine graduate students. There were no differences between the two cohorts for nutrition content and number of hours taught. Data collection occurred each year on a single day when students attended university to complete administrative tasks prior to graduation. To avoid bias, a person not involved with the study administered the process. Information relating to the study was provided to all medical students through the online student information system two months and one month prior to data collection.

A survey was developed from previously used surveys of medical students' attitudes to nutrition care [22] and GP registrars confidence in providing nutrition care [23] and included three sections (Table 1). McGaghie et al.'s [22] survey has proven reliability and Mihalynuk et al.'s [23] survey exhibits construct validity. Where necessary, wording was modified for relevance to the New Zealand context (such as using kilojoules instead of calories). Each item was measured using a 5-point Likert scale, where 1 indicated negative attitude or low confidence and 5 indicated positive attitude or high confidence. The survey was tested with a group of five final year medical students for clarity of understanding, three months prior to final examinations.

Data analysis was conducted using SPSS version 22. Representativeness of the sample for gender and age was investigated using a Chi-squared goodness of fit test and a single sample t-test. Descriptive statistics were calculated for each survey item. The relationship between students' perceived quantity and quality of nutrition education was received during medical training, their attitudes towards incorporating nutrition care into practice and self-perceived skills in providing nutrition care were investigated using Pearson's Chi-squared tests. In order to comply with the assumptions underpinning Chi-square tests, categories were collapsed to ensure that <20% of cells remained below minimum counts. Statistical significance was set at $P \leq 0.05$.

3. Results

A total of 183 out of 351 eligible students completed the questionnaire, resulting in a response rate of 52%. Seventeen surveys were excluded because of incomplete data. The majority of participating students ($n = 108$, 59%) were female, and the average age of the sample was 24.8 (SD = 2.5) years. There were no significant differences between the participating and nonparticipating students with regards to age (average population age = 25.1 years; $P = 0.277$) or gender (population 55% female; $P = 0.211$).

Table 2 displays students' attitudes towards incorporating nutrition care into practice. Nearly all students reported that patient motivation, advocating for healthy lifestyle behaviours, and support from other health professionals were important when providing nutrition care. In contrast, students reported variable attitudes about the likelihood of patients changing nutrition behaviour after receiving nutrition care from their doctor.

Table 3 displays students' self-perceived skills in providing nutrition care. Students were confident in skills related to the role of nutrition in health and disease, for example, calculating body mass index and waist-hip ratio, explaining the significance of modest weight loss for patients with type 2 diabetes, and explaining the influence of alcohol consumption on health. Students were less confident in skills associated with the nutrition composition of foods and general food knowledge, for example, assessing total kilojoules and saturated fat per portion of food, explaining how to identify anti-oxidant rich produce, and indicating when to use single vitamins or multivitamins.

The majority of students (60%) perceived the quantity of nutrition education received during medical training to be good or very good, and even more (83%) perceived the quality of nutrition education received during medical training to be good or very good. The perceived quantity and quality of nutrition education received during medical training had limited association with students' attitudes towards incorporating nutrition care into practice (Table 2). However, students who reported higher confidence in providing nutrition care were also more likely to perceive the quality and quantity of nutrition education received during medical training to be good or very good (Table 3).

4. Discussion

This is the first study tov investigate the nutrition-related competence of New Zealand medical students by measuring their attitudes towards incorporating nutrition care into practice and self-perceived skills in providing nutrition care to patients. The results indicated that students felt incorporating nutrition care into practice is important for doctors. However, they were less sure about the capacity of patients to improve their nutrition behaviour after receiving nutrition care by doctors. Students felt more confident discussing the role of nutrition in health and disease than explaining the nutrient composition of foods to patients.

International literature has demonstrated that nutrition care is perceived to be important by medical students, doctors, and medical educators [5, 23, 26, 27]. The results of the present study indicate that similar perceptions exist amongst New Zealand medical students. Despite these positive views, previous studies suggest that students' attitudes towards nutrition care decline after graduation [28–30]. Although attitudes towards nutrition care are positive in students about to graduate, it may still be important to reinforce the significance of nutrition care during the early stages of their career [21, 31].

Although students in the present study reported that nutrition care is important, they were less confident that patients would improve their nutrition behaviour after receiving nutrition care from doctors. This suggests that the nutrition-related self-efficacy of this group of students may be low. Given that self-efficacy is a barrier to incorporating nutrition care into practice [28, 32, 33], it is plausible that the students in the present study, despite thinking nutrition care is important, will not provide this care at every appropriate opportunity. It may also be that students were less confident that patients would improve their nutrition behaviour reflecting the reality of their practical experiences that changing dietary behaviour is very difficult and many patients are resistant to change. It may also be that nutrition care may not be modelled by senior doctors as part of medical practice. Further investigation for reasons why students feel less confident patients will improve nutrition behaviour after receiving nutrition care from doctors is required. This may include developing strategies to improve the nutrition-related self-efficacy of these students given that nutrition care provided by doctors can positively impact patients' nutrition behaviour [14].

Medical educators have highly variable views on the most important and relevant nutrition-related competencies for students to develop during medical training [5, 34]. Students in the present study were aligned with findings from previous studies, whereby they felt confident in skills related to describing the role of nutrition in health and disease [35]. However, they did not feel confident in skills related to nutrition composition of foods and general food knowledge. Given that these students also perceive that nutrition care should involve the support of other health professionals, such as nurses and dietitians, the specific nutrition-related skills required by doctors may not be universal. This suggests that the ideal role of doctors in providing nutrition care may be to engage with patients regarding their nutrition care needs and ensure access to supporting health professionals when required [34]. Notably, broader health care reforms are focusing on this type of patient-centered approach to care [36].

It has been reported in many international studies that students receive inadequate nutrition education in medical training [16, 37]. Early reports indicated that over 85% of medical students were not satisfied with some aspect of their nutrition education [38] and dissatisfaction still exists among the majority of students [16]. In contrast, most students in this New Zealand sample perceived the quality and quantity of nutrition education to be good or very good. One reason

Table 2: Students' attitudes towards incorporating nutrition care into practice, ranked in order of agreement ($n = 183$).

Items	Agree n (%)	Unsure n (%)	Disagree n (%)
Patient motivation is essential to achieving dietary change.	174 (95)	5 (3)	4 (2)
It is important that I evaluate a patient's alcohol intake as part of their overall nutritional status.	165 (90)	16 (9)	2 (1)
A change toward a healthier lifestyle is important at any stage of life.	166 (91)	17 (9)	0 (0)
Doctors require the support of health professionals such as nurses and dietitians to reinforce patient nutrition education[a].	159 (87)	21 (11)	3 (2)
It is important that I advocate diet and physical activity to promote weight control[a].	156 (85)	26 (14)	1 (1)
There is a role for practice nurses to provide nutrition education to patients when referred by the doctor.	155 (85)	20 (11)	8 (4)
Doctors can have an effect on a patient's dietary behaviour if they take the time to discuss the problem.	152 (84)	31 (17)	0 (0)
Patients requiring detailed nutrition counselling require referral to a dietitian[b].	153 (84)	26 (14)	4 (2)
Specific advice about how to make dietary changes could help some patients improve their dietary habits.	148 (81)	33 (18)	2 (1)
All doctors, regardless of specialty, should counsel high-risk patients about dietary change.	144 (79)	32 (17)	7 (4)
Patients need ongoing counselling following my initial instruction to maintain behaviour changes.	140 (76)	42 (23)	1 (1)
It is important that I assist paediatric patients to establish healthy eating patterns early to prevent risk of chronic diseases.	124 (68)	53 (29)	6 (3)
I have an obligation to improve the health of my patients including discussing nutrition with them.	132 (72)	48 (26)	3 (2)
It is important that I refer patients with diet-related problems to registered dietitians and other qualified nutrition staff.	132 (72)	43 (23)	8 (4)
Patients need specific instructions about how to change their eating behaviour[a].	123 (67)	54 (30)	6 (3)
It is important that I address the importance of diet whenever I care for a patient.	124 (68)	50 (27)	9 (5)
Nutrition counselling should be part of routine care by all doctors, regardless of speciality.	121 (66)	48 (26)	14 (6)
It is important that I encourage patients to ask diet-related questions and refer them for assistance when needed.	119 (65)	56 (30)	8 (5)
It is important that, wherever possible, I recommend diet changes before initiating drug therapy.	114 (62)	58 (32)	11 (6)
It is important that I assess each patient's stage of change before initiating dietary intervention.	106 (60)	61 (32)	16 (8)
My patient education efforts will be effective in increasing patients' compliance with nutritional recommendations[a].	102 (56)	68 (37)	13 (7)
It is important that I advocate a low-fat diet for weight control[a,b].	99 (54)	68 (37)	16 (9)
Most doctors are not adequately trained to discuss nutrition with patients[a,b].	97 (53)	68 (37)	18 (10)
It is important that I perform at least some nutritional assessment with every patient.	77 (42)	72 (39)	34 (19)
Nutrition assessment should be included in any routine appointment, just like any diagnosis and treatment.	73 (40)	78 (43)	32 (17)
Patients will rarely change their behaviour if they do not have active symptoms of disease.	74 (40)	80 (44)	29 (16)
Patients are not motivated to make changes unless they are sick.	58 (33)	73 (40)	52 (28)
Patients will change their eating patterns only if faced with a significant health problem (e.g., heart attack).	54 (30)	72 (39)	57 (31)
After receiving nutrition counselling, patients with poor eating patterns will make moderate changes in their eating behaviour.	48 (26)	110 (60)	25 (14)
It is important that I assess each patient's intake of vitamin, mineral, and dietary supplements.	42 (23)	89 (49)	52 (28)
Nutrition counselling is not an effective use of my professional time.	36 (20)	61 (33)	86 (47)
After receiving nutrition counselling, patients with poor eating habits will make major changes in their eating behaviour.	30 (16)	92 (50)	61 (34)
Most patients will try to change their lifestyle if I advise them to do so.	24 (13)	87 (48)	72 (39)

[a] Positively associated with students' self-perceived quality of nutrition education received during their medical degree ($P < 0.05$).

[b] Positively associated with students' self-perceived quantity of nutrition education received during their medical degree ($P < 0.05$).

Table 3: Students' confidence in providing nutrition care to patients, ranked in order of agreement ($n = 183$).

Items	Confident n (%)	Uncertain n (%)	Not confident n (%)
Calculating body mass index (BMI) and waist-hip ratio based on gender.	149 (81)	25 (14)	8 (5)
Explaining the overall benefits of aerobic exercise on health and well-being[a].	140 (77)	33 (18)	10 (5)
Explaining the significance of modest weight loss for patients with type two diabetes[a].	136 (75)	38 (21)	9 (5)
Defining moderate alcohol consumption and its role in health and disease.	129 (70)	49 (27)	5 (3)
Interpreting growth charts and pertinent trends for a child with failure to thrive[a].	132 (72)	43 (24)	8 (4)
Explaining the maternal and infant benefits and challenges anticipated with breast feeding[a,b].	124 (67)	43 (23)	16 (9)
Explaining the role of dietary cholesterol and saturated fats in elevating blood lipids[a,b].	120 (66)	51 (28)	12 (6)
Recommending dietary patterns for patients with type 2 diabetes.	113 (62)	56 (31)	14 (8)
Explaining the role of water and hydration in health based on activity level and age.	106 (58)	59 (32)	19 (10)
Recognising the warning signs and symptoms of patients with eating disorders.	98 (54)	64 (35)	21 (11)
Explaining avoidance of cross contamination when preparing and storing foods[a,b].	94 (51)	65 (36)	24 (13)
Recognising nutritional risk in elderly patients[a].	88 (48)	79 (43)	16 (9)
Explaining common nutrient deficiencies of adolescent women[b].	78 (43)	77 (42)	28 (15)
Giving advice on breast feeding or formula feeding for an infant with colic.	76 (42)	72 (39)	35 (19)
Giving nutrition strategies for individuals losing weight due to chronic cachexia[a].	73 (40)	70 (38)	40 (22)
Implementing strategies for osteoporosis prevention, including nutrition and lifestyle advice[a,b].	70 (38)	81 (44)	32 (18)
Addressing nutrition concerns of patients with gastrointestinal intolerances, maldigestion, or malabsorption[a,b].	71 (39)	71 (39)	41 (22)
Giving examples of serving sizes of meat or dairy from the Ministry of Health serving guide[a,b].	68 (37)	79 (43)	36 (20)
Explaining the indications and contraindications for enteral and parenteral nutrition[b].	66 (36)	84 (46)	33 (18)
Explaining potentially harmful interactions of medications with herbal or botanical supplements[a].	64 (35)	77 (42)	42 (23)
Explaining the reported health risks of high protein/high fat diets such as the Atkins diet[a,b].	61 (33)	81 (44)	41 (23)
Assessing total kilojoules and saturated fat per portion of food by using the nutrition label[a,b].	58 (32)	71 (39)	54 (29)
Indicating the use of single vitamins (i.e., A, C, E) or multivitamin supplements[b].	55 (30)	79 (43)	49 (27)
Explaining the role of omega-3 and omega-6 fatty acids in heart health.	51 (28)	78 (42)	54 (30)
Giving an explanation of the benefits of probiotics.	50 (27)	76 (42)	57 (31)
Explaining the kilojoules per gram of protein, carbohydrate, and fat and their basic metabolic roles.	49 (27)	68 (37)	66 (36)
Explaining the role of genetics, diet, and pharmacology in weight loss regimes[a,b].	47 (26)	89 (48)	47 (26)
Explaining how to identify antioxidant-rich produce while grocery shopping[a,b].	44 (24)	81 (44)	58 (32)
Explaining the scientifically confirmed benefits of St. John Wort and Echinacea[a,b].	37 (20)	73 (40)	73 (40)
Explaining the role of food constituents in health[b].	32 (18)	81 (44)	70 (38)

[a] Positively associated with students' self-perceived quality of nutrition education received during their medical degree ($P < 0.05$).

[b] Positively associated with students' self-perceived quantity of nutrition education received during their medical degree ($P < 0.05$).

why the results of the present study may have differed from international studies is because students are taught by a nutrition expert (dietitian), which has been recognised as critical to the success of nutrition education programmes and is lacking in many international medical schools [34]. Clearly, further research is required to identify the specific components of nutrition education required to meet the learning needs of New Zealand medical students.

The present study indicated that students' self-perceived skills in providing nutrition care were positively associated with the nutrition education received during medical training. However, there was a limited relationship between perceptions of quantity and quality of nutrition education and students' attitudes towards nutrition care. This suggests that the quantity and quality of medical education are likely to influence the nutrition-related skill development of students. This is consistent with findings reported in international literature [16, 39]. However, the somewhat rudimentary measure of nutrition education quantity and quality used in this study prevents definitive conclusions in the New Zealand context.

The present study has noteworthy strengths and limitations. Previous studies have utilised various methods to investigate the attitudes and self-perceived skills of medical students in providing nutrition care. The use of two previously validated tools to guide the development of the questionnaire in the current study enhances the confidence in findings, which can be used to inform future studies in New Zealand. However, with a response rate of 52% of the potential participant pool, it is possible that students interested in nutrition were more likely to complete the questionnaire and this may have overestimated the attitudes and self-perceived skills reported in this study. Furthermore, this study relates to only one of the two medical schools in New Zealand, and generalisability of the results should be cautioned. There is no consensus method for assessing the quantity and quality of medical nutrition education and this remains a challenge for the future. Finally, further research is required to determine whether attitudes and self-perceived skills in nutrition care influence students' future provision of nutrition care in practice and ultimately the health of their patients.

5. Conclusion

In conclusion, New Zealand medical students feel that incorporating nutrition care into practice is important for doctors. However, they believed the capacity of patients to improve their nutrition behaviour after receiving nutrition care by doctors is somewhat limited. Students perceived the quantity and quality of nutrition education received during medical training to be good. Further investigation of students' attitudes and self-perceived skills in providing nutrition care after graduation will inform whether additional nutrition education is warranted for these doctors. Considering that New Zealand GPs are well placed to provide nutrition care to patients with chronic disease, they may require support dealing with the barriers to providing this care to patients.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

References

[1] Ministry of Health, *The Health of New Zealand Adults 2011/12*, Ministry of Health, Wellington, New Zealand, 2012.

[2] World Health Organization, *Diet, Nutrition and the Prevention of Chronic Diseases*, WHO, Geneva, Switzerland, 2003.

[3] United States Department of Health and Human Services and Office of Disease Prevention and Health Promotion, "Healthy People 2020," 2013, http://www.healthypeople.gov/2020/default.aspx.

[4] M. F. Harris, *The Role of Primary Health Care in Preventing the Onset of Chronic Disease, with a Particular Focus on the Lifestyle Risk Factors of Obesity, Tobacco and Alcohol*, Sydney Centre for Primary Health Care and Equity, Sydney, Australia, 2008.

[5] L. E. Ball, R. M. Hughes, and M. D. Leveritt, "Nutrition in general practice: role and workforce preparation expectations of medical educators," *Australian Journal of Primary Health*, vol. 16, no. 4, pp. 304–310, 2010.

[6] P. Poole, D. Bourke, and B. Shulruf, "Increasing medical student interest in general practice in New Zealand: where to from here?" *New Zealand Medical Journal*, vol. 123, no. 1315, pp. 12–19, 2010.

[7] Ministry of Health, "Visiting a doctor," 2014, http://www.health.govt.nz/your-health/services-and-support/health-care-services/visiting-doctor.

[8] L. Ball, B. Desbrow, and M. Leveritt, "An exploration of individuals' preferences for nutrition care from Australian primary care health professionals," *Australian Journal of Primary Health*, vol. 20, no. 1, pp. 113–120, 2014.

[9] A. A. Jackson, "Educational group lecture. Human nutrition in medical practice: the training of doctors," *Proceedings of the Nutrition Society*, vol. 60, no. 2, pp. 257–263, 2001.

[10] K. Kolasa, "Developments and challenges in family practice nutrition education for residents and practicing physicians: an overview of the North American experience," *European Journal of Clinical Nutrition*, vol. 53, supplement 2, pp. S89–S96, 1999.

[11] G. J. Hiddink, J. G. A. J. Hautvast, C. M. J. van Woerkum, C. J. Fieren, and M. A. van 't Hof, "Consumers' expectations about nutrition guidance: the importance of primary care physicians," *American Journal of Clinical Nutrition*, vol. 65, no. 6, pp. 1974S–1979S, 1997.

[12] T. C. Keysering, A. S. Ammermann, C. E. Davis et al., "A randomised controlled trial of physician directed program for low income patientss with high blood cholesterol: The Southeast Cholesterol Project," *Archives of Family Medicine*, vol. 6, no. 2, pp. 134–145, 1997.

[13] I. S. Ockene, J. R. Herbert, J. K. Okene et al., "Effect of physician-delivered nutrition counseling training and an office support program on saturated fat intake, weight and serum lipid measurements in hyperlipidemia Worcester Area Trail for Counseling in Hyperlipidemia (WATCH)," *Archives of Internal Medicine*, vol. 157, pp. 725–731, 1999.

[14] L. Ball, C. Johnson, B. Desbrow, and M. Leveritt, "General practitioners can offer effective nutrition care to patients with lifestylerelated chronic disease," *Journal of Primary Health Care*, vol. 5, no. 1, pp. 59–69, 2013.

[15] F. Leslie and S. Thomas, "Competent to care. Are all doctors competent in nutrition?" *Proceedings of the Nutrition Society*, vol. 68, no. 3, pp. 296–299, 2009.

[16] K. M. Adams, M. Kohlmeier, and S. H. Zeisel, "Nutrition education in U.S. medical schools: latest update of a national survey," *Academic Medicine*, vol. 85, no. 9, pp. 1537–1542, 2010.

[17] K. Glanz, "Review of nutritional attitudes and counseling practices of primary care physicians," *American Journal of Clinical Nutrition*, vol. 65, no. 6, pp. 2016S–2019S, 1997.

[18] J. A. Cimino, "Why can't we educate doctors to practice preventive medicine?" *Preventive Medicine*, vol. 25, no. 1, pp. 63–65, 1996.

[19] K. S. Soltesz, J. H. Price, L. W. Johnson, and S. K. Tellijohann, "Family physicians' views of the preventive services task force recommendations regarding nutritional counseling," *Archives of Family Medicine*, vol. 4, no. 7, pp. 589–593, 1995.

[20] R. F. Kushner, "Barriers to providing nutrition counseling by physicians: a survey of primary care practitioners," *Preventive Medicine*, vol. 24, no. 6, pp. 546–552, 1995.

[21] J. Crowley, L. Ball, C. Wall, and M. Leveritt, "Nutrition beyond drugs and devices: a review of the approaches to enhance the capacity of nutrition care provision by general practitioners," *Australian Journal of Primary Health*, vol. 18, no. 2, pp. 90–95, 2012.

[22] W. C. McGaghie, L. van Horn, M. Fitzgibbon et al., "Development of a measure of attitude toward nutrition in patient care," *The American Journal of Preventive Medicine*, vol. 20, no. 1, pp. 15–20, 2001.

[23] T. V. Mihalynuk, C. S. Scott, and J. B. Coombs, "Self-reported nutrition proficiency is positively correlated with the perceived quality of nutrition training of family physicians in Washington State," *The American Journal of Clinical Nutrition*, vol. 77, no. 5, pp. 1330–1336, 2003.

[24] S. Verma, M. Paterson, and J. Medves, "Core competencies for health care professionals: what medicine, nursing, occupational therapy, and physiotherapy share," *Journal of Allied Health*, vol. 35, no. 2, pp. 109–115, 2006.

[25] D. A. Davis, P. E. Mazmanian, M. Fordis, R. Van Harrison, K. E. Thorpe, and L. Perrier, "Accuracy of physician self-assessment compared with observed measures of competence: a systematic review," *The Journal of the American Medical Association*, vol. 296, no. 9, pp. 1094–1102, 2006.

[26] M. L. Vetter, S. J. Herring, M. Sood, N. R. Shah, and A. L. Kalet, "What do resident physicians know about nutrition? An evaluation of attitudes, self-perceived proficiency and knowledge," *Journal of the American College of Nutrition*, vol. 27, no. 2, pp. 287–298, 2008.

[27] A. Helman, "Nutrition and general practice: an australian perspective," *The American Journal of Clinical Nutrition*, vol. 65, no. 6, pp. 1939S–1942S, 1997.

[28] E. H. Spencer, E. Frank, L. K. Elon, V. S. Hertzberg, M. K. Serdula, and D. A. Galuska, "Predictors of nutrition counseling behaviors and attitudes in US medical students," *The American Journal of Clinical Nutrition*, vol. 84, no. 3, pp. 655–662, 2006.

[29] B. W. Jack, A. B. Lasswell, W. McQuade, and L. Culpepper, "A follow-up survey of family physicians' interest in and knowledge of nutrition," *Academic Medicine*, vol. 65, no. 11, pp. 710–712, 1990.

[30] S. G. Mlodinow and E. Barrett-Connor, "Physicians' and medical students' knowledge of nutrition," *Academic Medicine*, vol. 64, no. 2, pp. 105–106, 1989.

[31] R. F. Kahn, "Continuing Medical Education in nutrition," *The American Journal of Clinical Nutrition*, vol. 83, no. 4, supplement, pp. 981S–984S, 2006.

[32] J. A. S. Carson, M. B. Gillham, L. M. Kirk, S. T. Reddy, and J. B. Battles, "Enhancing self-efficacy and patient care with cardiovascular nutrition eduction," *American Journal of Preventive Medicine*, vol. 23, no. 4, pp. 296–302, 2002.

[33] S. Katz, A. Feigenbaum, S. Pasternak, and S. Vinker, "An interactive course to enhance self-efficacy of family practitioners to treat obesity," *BMC Medical Education*, vol. 5, article 4, 2005.

[34] R. F. Kushner, L. Van Horn, C. L. Rock et al., "Nutrition education in medical school: a time of opportunity," *The American Journal of Clinical Nutrition*, vol. 99, no. 5, pp. 1167S–1173S, 2014.

[35] L. M. Gramlich, D. L. Olstad, R. Nasser et al., "Medical students' perceptions of nutrition education in Canadian universities," *Applied Physiology, Nutrition and Metabolism*, vol. 35, no. 3, pp. 336–343, 2010.

[36] World Health Organisation, *London Declaration: Patients for Patient Safety*, World Health Organisation, Geneva, Switzerland, 2006.

[37] W. A. Walker, "Advances in nutritional education for medical students," *The American Journal of Clinical Nutrition*, vol. 72, supplement, pp. 865S–867S, 2000.

[38] R. L. Weinsier, J. R. Boker, E. B. Feldman, M. S. Read, and C. M. Brooks, "Nutrition knowledge of senior medical students: a collaborative study of southeastern medical schools," *American Journal of Clinical Nutrition*, vol. 43, no. 6, pp. 959–968, 1986.

[39] K. M. Kolasa, "'Images' of nutrition in medical education and primary care," *The American Journal of Clinical Nutrition*, vol. 73, no. 6, pp. 1006–1009, 2001.

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Review Article

Learner-Directed Nutrition Content for Medical Schools to Meet LCME Standards

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Deficiencies in medical school nutrition education have been noted since the 1960s. Nutrition-related non-communicable diseases, including heart disease, stroke, cancer, diabetes, and obesity, are now the most common, costly, and preventable health problems in the US. Training medical students to assess diet and nutritional status and advise patients about a healthy diet, exercise, body weight, smoking, and alcohol consumption are critical to reducing chronic disease risk. Barriers to improving medical school nutrition content include lack of faculty preparation, limited curricular time, and the absence of funding. Several new LCME standards provide important impetus for incorporating nutrition into existing medical school curriculum as self-directed material. Fortunately, with advances in technology, electronic learning platforms, and web-based modules, nutrition can be integrated and assessed across all four years of medical school at minimal costs to medical schools. Medical educators have access to a self-study nutrition textbook, *Medical Nutrition and Disease, Nutrition in Medicine*© online modules, and the NHLBI *Nutrition Curriculum Guide for Training Physicians*. This paper outlines how learner-directed nutrition content can be used to meet several US and Canadian LCME accreditation standards. The health of the nation depends upon future physicians' ability to help their patients make diet and lifestyle changes.

1. Introduction

Deficiencies in nutrition education in medical schools and residency programs have been noted for over 30 years [1–6]. In 1982 and 1995, Weinsier published consensus statements from medical nutrition educators who prioritized nutrition content and stressed its importance in the medical school curriculum [7, 8]. Professional organizations, medical nutrition experts, and student groups have published reports, articles, book chapters, user's guides, and a congressional mandate urging medical schools to reform curriculum to spend more time integrating nutrition [9–19]. Recommendations were also made by medical nutrition experts after reviewing nutrition content across US Medical Licensing Examinations (USMLE) administered by the National Board of Medical Examiners [20].

As a result of these initiatives, the National Heart, Lung, and Blood Institute (NHLBI) and the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) established the Nutrition Academic Award (NAA) Program (http://www.nhlbi.nih.gov/research/training/naa/) [21, 22]. The NAA provided 21 US medical schools with 5-year grants to support nutrition education programs for medical students, medical residents, and clinical faculty [21, 22]. The NAA Curriculum Committee developed the *Nutrition Curriculum Guide to Training Physicians*, which contains over 200 educational learning objectives that medical students, residents, and physicians in practice should acquire to achieve competency [23, 24].

2. The Problem

While significant progress was made during the NAA program, ten years later we are facing the same issues. According to the Association of American Medical Schools (AAMC) All School Graduation Surveys, more than 50% of graduating

medical students felt their nutrition knowledge was insufficient [25, 26]. Practicing physicians also feel their nutrition training was inadequate and that they lack the skills to provide effective diet and lifestyle counseling to their patients [27–31]. A review of nutrition content in medical schools shows that, on average, only 4 to 6 hours are devoted to nutrition content over the entire 4-year curriculum [32, 33]. While curriculum hours and teaching methods vary widely among medical schools, nutrition educators have suggested that a minimum of 25 hours are needed to properly train medical students in nutrition [2, 9, 10, 13, 19, 30, 32–34].

According to our experience, lack of faculty to teach nutrition, competing curricular requirements, and the absence of funding for a nutrition curriculum coordinator at each medical school are major factors contributing to the ongoing problem. Fortunately, with advances in technology, electronic textbooks, online learning modules, and nutrition test questions posted on (e)-learning platforms for evaluation, these barriers can easily be overcome at minimal cost to medical schools.

3. Relevance to Medical Practice

Studies show that the relevance of the course material to medical practice is critical when integrating nutrition content [7, 8]. According to the Centers for Disease Control and Prevention (CDC), the majority of US health care costs are now spent on chronic, non-communicable diseases associated with health risk behaviors [35, 36]. Specifically, heart disease, stroke, cancer, diabetes, obesity, and arthritis are among the most common, costly, and preventable health problems [37–40]. As of 2012, about half of all adults, 117 million people, have one or more chronic health conditions [41]. One of four adults has two or more chronic health conditions [41]. Two of these chronic diseases, heart disease and cancer, together, accounted for nearly 48% of all deaths in 2010 [41]. According to the CDC, 47% of US adults have at least one of the following major risk factors for heart disease or stroke: high blood pressure, high LDL-cholesterol, or are current smokers [42–47]. Ninety percent of Americans consume too much sodium, increasing their risk of high blood pressure [48, 49]. With the current obesity epidemic and the costs associated with chronic disease skyrocketing, medical schools need to find creative learning opportunities to ensure that medical students graduate with the ability to recognize the association between lifestyle and chronic disease, take a diet and exercise history, and effectively intervene by promoting a healthy lifestyle [50–52].

Strong evidence indicates that diet, largely through its effect on serum lipids, influences the incidence of heart disease [53–55]. Intake of saturated fat increases LDL-C levels, thereby increasing the risk for coronary heart disease (CHD). Large-scale clinical trials have conclusively shown that reducing serum LDL-C levels reduces the number of acute cardiac events and deaths from CHD in both patients with existing disease and those at risk due to elevated lipids. Updated 2013 guidelines for the assessment of cardiovascular (CV) risk, lifestyle modifications to reduce CV risk, and management of blood cholesterol, overweight, and obesity in adults have been developed by the American College of Cardiology and the American Heart Association Task Force on Practice Guidelines [53–55]. Diet and lifestyle changes are also the primary focus of the Joint National Committee on the Treatment and Management of Hypertension (JNC8) and the American Diabetes Association Treatment Guidelines [56–58]. The American Cancer Society has published similar guidelines on nutrition and physical activity for cancer prevention [59]. Therefore, training medical students to advise patients to consume a healthy diet, exercise regularly, maintain desired body weight, avoid smoking, and drink alcohol in moderation is critical to reducing morbidity and mortality [42, 53–59].

4. Role of LCME and Medical Schools

Medical education programs leading to the MD degree in the US and Canada are accredited by the Liaison Committee on Medical Education (LCME) [60]. LCME accreditation is a peer-reviewed process to determine whether the medical school meets established standards. The LCME has created standards outlined in *Functions and Structure of a Medical School*, which medical schools must meet to achieve and maintain accreditation [60]. Demonstrating that medical students exhibit these general professional competencies is essential to accreditation and serves as the foundation for life-long learning and proficient medical care [60]. These standards are enforced through annual surveys and regular site visits. The purpose of this paper is to demonstrate how learner-directed nutrition content can be used to meet several US and Canadian LCME accreditation standards.

Several LCME standards provide important opportunities for incorporating nutrition into existing curriculum as self-directed material and to augment curricular content for medical students across all 4 years *(Standard 6: Competencies, Curricular Objectives, and Curricular Design; Standard 7: Curricular Content; and Standard 8: Curricular Management, Evaluation, and Enhancement)*. Liaison Committee on Medical Education (LCME) Standards 6.3, 7.1, 7.2, 7.5, 7.6, and 8.2 for accreditation of medical education programs leading to the MD degree are shown below [60]:

6.3: self-directed and life-long learning;

7.1: biomedical, behavioral, social sciences;

7.2: organ systems/life cycle/primary care/prevention/wellness/symptoms/signs/differential diagnosis, treatment planning, and impact of behavioral/social factors;

7.5: societal problems;

7.6: cultural competence/health care disparities/personal bias;

8.2: use of medical educational program objectives.

These standards are described and nutrition examples are provided to assist with meeting these standards.

Standard 6.3 Self-Directed and Life-Long Learning. "The faculty of a medical school ensures that the medical curriculum

includes self-directed learning experiences and time for independent study to allow medical students to develop the skills of life-long learning. Self-directed learning involves medical students' self-assessment of learning needs; independent identification, analysis, and synthesis of relevant information; and appraisal of the credibility of information sources" [60].

Nutrition Example. Given the shortage of faculty prepared to teach nutrition and the ability to use relevant clinical material in a variety of basic science courses and clinical clerkships, nutrition content lends itself very well to self-directed learning and can help promote life-long learning [52]. Originally developed in 1995 as a self-directed nutrition curriculum for medical students at the University of Pennsylvania School of Medicine, the 5th edition of *Medical Nutrition and Disease: A Case-Based Approach* can be used to meet Standard 6.3 [61–67]. All 13 chapters and 29 cases include at least 4 NAA *Curriculum Guide* learning objects. The cases begin with a patient vignette covering past medical history, family history, medications, social and diet history, review of systems, physical examination, and laboratory data [67]. Each case includes at least 5 questions as well as the answers to these questions, making this an ideal self-study resource. The questions and answers cover physiology, pathophysiology, epidemiology, risk assessment, diagnosis, laboratory evaluation, treatment planning, medical nutrition therapy, prevention, wellness, and counseling issues.

Nutrition in Medicine Modules©, developed by University of North Carolina School of Medicine, is a comprehensive online medical nutrition curriculum for training current and future health care professionals [34, 68]. The content for medical students includes the preventive and therapeutic aspects of medical nutrition care for both preclinical and clinical education [68]. The objectives of the *Nutrition in Medicine©* medical school curriculum are to provide a core curriculum in nutrition for medical students that:

(i) includes preventive and therapeutic perspectives of nutrition;

(ii) spans the preclinical and clinical training of physicians;

(iii) presents the biochemical basis of nutrition, nutrition epidemiology, clinical nutrition [including nutrition assessment], and nutrition-related preventive health care;

(iv) uses innovative techniques to excite students about the field of nutrition and can be transportable by medical schools with different types of curricular organization.

In this era of nutrition therapeutics, it is important to prepare students with the basic concepts of nutrition that will provide a foundation for reading the literature and for life-long learning. For example, with ongoing discoveries in the human microbiome project and nutrigenetics, future physicians will need to be prepared for new avenues of therapy with probiotics [69–71]. The rapidly expanding fields of metabolomics, proteomics, and nutrigenetics will likely drive an era of nutrition therapeutics that current medical students will need to understand and take advantage of [69–72].

The updated American Board of Medical Specialties (ABMS) *Maintenance of Certification* (MOC) program is also designed as a comprehensive approach to foster life-long learning, self-assessment, and quality improvement [73, 74]. The role of ABMS is to assist the 24 approved medical specialty boards in the development and use of these standards for the ongoing evaluation and certification of physicians. The MOC assures that physicians are committed to life-long learning and competency in a specialty and/or subspecialty by requiring ongoing measurement of six core competencies adopted by ABMS and the Accreditation Council for Graduate Medical Education (ACGME) [74, 75]. These core competencies include (1) patient care, (2) interpersonal and communication skills, (3) professionalism, (4) practice-based learning, (5) systems-based practice, and (6) medical knowledge. At least 10 of the subspecialty boards, including family medicine, internal medicine, OB/GYN, surgery, pediatrics, preventive medicine, and ophthalmology, among others, need to integrate nutrition training, and a "call for action" has recently been published [76]. The nutrition foundation instilled during medical school, even as self-study curriculum, will facilitate life-long learning and quality patient care and encourage residency and subspecialty training to integrate nutrition concepts [73–76].

Standard 7.1 Biomedical, Behavioral, Social Sciences. "The faculty of a medical school ensures that the medical curriculum includes content from the biomedical, behavioral, and socioeconomic sciences to support medical students' mastery of contemporary scientific knowledge and concepts and the methods fundamental to applying them to the health of individuals and populations" [60].

Nutrition Example. In 2011, AAMC published the report, *Behavioral and Social Science Foundations for Future Physicians*, indicating that diet, exercise, smoking, and socioeconomic status contribute to at least 50% of premature morbidity and mortality in the US population and are major contributors to health disparities [77]. The CDC defines health risk behaviors as unhealthy behaviors that individuals can change [36, 38, 41, 42]. Four of these health risk behaviors—lack of exercise or physical activity, poor nutrition, tobacco use, and drinking too much alcohol—cause much of the illness, suffering, and early deaths related to chronic diseases [36, 38, 41, 42, 46, 47, 78].

In 2011, more than half (52%) of adults aged 18 years or older did not meet recommendations for aerobic exercise or physical activity [41]. Therefore, medical students should learn to take a diet and physical activity history, at the same time they are learning how to assess tobacco and alcohol intake as part of routine clinical care [52, 67, 68, 79–86]. With inadequate instruction in nutrition, they are not prepared to use the information they gain from a dietary history and will quickly cease collecting the information [87]. These concepts are covered in *Medical Nutrition and Disease* and *Nutrition in Medicine©* modules as part of nutrition assessment [67, 68]. As students work through the various case vignettes, they see

how clinical nutrition and dietary change can be applied to the medical problems they are learning to understand and manage (Table 1).

Standard 7.2 Organ Systems/Life Cycle/Primary Care/Prevention/Wellness/Symptoms/Signs/Differential Diagnosis, Treatment Planning, and Impact of Behavioral/Social Factors. "The faculty of a medical school ensures that the medical curriculum includes content and clinical experiences related to each organ system; each phase of the human life cycle; continuity of care; and preventive, acute, chronic, rehabilitative, end-of-life, and primary care in order to prepare students to [60]:

(i) recognize wellness, determinants of health, and opportunities for health promotion and disease prevention;

(ii) recognize and interpret symptoms and signs of disease;

(iii) develop differential diagnoses and treatment plans;

(iv) recognize the potential health-related impact on patients of behavioral and socioeconomic factors;

(v) Assist patients in addressing health-related issues involving all organ systems."

Nutrition Example. There are numerous ways nutrition content can be assigned to students, either through lectures, small group sessions, problem-based and case-based learning, web-based modules, or though using e-textbook content [9, 10, 34, 52, 67, 68, 88]. It is important that nutrition-related clinical cases be used in each phase of the human life cycle, including pregnancy, breast feeding, infant growth and development, childhood, adolescence, adulthood, women's and men's health, and geriatrics including diverse cultures and low socioeconomic groups (Table 1).

Proper nutrition is critical for wellness, has major impact on determinants of health, and provides many opportunities for health promotion and disease prevention education. For example, the role of the Mediterranean diet in the prevention of heart disease; the DASH diet for hypertension and stroke prevention; and healthy eating and exercise strategies for cancer prevention and diabetes management [58, 59, 89–91]. Recognizing and interpreting symptoms and signs of nutrition-related diseases including malnutrition, overweight and obesity, and eating disorders can be integrated into physical diagnosis courses. Nutrition assessment and counseling needs to be a part of the treatment plan for disorders across many organ systems including cardiovascular, pulmonary, endocrine, hematology, oncology, renal, neurology, and gastroenterology [24, 67, 68]. Taking a diet, exercise, and weight history; calculating body mass index (BMI); measuring waist-to-hip ratio; and understanding and interpreting relevant laboratory measures are critical skills for students to acquire [7, 8, 23, 24, 67, 68].

The chapters and cases in *Medical Nutrition and Disease* and the online modules in *Nutrition in Medicine*© cover each organ system; each phase of the human life cycle; continuity of care; and preventive, acute, chronic, and primary care issues as described in Standard 7.2 [67, 68]. Several examples include the association between obesity and sleep apnea, insulin resistance and diabetes, nutritional anemias, and malnutrition and depression.

Standard 7.5 Societal Problems. "The faculty of a medical school ensure that the medical curriculum includes instruction in the diagnosis, prevention, appropriate reporting, and treatment of the medical consequences of common societal problems" [60].

Nutrition Example. Obesity is a complex, multifactorial disease that has become a societal problem and increasingly common among adults and children worldwide [92, 93]. Once considered a problem only in developed countries, overweight and obesity are now dramatically on the rise in developing countries as well, particularly in urban settings [35, 38]. Obese individuals have an increased risk of diabetes, cardiovascular disease, hyperlipidemia, hypertension, stroke, gallbladder disease, sleep apnea, osteoarthritis, respiratory problems, and certain types of cancers (endometrial, breast, prostate, and colon), all of which increase their mortality [67, 93]. According to the CDC, seven out of ten deaths among Americans each year result from chronic diseases [36–38]. Obesity related conditions such as heart disease, type 2 diabetes, stroke, and certain types of cancer account for more than 50% of preventable deaths each year [36–38, 42].

Teaching medical students about obesity and diabetes, potentially as themes, can span the entire curriculum across many disciplines [94–97]. There are opportunities in year 1 during history taking and physical exam courses; year 2 during psychiatry, cardiology, endocrinology, pulmonary, gastroenterology, and ophthalmology courses; year 3 during OB/GYN, medicine, family medicine, ophthalmology, and surgery clerkships, and during electives and subinternships (Table 1) [67].

Standard 7.6 Cultural Competence/Health Care Disparities/Personal Bias. "The faculty of a medical school ensures that the medical curriculum provides opportunities for medical students to learn to recognize and appropriately address gender and cultural biases in themselves, in others, and in the health care delivery process. The medical curriculum includes instruction regarding the following [60]:

(i) the manner in which people of diverse cultures and belief systems perceive health and illness and respond to various symptoms, diseases, and treatments;

(ii) the basic principles of culturally competent health care;

(iii) the recognition and development of solutions for health care disparities;

(iv) the importance of meeting the health care needs of medically underserved populations;

(v) the development of core professional attributes (e.g., altruism and accountability) needed to provide effective care in a multidimensionally diverse society."

Table 1: Integration of *Medical Nutrition and Disease* content across the medical school curriculum to meet LCME standards.

	Content title	Medical school course	Year 1	Year 2	Year 3	Year 4
Chapter 1	Overview of nutrition assessment in clinical care	Biochemistry	x	—	—	—
		History taking	x	—	—	—
		Physical exam	—	x	—	—
Case 1	Obesity and metabolic syndrome	Cardiovascular	—	x	—	—
		Medicine	—	—	x	x
		Family medicine	—	—	x	x
Case 2	Bariatric surgery and obesity	Surgery	—	—	x	x
Chapter 2	Vitamin, minerals, and dietary supplements	Biochemistry	x	—	—	—
		Pharmacology	—	x	—	—
Case 1	Iron deficiency anemia in women	Hem/oncology	—	x	—	—
		Medicine	—	—	x	x
		Family medicine	—	—	x	x
Case 2	Drug-herb interaction with St. John's wort	Pharmacology	x	x	—	—
Case 3	Nutrient deficiencies and lead poisoning in children	Pharmacology	—	x	—	—
		Pediatrics	—	—	x	x
Chapter 3	Pregnancy and lactation	Endo/reproduction	—	x	—	—
		OB/gynecology	—	—	x	x
Case 1	Prevention of neural tube defects	Embryology	x	—	—	—
		Biochemistry	x	—	—	—
		OB/gynecology	—	—	x	x
Case 2	Encouraging breast feeding	Endo/reproduction	—	x	—	—
		Pediatrics	—	—	x	x
		OB/gynecology	—	—	x	x
Chapter 4	Infants, children, and adolescents	Pediatrics	—	x	x	x
Case 1	Overweight child with insulin resistance	Biochemistry	x	—	—	—
		Endocrinology	—	x	x	x
		Pediatrics	—	—	x	x
Case 2	Malnutrition and refeeding syndrome in children	Pediatrics	—	—	x	x
		Surgery	—	—	x	x
Case 3	Eating disorder in adolescent athlete	Psychiatry	—	x	—	x
		Pediatrics	—	—	x	x
Chapter 5	Older adults	Medicine/geriatrics	—	—	x	x
		Family medicine	—	—	x	x
Case 1	Depression and malnutrition	Psychiatry	—	x	x	x
		Geriatrics	—	—	x	x
Case 2	Macular degeneration	Ophthalmology	—	—	x	x
		Geriatrics	—	—	x	x
Case 3	Menopause and weight gain	Medicine/geriatrics	—	—	x	x
		Family medicine	—	—	x	x
Chapter 6	Cardiovascular disease	Cardiovascular	—	x	—	—
		Medicine/cardiology	—	—	x	x
		Family medicine	—	—	x	x
Case 1	Disorders of lipid metabolism	Cardiovascular	—	x	—	—
		Medicine/Cardiology	—	—	x	x
		Family medicine	—	—	x	x
Case 2	Hypertension and lifestyle modifications	Cardiovascular	—	x	—	—
		Medicine/cardiology	—	—	x	x
		Family medicine	—	—	x	x

Table 1: Continued.

	Content title	Medical school course	Year 1	Year 2	Year 3	Year 4
Case 3	Metabolic syndrome and LP(a) genetic defect in Asian Indian man	Genetics	x	—	—	—
		Cardiovascular	—	x	—	—
		Medicine/cardiology	—	—	x	x
		Family medicine	—	—	x	x
Chapter 7	Gastrointestinal disease	Gastroenterology	—	x	—	—
		Medicine/GI	—	—	x	x
		Family medicine	—	—	x	x
Case 1	Alcohol and vitamin deficiencies	Biochemistry	x	—	—	—
		Physiology	x	—	—	—
		Medicine/GI	—	—	x	x
		Family medicine	—	—	x	x
Case 2	Malabsorption	Gastroenterology	—	x	—	—
		Surgery/GI	—	—	x	x
Case 3	Celiac disease	Gastroenterology	—	x	—	—
		Medicine/GI	—	—	x	x
		Family medicine	—	—	x	x
		Pediatrics	—	—	x	x
Chapter 8	Endocrine disease	Endocrinology	—	x	—	—
		Medicine/endocrine	—	—	x	x
		Family medicine	—	—	x	x
		Pediatrics	—	—	x	x
Case 1	Type 1 diabetes and diabetic ketoacidosis	Biochemistry	x	—	—	—
		Endocrinology	—	x	—	—
		Medicine/endocrine	—	—	x	x
		Family medicine	—	—	x	x
		Pediatrics	—	—	x	x
Case 2	Type 2 diabetes	Endocrinology	—	x	—	—
		Medicine/endocrine	—	—	x	x
		Family medicine	—	—	x	x
		Pediatrics	—	—	x	x
Case 3	Polycystic ovarian syndrome	Endo/reproduction	—	x	—	—
		Medicine/endocrine	—	—	x	x
		Family medicine	—	—	x	x
		Pediatrics	—	—	x	x
		OB/gynecology	—	—	x	x
Chapter 9	Pulmonary disease	Pulmonary	—	x	—	—
		Medicine/pulmonary	—	—	x	x
		Family medicine	—	—	x	x
		Pediatrics	—	—	x	x
Case 1	Chronic obstructive pulmonary disease	Pulmonary	—	x	—	—
		Medicine/pulmonary	—	—	x	x
		Family Medicine	—	—	x	x
		Pediatrics	—	—	x	x
Case 2	Obstructive sleep apnea and metabolic syndrome	Pulmonary	—	x	—	—
		Medicine/pulmonary	—	—	x	x
		Family medicine	—	—	x	x
		Pediatrics	—	—	x	x
Case 3	Cystic fibrosis	Pulmonary	—	x	—	—
		Medicine/pulmonary	—	—	x	x
		Family medicine	—	—	x	x
		Pediatrics	—	—	x	x

Table 1: Continued.

Content title		Medical school course	Year 1	Year 2	Year 3	Year 4
Chapter 10	Renal disease	Nephrology	—	x	—	—
		Medicine	—	—	x	x
		Family medicine	—	—	x	x
Case 1	Chronic renal failure advancing to dialysis	Nephrology	—	x	—	—
		Medicine	—	—	x	x
		Family medicine	—	—	x	x
Chapter 11	Cancer prevention and treatment	Hem/oncology	—	x	—	—
		Medicine	—	—	x	x
		Family medicine	—	—	x	x
Case 1	Prevention of colon cancer	Pathology	x	x	—	—
		Hem/oncology	—	x	—	—
		Medicine	—	—	x	x
		Family medicine	—	—	x	x
Chapter 12	Enteral nutrition support	Surgery	—	—	x	x
		Medicine/geriatrics	—	—	x	x
Case 1	Esophageal cancer and enteral feeding	Hem/oncology	—	—	x	x
		Surgery	—	—	x	x
Chapter 13	Parenteral nutrition support	Surgery	—	—	x	x
		Critical care/ICU	—	—		x
Case 1	Colon cancer and postoperative care	Hem/oncology	—	—	x	x
		Critical care/ICU	—	—	x	x

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Nutrition Example. In 2010, with the passage of the Patient Protection and Affordable Care Act, the National Center on Minority Health and Health Disparities was redesignated an institute (NIMHD) at the National Institutes of Health (NIH) [98]. The NIMHD conducts research and brings attention to the unequal burden of illness and death experienced by racial and ethnic minorities and rural and poor populations in the US [98]. For example, African Americans are more likely to present with obesity and hypertension [56, 57, 99, 100]. Among women, the age-adjusted prevalence of overweight or obesity among racial and ethnic minorities is higher among non-Hispanic black and Mexican-American women than among non-Hispanic white women [38]. According to the CDC, non-Hispanic black adults (17%) and Hispanic adults (14%) are less physically active compared to non-Hispanic white adults (23%) [41, 101].

Assigning self-study cases across the 4-year curriculum can help medical students achieve cultural competency as they progress through medical school [102]. Culturally competent health care builds upon the understanding of these cultural influences and facilitates the development of stronger patient-provider relationships with higher levels of trust.

It is well known that cultural factors and diet-related attitudes and behaviors strongly influence health [102, 103]. Therefore, the basic principles of culturally competent care include assessing nutritional issues and providing appropriate advice and counseling. The manner in which people of diverse cultures and beliefs system perceive their health is influenced by the person's upbringing, whether or not the person emigrates to a new society, the degree of acculturation to the new society, and the degree to which traditional foods in the culture of origin are available in the new society [102–104]. The meanings and uses ascribed to foods in any particular culture may be unique to that culture and should be considered when prescribing treatment plans [104, 105]. Culture influences many food-related behaviors including food choice, food purchasing, preparation, where and with whom food is eaten, health beliefs related to food, and adherence to dietary recommendations [103, 104]. Therefore, understanding the sociocultural context of health for individuals is very important to meet the healthcare needs of all populations, as culture may influence health knowledge, attitudes, and behaviors, including adherence to diet and lifestyle recommendations.

Standard 8.2 Use of Medical Educational Program Objectives. "The faculty of a medical school, through the faculty committee responsible for the medical curriculum, ensures that the medical curriculum uses formally adopted medical education program objectives to guide the selection of curriculum content, to review and revise the curriculum, and to establish the basis for evaluating programmatic effectiveness. The learning objectives of each required course and clerkship are linked to medical education program objectives" [60].

Nutrition Example. Each of the 13 chapters and 29 cases in the 5th edition of *Medical Nutrition and Disease* includes at least four educational learning objectives based on the *Nutrition Curriculum Guide to Training Physicians* that was developed by the medical nutrition educators from the NAA Curriculum Committee (http://www.nhlbi.nih.gov/research/training/naa/products/curr_gde/index.htm) [23, 24]. These

learning objectives were designed to be used by medical educators and evaluators, curriculum committees, and deans' offices to assist in creating, evaluating, modifying, and updating nutrition curricula at individual programs (medical schools, residency, and fellowship training programs). The section topics include the following:

(1) practice behavior skills and attitudes;

(2) overview and nutrition basics;

(3) lifespan;

(4) cardiovascular system;

(5) metabolic/endocrine systems;

(6) other organ systems;

(7) nutrition support and contemporary trends.

The learning objectives use language consistent with Bloom's taxonomy and are presented for each level of development of expertise, from medical student through practicing physician. The 200 learning objectives encompass knowledge and practice behavior skills and attitudes, both cognitive and problem-solving. The objectives were submitted to a consensus-generating "Delphi" process to prioritize objectives and rank the top 1/3 of all objectives at each learner level. These objectives provide medical educators with a vetted resource to assist learner development and creation of evaluation strategies.

5. Conclusion

Medical educators have access to well-established, self-study resources to teach nutrition, such as *Medical Nutrition and Disease 5th Edition*, *Nutrition in Medicine*© online modules, and the NHLBI *Nutrition Curriculum Guide for Training Physicians* [23, 67, 68]. Nutrition topics can be integrated across all four years of medical school and during residency training without significant curricular time or cost. Considering trends in team-based learning, interprofessional education, *Maintenance of Certification* requirements, and longitudinal learning environments, it is an ideal time to make sure that 100% of medical students and residents graduate with the nutrition-related knowledge, skills, and positive attitudes needed to help their patients make diet and lifestyle changes to reduce, prevent, treat, and manage acute and chronic diseases [52, 67, 68, 73, 105–109].

Building on previous research, the relevance of the course material to medical practice is the critical requirement to implement a successful nutrition education program for medical students [4, 7, 8]. It is imperative to take advantage of this highly relevant time in society when nutrition content can be successfully incorporated into all medical school curriculum to meet LCME standards as well as ACGME programs for ABMS *Maintenance of Certification*. The health of the nation depends upon this important training at both the medical school and residency level.

Conflict of Interests

The authors of this paper are editors and contributors to the textbook *Medical Nutrition and Disease*.

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References

[1] "American Medical Association concepts of nutrition and health. Council on Scientific Affairs," *The Journal of the American Medical Association*, vol. 242, no. 21, pp. 2335–2338, 1979.

[2] National Research Council Committee on Nutrition in Medical Education, *Nutrition Education in U.S. Medical Schools*, The National Academy Press, Washington, DC, USA, 1985.

[3] M. Winick, "Nutrition education in medical schools," *The American Journal of Clinical Nutrition*, vol. 58, no. 6, pp. 825–827, 1993.

[4] R. L. Weinsier, J. R. Boker, C. M. Brooks et al., "Priorities for nutrition content in a medical school curriculum: a national consensus of medical educators," *The American Journal of Clinical Nutrition*, vol. 50, no. 4, pp. 707–712, 1989.

[5] E. B. Feldman, P. R. Borum, M. DiGirolamo et al., "Creation of a regional medical-nutrition education network," *The American Journal of Clinical Nutrition*, vol. 49, no. 1, pp. 1–16, 1989.

[6] M. Cooke, D. M. Irby, W. Sullivan, and K. M. Ludmerer, "American medical education 100 years after the flexner report," *The New England Journal of Medicine*, vol. 355, no. 13, pp. 1339–1344, 2006.

[7] R. L. Weinsier, "Nutrition education in the medical school: factors critical to the development of a successful program.," *The Journal of the American College of Nutrition*, vol. 1, no. 3, pp. 219–226, 1982.

[8] R. L. Weinsier, "National dairy council award for excellence in medical/dental nutrition education lecture, 1995: medical-nutrition education—factors important for developing a successful program," *The American Journal of Clinical Nutrition*, vol. 62, no. 4, pp. 837–840, 1995.

[9] R. F. Kushner, F. K. Thorp, J. Edwards, R. L. Weinsier, and C. M. Brooks, "Implementing nutrition into the medical curriculum: a user's guide," *The American Journal of Clinical Nutrition*, vol. 52, no. 2, pp. 401–403, 1990.

[10] M. Kohlmeier and S. H. Zeisel, "Teaching preventive nutrition in medical schools," in *Preventive Nutrition: The Comprehensive Guide for Health Professionals*, A. Bendich and R. J. Deckelbaum, Eds., pp. 889–899, Humana Press, Totowa, NJ, USA, 3rd edition, 2005.

[11] L. Hark, *Medical Nutrition Education Initiatives in the US. Nutricion Clinical*, Editorial Medical Panamericana, 2002.

[12] Report of the Ad Hoc Committee of Deans, *Education Doctors to Provide High Quality Medical Care: A Vision for Medical Education in the United States*, Association of American Medical Colleges, Washington, DC, USA, 2004.

[13] N. F. Krebs and L. E. Primak, "Comprehensive integration of nutrition into medical training," *The American Journal of Clinical Nutrition*, vol. 83, no. 4, supplement, pp. 945S–950S, 2006.

[14] R. A. Bruer, R. E. Schmidt, and T. Chapel, *Nutrition Education for Physicians: Alternative Federal Roles for Creating an Improved System*, Richard Schmidt Associates, Bethesda, Md, USA, 1993.

[15] C. H. Davis, "The report to Congress on the appropriate federal role in assuring access by training in nutrition," *Public Health Reports*, vol. 109, no. 6, pp. 824–826, 1994.

[16] "National Nutrition Monitoring and Related Research Act of 1990," PubL No. 1101-445/HR1608, Section 302, 1990.

[17] "Report of the American Medical Student Association's Nutrition Curriculum Project. Essentials of nutrition education in medical schools: a national consensus," *The American Journal of Clinical Nutrition*, vol. 65, pp. 1559–1561, 1997.

[18] D. M. Irby, M. Cooke, and B. C. O'Brien, "Calls for reform of medical education by the Carnegie Foundation for the advancement of teaching: 1910 and 2010," *Academic Medicine*, vol. 85, no. 2, pp. 220–227, 2010.

[19] W. A. Walker, "Innovative teaching strategies for training physicians in clinical nutrition: an overview," *Journal of Nutrition*, vol. 133, supplement 2, pp. 541S–543S, 2003.

[20] L. A. Hark, C. Iwamoto, D. E. Melnick et al., "Nutrition coverage on medical licensing examinations in the United States," *The American Journal of Clinical Nutrition*, vol. 65, no. 2, pp. 568–571, 1997.

[21] T. A. Pearson, E. J. Stone, S. M. Grundy, P. E. McBride, L. van Horn, and B. W. Tobin, "Translation of nutritional sciences into medical education: the Nutrition Academic Award Program," *The American Journal of Clinical Nutrition*, vol. 74, no. 2, pp. 164–170, 2001.

[22] Nutrition Academic Award (NAA), Program at the National Heart, Lung, and Blood Institute, http://www.nhlbi.nih.gov/research/training/naa/.

[23] Curriculum Committee of the Nutrition Academic Award Program, *Nutrition Curriculum Guide for Training Physicians*, 2014, http://www.nhlbi.nih.gov/research/training/naa/products/curr_gde/index.htm.

[24] B. M. Tobin, M. Smith, R. L. Kushner, L. Hark, and C. Eaton, "Nutrition curriculum guide for training physicians," *The FASEB Journal*, vol. 15, no. 4, p. A1095, 2001.

[25] Association of American Medical Colleges, Medical School Graduation Questionnaire. All Schools Report, 2005, https://www.aamc.org/data/gq/allschoolsreports.

[26] D. L. Taren, C. A. Thomson, N. A. Koff et al., "Effect of an integrated nutrition curriculum on medical education, student clinical performance, and student perception of medical-nutrition training," *The American Journal of Clinical Nutrition*, vol. 73, no. 6, pp. 1107–1112, 2001.

[27] M. L. Vetter, S. J. Herring, M. Sood, N. R. Shah, and A. L. Kalet, "What do resident physicians know about nutrition? An evaluation of attitudes, self-perceived proficiency and knowledge," *The Journal of the American College of Nutrition*, vol. 27, no. 2, pp. 287–298, 2008.

[28] J. D. Darer, W. Hwang, H. H. Pham, E. B. Bass, and G. Anderson, "More training needed in chronic care: a survey of U.S. physicians," *Academic Medicine*, vol. 79, no. 6, pp. 541–548, 2004.

[29] R. F. Kushner, "Barriers to providing nutrition counseling by physicians: a survey of primary care practitioners," *Preventive Medicine*, vol. 24, no. 6, pp. 546–552, 1995.

[30] B. S. Levine, M. M. Wigren, D. S. Chapman, J. F. Kerner, R. L. Bergman, and R. S. Rivlin, "A national survey of attitudes and practices of primary-care physicians relating to nutrition: strategies for enhancing the use of clinical nutrition in medical practice," *The American Journal of Clinical Nutrition*, vol. 57, no. 2, pp. 115–119, 1993.

[31] M. Flynn, C. Sciamanna, and K. Vigilante, "Inadequate physician knowledge of the effects of diet on blood lipids and lipoproteins," *Nutrition Journal*, vol. 2, article 19, 2003.

[32] K. M. Adams, M. Kohlmeier, and S. H. Zeisel, "Nutrition education in U.S. medical schools: latest update of a national survey," *Academic Medicine*, vol. 85, no. 9, pp. 1537–1542, 2010.

[33] K. M. Adams, K. C. Lindell, M. Kohlmeier, and S. H. Zeisel, "Status of nutrition education in medical schools," *The American Journal of Clinical Nutrition*, vol. 83, no. 4, pp. 941S–944S, 2006.

[34] K. C. Lindell, K. M. Adams, M. Kohlmeier, and S. H. Zeisel, "The evolution of nutrition in medicine, a computer-assisted nutrition curriculum," *The American Journal of Clinical Nutrition*, vol. 83, no. 4, pp. 956S–962S, 2006.

[35] E. A. Finkelstein, J. G. Trogdon, J. W. Cohen, and W. Dietz, "Annual medical spending attributable to obesity: payer- and service-specific estimates," *Health Affairs*, vol. 28, no. 5, pp. w822–w831, 2009.

[36] Centers for Disease Control and Prevention, "Death and Mortality," NCHS FastStats Website, http://www.cdc.gov/nchs/fastats/deaths.htm.

[37] B. W. Ward, J. S. Schiller, and R. A. Goodman, "Multiple chronic conditions among us adults: a 2012 update," *Preventing Chronic Disease*, vol. 11, no. 4, Article ID 130389, 2014.

[38] Centers for Disease Control and Prevention, "NCHS Data on Obesity. NCHS Fact Sheet," 2014, http://www.cdc.gov/nchs/data/factsheets/factsheet_obesity.htm.

[39] K. E. Barbour, C. G. Helmick, K. A. Theis et al., "Prevalence of doctor-diagnosed arthritis and arthritis-attributable activity limitation—United States, 2010–2012," *Morbidity and Mortality Weekly Report*, vol. 62, no. 14, pp. 869–873, 2013.

[40] J. M. Hootman, M. W. Brault, C. G. Helmick, K. A. Theis, and B. S. Armour, "Prevalence and most common causes of disability among adults-United States," *Morbidity and Mortality Weekly Report*, vol. 58, no. 16, pp. 421–426, 2005.

[41] Centers for Disease Control and Prevention, Division of Nutrition, National Center for Chronic Disease Prevention and Health Promotion, 2014, http://www.cdc.gov/physicalactivity/data/facts.html.

[42] Centers for Disease Control and Prevention, *National Diabetes Fact Sheet, 2011*, Centers for Disease Control and Prevention, US Department of Health and Human Services, Atlanta, Ga, USA, 2011, http://www.cdc.gov/diabetes/pubs/pdf/ndfs_2011.pdf.

[43] C. D. Fryar, T. Chen, and X. Li, "Prevalence of uncontrolled risk factors for cardiovascular disease: United States, 1999–2010," NCHS Data Brief 103, National Center for Health Statistics, Centers for Disease Control and Prevention, US Department of Health and Human Services, Hyattsville, Md, USA, 2012.

[44] A. S. Go, D. Mozaffarian, V. L. Roger et al., "Executive summary: heart disease and stroke statistics—2014 update: a report from the American Heart Association," *Circulation*, vol. 129, no. 3, pp. 399–410, 2014.

[45] US Department of Health and Human Services, *The Health Consequences of Smoking—50 Years of Progress: A Report of the Surgeon General*, US Department of Health and Human Services, Centers for Disease Control and Prevention, Atlanta, Ga,

USA, 2014, http://www.surgeongeneral.gov/library/reports/50-years-of-progress/index.html.

[46] Centers for Disease Control and Prevention, "Alcohol and Public Health: Alcohol Related Disease Impact (ARDI)," http://apps.nccd.cdc.gov/DACH_ARDI/Default/Default.aspx.

[47] Centers for Disease Control and Prevention, "Alcohol-attributable deaths and years of potential life lost, United States, 2001," *Morbidity and Mortality Weekly Report*, vol. 53, pp. 866–870, 2004.

[48] M. E. Cogswell, Z. Zhang, A. L. Carriquiry et al., "Sodium and potassium intakes among US adults: NHANES 2003–2008," *The American Journal of Clinical Nutrition*, vol. 96, no. 3, pp. 647–657, 2012.

[49] S. S. Yoon, V. Burt, T. Louis, and M. D. Carroll, "Hypertension among adults in the United States, 2009–2010," NCHS Data Brief no. 107, National Center for Health Statistics, Hyattsville, Md, USA, 2012.

[50] A. G. Tsai, D. F. Williamson, and H. A. Glick, "Direct medical cost of overweight and obesity in the USA: a quantitative systematic review," *Obesity Reviews*, vol. 12, no. 1, pp. 50–61, 2011.

[51] C. Lenders, K. Gorman, H. Milch et al., "A novel nutrition medicine education model: the Boston University experience," *Advances in Nutrition*, vol. 4, no. 1, pp. 1–7, 2013.

[52] R. F. Kushner, L. Van Horn, C. L. Rock et al., "Nutrition education in medical school: a time of opportunity," *The American Journal of Clinical Nutrition*, vol. 99, no. 5, pp. 1167S–1173S, 2014.

[53] S. S. Gidding, A. H. Lichtenstein, M. S. Faith et al., "Implementing American Heart Association pediatric and adult nutrition guidelines: a scientific statement from the American Heart Association Nutrition Committee of the Council on Nutrition, Physical Activity and Metabolism, Council on Cardiovascular Disease in the Young, Council on Arteriosclerosis, Thrombosis and Vascular Biology, Council on Cardiovascular Nursing, Council on Epidemiology and Prevention, and Council for High Blood Pressure Research," *Circulation*, vol. 119, no. 8, pp. 1161–1175, 2009.

[54] R. H. Eckel, J. M. Jakicic, J. D. Ard et al., "2013 AHA/ACC guideline on lifestyle management to reduce cardiovascular risk: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines," *Journal of the American College of Cardiology*, vol. 63, no. 25, part B, pp. 2960–2984, 2014.

[55] R. H. Eckel, J. M. Jakicic, J. D. Ard et al., "2013 AHA/ACC guideline on lifestyle management to reduce cardiovascular risk: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines," *Circulation*, vol. 129, no. 25, supplement 2, pp. S76–S99, 2014.

[56] P. K. Whelton, L. J. Appel, R. L. Sacco et al., "Sodium, blood pressure, and cardiovascular disease: further evidence supporting the American Heart Association sodium reduction recommendations," *Circulation*, vol. 126, no. 24, pp. 2880–2889, 2012.

[57] P. A. James, S. Oparil, B. L. Carter et al., "2014 evidence-based guideline for the management of high blood pressure in adults: report from the panel members appointed to the Eighth Joint National Committee (JNC 8)," *The Journal of the American Medical Association*, vol. 311, no. 5, pp. 507–520, 2014.

[58] A. B. Evert, J. L. Boucher, M. Cypress et al., "Nutrition therapy recommendations for the management of adults with diabetes," *Diabetes Care*, vol. 36, no. 11, pp. 3821–3842, 2013.

[59] L. H. Kushi, C. Doyle, M. McCullough et al., "American Cancer Society guidelines on nutrition and physical activity for cancer prevention: reducing the risk of cancer with healthy Food choices and physical activity," *CA: Cancer Journal for Clinicians*, vol. 62, no. 1, pp. 30–67, 2012.

[60] Functions and Structure of a Medical School, "Standards for Accreditation of Medical Education Programs Leading to the MD Degree March 2014," Standards and Elements, July 2015, http://www.lcme.org/publications.htm#guidelines.

[61] L. Hark, "One programs'experiences in nutrition in medical education," *Topics in Clinical Nutrition*, vol. 12, no. 3, pp. 42–48, 1997.

[62] L. Hark, "The development of a case-based, integrated curriculum for medical students," *The American Journal of Clinical Nutrition*, vol. 72, pp. 890S–897S, 2000.

[63] L. Hark and G. Morrison, Eds., *Medical Nutrition and Disease: A Case-Based Approach*, Blackwell, Malden, Mass, USA, 1st edition, 1995.

[64] L. Hark and G. Morrison, Eds., *Medical Nutrition and Disease: A Case-Based Approach*, Blackwell Publishing, Malden, Mass, USA, 2nd edition, 1999.

[65] L. Hark and G. Morrison, Eds., *Medical Nutrition and Disease: A Case-Based Approach*, Wiley-Blackwell, Malden, Mass, USA, 3rd edition, 2005.

[66] L. Hark and G. Morrison, Eds., *Medical Nutrition and Disease: A Case-Based Approach*, Wiley, Malden, Mass, USA, 4th edition, 2009.

[67] L. Hark, D. D. Deen, and G. Morrison, Eds., *Medical Nutrition and Disease: A Case-Based Approach*, John Wiley & Sons, Malden, Mass, USA, 5th edition, 2014.

[68] Nutrition in Medicine, "A comprehensive online medical nutrition curriculum for training current and future healthcare professional," 2014, http://www.nutritioninmedicine.org/.

[69] N. B. Nuno and R. Heuberger, "Nutrigenetic associations with cardiovascular disease," *Reviews in Cardiovascular Medicine*, vol. 15, no. 3, pp. 217–225, 2014.

[70] N. M. R. Sales, P. B. Pelegrini, and M. C. Goersch, "Nutrigenomics: definitions and advances of this new science," *Journal of Nutrition and Metabolism*, vol. 2014, Article ID 202759, 6 pages, 2014.

[71] S. Rauschert, O. Uhl, B. Koletzko, and C. Hellmuth, "Metabolomic biomarkers for obesity in humans: a short review," *Annals of Nutrition and Metabolism*, vol. 64, no. 3-4, pp. 314–324, 2014.

[72] E. Viennois, M. T. Baker, B. Xiao, L. Wang, H. Laroui, and D. Merlin, "Longitudinal study of circulating protein biomarkers in inflammatory bowel disease," *Journal of Proteomics*, vol. 112, pp. 166–179, 2014.

[73] American Board of Medical Specialties, "Setting the standard for quality medical care," http://www.abms.org/.

[74] L. E. Peterson, P. Carek, E. S. Holmboe, J. C. Puffer, E. J. Warm, and R. L. Phillips, "Medical specialty boards can help measure graduate medical education outcomes," *Academic Medicine*, vol. 89, no. 6, pp. 840–842, 2014.

[75] R. E. Hawkins, R. S. Lipner, H. P. Ham, R. Wagner, and E. S. Holmboe, "American Board of Medical Specialties maintenance of certification: theory and evidence regarding the current framework," *Journal of Continuing Education in the Health Professions*, vol. 33, supplement 1, pp. S7–S19, 2013.

[76] C. M. Lenders, D. D. Deen, B. Bistrian et al., "Residency and specialties training in nutrition: a call for action," *The American*

Journal of Clinical Nutrition, vol. 99, supplement 5, pp. 1174S–1183S, 2014.

[77] Report of the Behavioral and Social Science Expert Panel, *Behavioral and Social Science Foundations for Future Physicians*, Association of American Medical Colleges, Washington, DC, USA, 2011, https://www.aamc.org/download/271020/data/behavioralandsocialsciencefoundationsforfuturephysicians.pdf.

[78] S. S. Lim, T. Vos, A. D. Flaxman et al., "A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the global burden of disease study 2010," *The Lancet*, vol. 380, no. 9859, pp. 2224–2260, 2012.

[79] E. Frank, L. Elon, and V. Hertzberg, "A quantitative assessment of a 4-year intervention that improved patient counseling through improving medical student health," *Medscape General Medicine*, vol. 9, no. 2, article 58, 2007.

[80] E. Frank, J. Hedgecock, and L. K. Elon, "Personal health promotion at US medical schools: a quantitative study and qualitative description of deans' and students' perceptions," *BMC Medical Education*, vol. 4, article 29, 2004.

[81] L. Hark and D. Deen Jr., "Taking a nutrition history: a practical approach for family physicians," *The American Family Physician*, vol. 59, no. 6, pp. 1521–1528, 1999.

[82] R. F. Kushner, S. Kessler, and W. C. McGaghie, "Using behavior change plans to improve medical student self-care," *Academic Medicine*, vol. 86, no. 7, pp. 901–906, 2011.

[83] A. Oster, L. Hark, and J. Von Feldt, "An educational module designed to teach second-year medical students about counseling on behavior change," *Annals of Behavioral Science and Medical Education*, vol. 11, pp. 8–13, 2005.

[84] K. E. Hauer, P. A. Carney, A. Chang, and J. Satterfield, "Behavior change counseling curricula for medical trainees: a systematic review," *Academic Medicine*, vol. 87, no. 7, pp. 956–968, 2012.

[85] S. Schlair, K. Hanley, C. Gillespie et al., "How medical students' behaviors and attitudes affect the impact of a brief curriculum on nutrition counseling," *Journal of Nutrition Education and Behavior*, vol. 44, no. 6, pp. 653–657, 2012.

[86] M. Makowske and R. D. Feinman, "Nutrition education: a questionnaire for assessment and teaching," *Nutrition Journal*, vol. 4, article 2, 2005.

[87] C. O. Walsh, S. I. Ziniel, H. K. Delichatsios, and D. S. Ludwig, "Nutrition attitudes and knowledge in medical students after completion of an integrated nutrition curriculum compared to a dedicated nutrition curriculum: a quasi-experimental study," *BMC Medical Education*, vol. 11, no. 1, article 58, 2011.

[88] M. S. Edwards and G. C. Rosenfeld, "A problem-based learning approach to incorporating nutrition into the medical curriculum," *Medical Education Online*, vol. 11, article 10, 2006.

[89] F. M. Sacks, L. P. Svetkey, W. M. Vollmer et al., "Effects on blood pressure of reduced dietary sodium and the Dietary Approaches to Stop Hypertension (DASH) diet. DASH-Sodium Collaborative Research Group," *The New England Journal of Medicine*, vol. 344, no. 1, pp. 3–10, 2001.

[90] K. Rees, L. Hartley, N. Flowers et al., "'Mediterranean' dietary pattern for the primary prevention of cardiovascular disease," *The Cochrane Database of Systematic Reviews*, vol. 12, no. 8, Article ID CD009825, 2013.

[91] J. A. Blumenthal, M. A. Babyak, A. Hinderliter et al., "Effects of the DASH diet alone and in combination with exercise and weight loss on blood pressure and cardiovascular biomarkers in men and women with high blood pressure: the ENCORE study," *Archives of Internal Medicine*, vol. 170, no. 2, pp. 126–135, 2010.

[92] A. B. de Gonzalez, P. Hartge, J. R. Cerhan et al., "Body-mass index and mortality among 1.46 million white adults," *The New England Journal of Medicine*, vol. 363, no. 23, pp. 2211–2219, 2010.

[93] Institute of Medicine, *Accelerating Progress in Obesity Prevention*, National Academies Press, Washington, DC, USA, 2012.

[94] G. Rao, L. E. Burke, B. J. Spring et al., "New and emerging weight management strategies for busy ambulatory settings: a scientific statement from the American Heart Association: endorsed by the society of behavioral medicine," *Circulation*, vol. 124, no. 10, pp. 1182–1203, 2011.

[95] T. V. Mihalynuk, C. S. Scott, and J. B. Coombs, "Self-reported nutrition proficiency is positively correlated with the perceived quality of nutrition training of family physicians in Washington State," *The American Journal of Clinical Nutrition*, vol. 77, no. 5, pp. 1330–1336, 2003.

[96] T. V. Mihalynuk, R. H. Knopp, C. S. Scott, and J. B. Coombs, "Physician informational needs in providing nutritional guidance to patients," *Family Medicine*, vol. 36, no. 10, pp. 722–726, 2004.

[97] M. Jay, C. Gillespie, T. Ark et al., "Do internists, pediatricians, and psychiatrists feel competent in obesity care? Using a needs assessment to drive curriculum design," *Journal of General Internal Medicine*, vol. 23, no. 7, pp. 1066–1070, 2008.

[98] National Institute of Minority Health and Health Disparities, 2014, http://www.nimhd.nih.gov/.

[99] S. Moore, M. Daniel, C. Paquet, L. Dubé, and L. Gauvin, "Association of individual network social capital with abdominal adiposity, overweight and obesity," *Journal of Public Health*, vol. 31, no. 1, pp. 175–183, 2009.

[100] T. G. K. Bentley, M. Palta, A. J. Paulsen et al., "Race and gender associations between obesity and nine health-related quality-of-life measures," *Quality of Life Research*, vol. 20, no. 5, pp. 665–674, 2011.

[101] Centers for Disease Control and Preventio, Facts on physical activity, 2014, http://www.cdc.gov/physicalactivity/data/facts.html.

[102] L. Hark and H. Delisser, *Achieving Cultural Competency: A Case-Based Approach*, John Wiley & Sons, Malden, Mass, USA, 2009, http://www.lisahark.com/.

[103] D. C. S. James, "Factors influencing food choices, dietary intake, and nutrition-related attitudes among African Americans: application of a culturally sensitive model," *Ethnicity and Health*, vol. 9, no. 4, pp. 349–367, 2004.

[104] L. Hark, K. Ashton, and D. D. Deen, *The Nurse Practitioner's Guide to Nutrition*, John Wiley & Sons, Malden, Mass, USA, 2012.

[105] C. O. Airhihenbuwa, S. Kumanyika, T. D. Agurs, A. Lowe, D. Saunders, and C. B. Morssink, "Cultural aspects of African American eating patterns," *Ethnicity and Health*, vol. 1, no. 3, pp. 245–260, 1996.

[106] A. V. Blue, M. Mitcham, T. Smith, J. Raymond, and R. Greenberg, "Changing the future of health professions: embedding interprofessional education within an academic health center," *Academic Medicine*, vol. 85, no. 8, pp. 1290–1295, 2010.

[107] Interprofessional Education Collaborative Expert Panel, *Core Competencies for Interprofessional Collaborative Practice: Report of an Expert Panel*, Interprofessional Education Collaborative, Washington, DC, USA, 2011.

[108] P. M. Kris-Etherton, S. R. Akabas, C. W. Bales et al., "The need to advance nutrition education in the training of health care professionals and recommended research to evaluate implementation and effectiveness," *The American Journal of Clinical Nutrition*, vol. 99, no. 5, pp. 1153S–1166S, 2014.

[109] R. A. DiMaria-Ghalili, J. M. Mirtallo, B. W. Tobin, L. Hark, L. van Horn, and C. A. Palmer, "Challenges and opportunities for nutrition education and training in the health care professions: intraprofessional and interprofessional call to action," *The American Journal of Clinical Nutrition*, vol. 99, no. 5, pp. 1184S–1193S, 2014.

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Research Article

Enabling Valuation of Nutrition Integration into MBBS Program

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Good nutrition is the foundation for good health. While basic nutritional assessment is part of many medical consultations, it remains underutilized despite becoming increasingly recognized as important for chronic disease prevention and management. Many studies identify shortfalls in physicians' knowledge and attitudes toward nutrition as a result of inadequate emphasis in medical school. Additional teaching about nutrition and nutritional assessment procedures was integrated within a first year module of a MBBS program. Blended learning techniques were employed to facilitate student engagement and sessions were evaluated via student response system technology (clickers) or minute paper feedback. The initial survey to all medical students ($n = 1037$) documented that less than half (45%) felt they could discuss nutrition with patients. The majority ($n = 606$) regularly consulted the internet for nutrition information, while only 163 utilised peer-reviewed journals. With the first year cohort ($n = 297$) "clickers" revealed that 91% felt nutrition important to health care and 82% felt it important in general practice. 71% found using clickers an interesting enhancement, whilst 70% noted the nutrition content informative. Early nutrition teaching was well received by students. Long-term increases in nutritional information dissemination, particularly by influential health care workers, might benefit not only economies but also the health of society as a whole.

1. Introduction

Nutrition assessment and advice are underutilized in medical practice despite becoming recognized as increasingly vital [1]. The rise of chronic diseases such as type 2 diabetes and cardiovascular disease may be attributed to long-term poor diet and lifestyle choices. In 2000 more than half of the 10 leading causes of death in the USA were associated with poor dietary intake [2]. General practitioners are the first point of contact to address patients' needs and concerns, including that of nutrition and dietary advice. A large consumer telephone survey was conducted in the Netherlands in order to ascertain public preference and perceived expertise of 11 different sources of nutritional information. Results indicated that primary care physicians scored the highest (36%) with respondents choosing physicians for nutrition information above both dieticians (21%) and the Food and Nutrition Education Bureau (17%); despite only ranking 3rd in level of perceived expertise, primary care physicians ranked the highest as public preference to receive nutritional advice [3]. Despite sometimes large differences in health systems and medical education methods internationally, the same barriers to the provision of nutrition services and nutrition education appear to exist.

In 1985 a nationwide survey in the USA was conducted to assess the extent of physicians providing nutritional information, which resulted in a total less than 30% indicating their use of nutrition in patient treatment plans [4]. As a result, the US Department of Health and Human Services issued a national objective to increase the number of physicians providing nutritional screening or education to their patients [5]. In 1992 a follow-up survey demonstrated only a slight increase in numbers to less than 35% [6]. Over the years similar reports have been presented which have led to increased calls for emphasis on and reform of nutrition education of physicians [7]. The US governments Healthy People 2010 objectives identified this deficit and included a target goal of 75% of physicians offering nutrition counselling to the

majority of their patients [8]. Today in their Healthy People 2020 Topics and Objectives, physicians providing nutritional and dietary counselling are still a priority [9].

The only national guidelines in Australia on nutritional topics which should be covered during medical education were published over 20 years ago by the National Health and Medical Research Council and there are no current guidelines in this area. Considering the exponential rate of discovery through research, particularly in the health sector over the past decade, the significance placed on nutritional information and its dissemination should be addressed. The Australasian Medical Council (AMC) does however encourage medical schools to provide teaching and learning strategies which address a number of objectives relating to knowledge and understanding of nutritional therapies. This AMC document also highlights that Medical Board guidelines encourage doctors to present all information available to allow patients to make informed choices relating to their management [10].

Literature surrounding small group activities has shown numerous positive outcomes such as higher academic achievement [11] and self-esteem [12], increased positive attitudes toward the subject area studied, greater persistence and acceptance of differences among peers, and greater retention across a wide range of educational settings [13]. While interacting with classmates, students are met with a variety of ideas from peers and have the responsibility of comparing, contrasting, and criticizing these ideas for themselves. Active learning, such as this, is much more like life-long learning than the mere recital of lecture content [14].

To benefit the students, lectures should contain interactive components and should not be entirely passive. Learning has been shown to be more permanent and meaningful when students take a more active role in the process [15]. Schlechty outlined the criteria for what he terms educational design qualities, based on the premise that when learning activities are created using this criterion, the students will be more likely to engage in their work, persevere, and find satisfaction within it. These qualities include activities which improve formative feedback, as well as those designed to encourage cooperative action between students and their peers. In order to achieve good educational practice, given tasks were varied and required that students acquire new skills, as well as different approaches, presentation styles, and modes of analysis [16].

This project set out to assess students' perceptions of the value of nutrition and a range of interactive and innovative teaching practices, including small group learning on improving student's knowledge and skills in the area of nutrition. Evaluation tools and other classroom assessment techniques were also utilized to increase student engagement and knowledge retention, as well as gain feedback [17]. The lectures also contained interactive components for students to take a more active role in their learning process [15]. Blended learning tools such as a variety of online resources, such as links to government public health and nutrition program support websites, health organization, and other credible and nutritionally relevant materials (Appendix), alongside the interactive lecture formats, were made accessible to students.

With increasing international support for the development of integrated nutrition curricula in medical schools, it is essential to evaluate the impact and assess its outcomes, while continuing to improve teaching and learning methods as action research cycles. The aim of this project was to evaluate students' perceptions of nutrition and the use of a variety of blended learning techniques, to enhance medical student's engagement and clinical practice development in relation to nutrition education in the first year Bachelor of Medicine and Bachelor of Surgery (MBBS) students.

2. Materials and Methods

At the outset of the project a school wide survey was also conducted to ascertain attitudes and perceived nutritional knowledge of all current medical students years 1–4 at the University of Queensland (UQ) ($n = 1037$). Relevant faculty members were also engaged and requested to provide details for where in each of their courses nutrition content was included.

First year medical students ($n = 297$) participated in an add-on series of 2 small group interactive nutritionally based educational sessions, integrating with their existing Gastrointestinal/metabolism module which spans 5 weeks and includes 54 other educational components. The initial session delivered over weeks 2 and 3 of the module comprised an overview of nutrition as possessing both nutritive and pharmacological properties, as well as the current state of evidence relating to the function and uses of probiotics. The second half of the first 2-hour session included a practical component, where students completed their own nutrition assessments. The second session was delivered to small groups at the conclusion of the Gastrointestinal/metabolism module. This session was composed of both evidence-based research information and practical role-playing components, to tie in the theory delivered over both sessions. Learning revolved around nutritional causes and potential treatments, as well as the biochemical mechanisms of action in relation to obesity and type II diabetes, with emphasis placed on utilizing primary research literature. Students were not required to do any preparation prior to the sessions.

This preliminary session was blended with the use of student response systems "clickers" not only to gain feedback from the students at the session's conclusion, but also to assist them in summarizing important points throughout the lecture content.

Nutritional assessments in both sessions were completed using modified versions of REAP and WAVE tools [18]. These tools have been developed by Brown University, USA, and were adapted with permission into Australian standards. The REAP or Rapid Eating Assessment for Patients is a food frequency questionnaire, which can be filled out by patients while they are in the waiting room. The REAP tool is designed to allow immediate recognition of any nutritional issues at a glance and hence is feasible for use in the general practice setting. The WAVE or weight, activity, variety, and excess tool is a desktop flash type card with key inquiries on one side and recommendations on the other.

The second session was presented as role-play case studies utilizing the WAVE and REAP tools, in a 20-minute consultation style format. A variety of patient information tools were also provided to be used as an adjunct during the consultation. In pairs the students took turns at being the patient and physician with a concluding facilitated whole group discussion. A proportion of the groups were also video-taped and reviewed by the students for reflection, which may assist students in gauging their own progress and methods of enquiry.

Minute papers, by Angelo and Cross, were used on completion of these sessions asking "What was the most important thing learned in the class?," "What important questions remain unanswered?," and "Are there any improvements you could suggest for this session?" Students were provided with small pieces of paper outlining the above questions along with space for their brief responses. This method enables session evaluation in a very short time period and engenders no further participant burden. These authors have designed a number of classroom assessment techniques (CATs) as a type of simple evaluation utilized to collect data on student learning, with the aim of improving it. They are designed to gain feedback and assist teachers in finding out what and how well students are learning [17].

3. Results

The initial school wide survey administered to all medical students (n = 1037) documented that less than half (45%) of the students felt they knew enough about nutrition to counsel patients. Interestingly the majority of students (n = 606) regularly consulted the internet for information about nutrition, while only 163 utilised peer-reviewed journals. The remaining results of this component are currently under analysis.

Participating students (n = 297) responses with the "clickers," utilised during the first sessions, revealed that 91% felt nutrition was important to health care and 82% felt it is important in general practice (Figure 1). 71% of the students found using the clickers to be an interesting enhancement to the session (Figure 2), whilst 70% noted the nutrition content to be informative.

When asked about their preferred choice of "junk" food or vegetables snacks, students responded with 54% and 46%, respectively. When asked about the one which they would be more likely to choose, responses were 51% and 49%. The main driving force for their consumption was based on taste (38%), availability (26%), and price (20%), followed, then, by health (15%) and peers (2%).

In relation to the multiple choice questions which appeared periodically throughout the session, the majority of students were able to answer correctly. When asked "Which micronutrient assists in both immune function and tissue synthesis" 72% of students correctly answered Vitamin C. In response to the question "Which most accurately describes factors which determine nutrient needs" 85% identified absorption, metabolism, and excretion, as well as food intake and underlying disease, as had been discussed during the session.

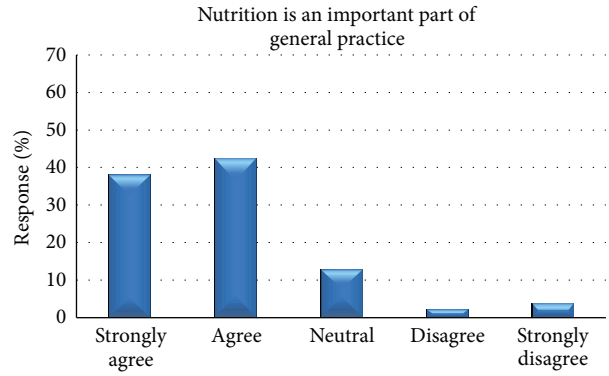

Figure 1: Clicker response system result from first series session.

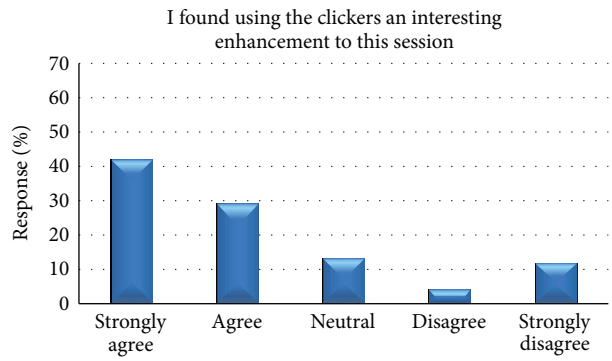

Figure 2: Clicker response system result from first series session.

For the second series of sessions 68% of students felt they would utilise the nutritional assessment tools if they were in general practice, while 12% were opposed and 20% unsure (Figure 3).

Students' qualitative feedback on the educational sessions is outlined in Table 1. Major emerging themes included some students recommending further lecture time to enhance their understanding of the underlying biochemical mechanisms of nutritional interventions, whilst others indicated that more practice at nutritional consulting would be beneficial. The sessions were overall well received with more students preferring practical components over theory.

4. Discussion

In phase I of the UQ MBBS program, students receive approximately 7 hours of formal nutrition education not including the informal learning within PBL groups, as informed by relevant faculty. In phase II, nutrition is thought to be considered where appropriate; however there is no standard to ensure this is being completed. In light of this, the introduction of increased nutrition components is being investigated to address this shortfall, beginning with phase I of the program.

With almost half of the entire student cohort from years 1–4 documenting insufficient knowledge to mention nutrition to patients, the limited training provided may be a causal factor in the lack of nutritional assessment and advice utilized in

Table 1: Students' feedback when asked, "Are there any improvements you could suggest for the session?"

Session	Overall theme	Selection of quotes
Part 1: interactive lecture	Some students indicated they would have liked additional lecture time given the broad scope of nutritional interventions and others indicated additional practical exercises would be beneficial.	"I enjoyed the power point lecture and wished it could have been longer" "More focus on mechanisms of action" "Considering the vast scope of nutrition and health, session was a brief overview" "Exemplar video examples of experts taking cases and providing advice" "Maybe less of a focus on research and more practical tips on approaching weight loss with our patients" "Best ways to convince people to change their diet"
Part 2: practical case studies	More students were in favor of the practical applications over the research details.	"More interactive activities and shorter lecture" "Breaking up lecture with more activities to maintain interest" "Spend more time doing cases" "Case studies at the end were most useful. Not sure whether these could be worked in throughout to be even more interactive?"
Part 2: practical case studies: subset who participated in the videotaped role plays	These sessions were generally well received	"Really great, interactive, educational session" "Very good"; "Interesting" "I found this session much more interesting and applicable then the first. I will try and eat better as a result of what I have learned. Good session overall"

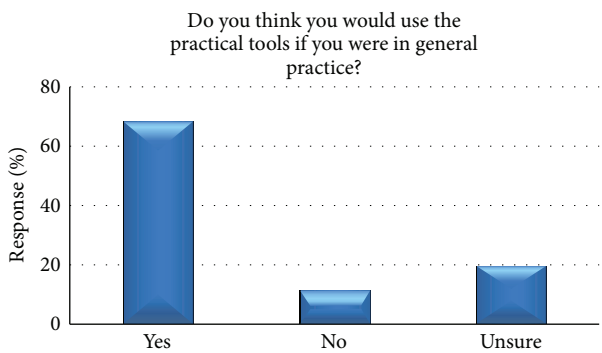

Figure 3: Clicker response system result from second series session.

current medical practice. In order to ascertain the importance students placed on their own food choices, they were asked whether they preferred or would likely choose either junk food or vegetable snack options. More students preferred junk food and only a small percentage of these indicated they would more likely choose healthier options. Considering that the majority of students documented that nutrition was an important part of healthcare, nutrition as such was not highly considered when selecting food choices. This disassociation of food consumption and health outcomes might be explained by the lack of emphasis of nutrition in their medical school curricula and also in current health care models. Another deliberation is the commonly large scale availability and low price point for unhealthy food choices. This in reflection with the sometimes limited budgets of medical students need also be considered.

It is well established that many blended learning techniques and activities might be useful in assisting students with the integration of knowledge and the development of deeper thought processes such as critical thinking and problem solving. Bloom's Taxonomy of Educational Objectives identifies these types of objectives as higher level intellectual processes such as analysis, synthesis, and evaluation [19]. This cohort found the practical application of the theoretical components to be beneficial to their learning and also conducive to their willingness to participate in the blended learning sessions.

Another important component is feedback, which is more than it is merely happening or not happening. Technologies such as "clickers" provide immediate responses to students as to the state of their current understanding of topics being discussed. Good practice gives prompt feedback which should happen reasonably soon after the learning activity [20]. What is needed for a lecture to be effective is for evidence on performance to be available at the time so corrections can be progressively made when necessary. The clicker technology is a useful method to provide this immediate feedback and also enhance student engagement.

Regular intervals which allow students to discuss previous material can help them to summarize and clarify related information before moving on [21]. As opposed to asking questions at the end of a lecture period, utilizing a step-by-step lecture method whereby the content is arranged into any number of short periods of exposition, followed by a class discussion has been shown to be more effective [22]. In this way students can also receive their own immediate feedback and gauge their understanding and progress through the subject material while keeping them motivated. If things are not clear at any stage in a learning process, it is better to resolve these issues before the problem becomes any more extensive.

Most of the students in the cohort were able to answer multiple choice questions correctly when they were positioned periodically throughout the lecture, which demonstrated their engagement with the theoretical lecture style

content. This type of arrangement has been documented to lend its success to a number of additional variables along with the benefits of immediate feedback. These include the opportunity for rehearsal and the reduction of retroactive interference, along with the effect of a change of activity and stimulation on the potential decline of students' attention [22]. The students seemed overall in favor of the interactive nature of the sessions, some making comments about further integration of the practical component discussions throughout the initial background research lecture, to maintain their concentration and interest. Many suggested a greater interest in the "case studies" rather than the research and background theories. Those who participated in the video-taped role plays found the sessions to be most useful.

Limitations to this study included the inability to formally assess students on their actual content knowledge before and after the additional nutrition sessions. Summative evaluation of students' ability to perform a clinical nutritional assessment would have also been beneficial.

5. Conclusions

Favorable feedback was highlighted with the provision of nutrition education and also the utility of blended learning techniques to enhance student engagement. Importantly nutrition as the topic focus was deemed, by students, as essential to their education and also to healthcare practices. Integration of nutrition in medical education should enhance future primary care physicians' ability to recommend nutrition. The underlying processes should recognise nutrition as both being the cornerstone of preventative health and being vital to lowering the risk of chronic disease pathologies. Increasing this awareness, in both physicians and their patients, may assist in modifying treatment plans and allow for further health recommendations as opposed to being limited to drug types of therapy. The burden of rising health care costs as morbidity, prospective drug prescriptions, and their potential side effects, may also subsequently be reduced.

Appendix

Online Nutrition Support Resources

Australian Government Health Promotion websites are

(i) Australian Dietary Guidelines and support resources: http://www.eatforhealth.gov.au/,

(ii) Go for 2 & 5 fruit and veggie ideas: http://www.gofor2and5.com.au/,

(iii) Happier Healthier nutrition and fitness: http://healthier.qld.gov.au/fitness/,

(iv) Better Health Channel: http://www.betterhealth.vic.gov.au/bhcv2/bhcarticles.nsf/pages/healthy_living?open,

(v) Public Health Nutrition programs: http://www.public.health.wa.gov.au/2/1575/2/nutrition_and_healthy_weight.pm.

Other healthy recipe sites to assist in ideas and menu planning are

(i) http://www.healthyfoodguide.com.au/,

(ii) http://www.betterhealth.vic.gov.au/bhcv2/bhcsite.nsf/pages/bhc_recipes,

(iii) http://daa.asn.au/for-the-public/smart-eating-for-you/recipes/browse/.

For kids sites are

(i) http://www.healthykids.nsw.gov.au/recipes.aspx,

(ii) http://healthy-kids.com.au/parents/recipes/,

(iii) http://kidshealth.org/kid/recipes/index.html.

Activity calorie counter site is

(i) http://www.8700.com.au/balance-and-burn/kj-activity-comparison/.

Consumer information site is

(i) http://www.foodstandards.gov.au/consumer/Pages/default.aspx.

Nutrient reference values site is

(i) http://www.nrv.gov.au/.

Drug and supplement information site is

(i) http://www.nlm.nih.gov/medlineplus/druginformation.html.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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References

[1] K. A. Tappenden, B. Quatrara, M. L. Parkhurst, A. M. Malone, G. Fanjiang, and T. R. Ziegler, "Critical role of nutrition in improving quality care: an interdisciplinary call to action to address adult hospital malnutrition," *Journal of the Academy of Nutrition and Dietetics*, vol. 113, no. 9, pp. 1219–1237, 2013.

[2] A. Minino and L. Smith, "Deaths: preliminary data for 2000," in *National Vital Statistics Reports*, 2001.

[3] G. J. Hiddink, J. G. A. J. Hautvast, C. M. J. Van Woerkum, C. J. Fieren, and M. A. Van 't Hof, "Consumers' expectations about nutrition guidance: the importance of primary care physicians," *American Journal of Clinical Nutrition*, vol. 65, no. 6, pp. 1974S–1979S, 1997.

[4] M. G. Stephenson, A. S. Levy, N. L. Sass, and W. E. McGarvey, "1985 NHIS findings: nutrition knowledge and baseline data for the weight-loss objectives," *Public Health Reports*, vol. 102, no. 1, pp. 61–67, 1987.

[5] US Department of Health and Human Services, "The surgeon general's report on nutrition and health," in *The Reports of the Surgeon General*, Nutrition Policy Board, Ed., Public Health Service, Office of the Surgeon General United States, 1988, http://profiles.nlm.nih.gov/NN/B/C/Q/G/.

[6] US Department of Health and Human Services and Public Health Service, *Healthy People 2000: Progress Review; Nutrition*, US Department of Health and Human Services, 1998.

[7] F. M. Torti, K. Adams, L. Edwards, K. Lindell, and S. Zeisel, "Survey of nutrition education in U.S. medical schools—an instructor-based analysis," *Medical Education Online*, vol. 6, p. 8, 2001, http://www.med-ed-online.org/res00023.htm.

[8] US Department of Health and Human Services and Public Health Service, *Healthy People 2010 Objectives; Nutrition Counselling*, US Department of Health and Human Services, Washington, DC, USA, 2000.

[9] USDHHS, *Increase the Proportion of Physician Visits Made by All Child or Adult Patients That Include Counseling about Nutrition or Diet in 2020 Topics and Objectives*, US Department of Health and Human Services, Washington, DC, USA, 2007, http://www.healthypeople.gov/node/4965/data_details.

[10] P. M. Brooks, "Undergraduate teaching of complementary medicine," *Medical Journal of Australia*, vol. 181, no. 5, pp. 275–277, 2004.

[11] M. A. Lyon, "Academic self concept and its relationship to achievement in a sample of junior high students," *Educational and Psychological Measurement*, vol. 53, no. 1, pp. 201–210, 1993.

[12] J. A. Box and D. Little, "Cooperative small-group instruction combined with advanced organizers and their relationship to self-concept and social studies achievement of elementary school students," *Journal of Instruction Psychology*, vol. 30, no. 4, pp. 285–287, 2003.

[13] M. H. Towns, K. Kreke, and A. Fields, "An action research project: student perspectives on small-group learning in chemistry," *Journal of Chemical Education*, vol. 77, no. 1, pp. 111–115, 2000.

[14] M. W. Jackson and M. T. Prosser, "Less lecturing, more learning," *Studies in Higher Education*, vol. 14, no. 1, pp. 55–68, 1989.

[15] F. A. Sojoka, "The need for hands-on science," *Journal of College Science Teaching*, vol. 22, no. 11, pp. 4–5, 1992.

[16] P. C. Schlechty, *Inventing Better Schools. An Action Plan for Educational Reform*, Jossey-Bass, San Fransisco, Calif, USA, 1997.

[17] T. A. Angelo and K. P. Cross, *Classroom Assessment Techniques: A Handbook for College Teachers*, Jossey-Bass, San Francisco, Calif, USA, 1993.

[18] K. M. Gans, E. Ross, C. W. Barner, J. Wylie-Rosett, J. McMurray, and C. Eaton, "REAP and WAVE: new tools to rapidly assess/discuss nutrition with patients," *The Journal of Nutrition*, vol. 133, no. 2, pp. 556S–562S, 2003.

[19] B. S. Bloom, *Taxonomy of Educational Objectives*, Longman, London, UK, 1972.

[20] A. W. Chickering and Z. F. Gamson, "Seven principles for good practice in undergraduate education," *Wingspread Journal*, vol. 9, special insert, no. 2, 1987.

[21] L. L. C. Jones, "Are lectures a thing of the past?" *Journal of College Science Teaching*, vol. 32, no. 7, pp. 453–457, 2003.

[22] D. Bligh, *What's the Use of Lectures?* Intellect, Bristol, UK, 1998.

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Research Article

Nutrition Knowledge, Attitudes, and Confidence of Australian General Practice Registrars

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Nutrition knowledge, attitudes, and confidence were assessed in General Practice Registrars (GPRs) throughout Australia. Of approximately 6,000 GPRs invited to complete a nutrition survey, 93 respondents (2%) completed the online survey, with 89 (20 males, 69 females) providing demographic and educational information. Fifty-one percent had graduated from medical school within the last two years. From a list of 11 dietary strategies to reduce cardiovascular risk, respondents selected weight loss (84%), reducing saturated fats (90%), a maximum of two alcoholic drinks/day (82%), and increasing vegetables (83%) as "highly appropriate" strategies, with only 51% indicating that salt reduction was "highly appropriate." Two-thirds of registrars felt "moderately" (51%) or "very" confident (16%) providing nutrition advice. Most of them (84%) recalled receiving information during training, but only 34% recalled having to demonstrate nutritional knowledge. The results indicate that this group of Australian GPRs understood most of the key dietary recommendations for reducing cardiovascular risk but lacked consensus regarding the recommendation to reduce salt intake and expressed mixed levels of confidence in providing nutritional advice. Appropriate nutrition education before and after graduation is recommended for GPRs to ensure the development of skills and confidence to support patients to make healthy dietary choices and help prevent chronic diseases.

1. Introduction

Nutrition is vital to the maintenance of health and the prevention of disease. Inappropriate nutrition management contributes to the development and progression of chronic diseases, which often require longer hospitalization, leading to increased health care costs [1]. General Practice Practitioners (GPs) provide coordinated holistic health care to individuals and families in their communities. In Australia, approximately 4 years of training following graduation from medicine is required for GPs, two years in hospitals and two years in GP practice under supervision. As a medical practitioner who has received specialist training in the area of general practice, an Australian GP has undergone similar training to a US "family physician."

GPs are often the first point of call and in remote areas may be the only possible point of call, for individuals with chronic diseases where nutrition modifications are effective interventions. If doctors are equipped with the knowledge and skills to assess and address nutrition risks, they can assist in the prevention of disease, deterioration of disease, and optimal disease management [2, 3].

The Australian Medical Council (AMC) states that medical practitioners need to have appropriate knowledge and skills in identifying nutrition issues for patients in order to prevent and treat common chronic disease [4]. However, doctors around the world, including Australia, have been found to be ill-equipped to identify and appropriately manage nutrition-related issues of patients, whether inpatients or those living in residential care or the community [5–7]. The most common cause of insufficient nutrition practice that has been identified is lack of nutrition knowledge [3, 8, 9]. Results from a recent survey indicated that there was no consistent integration of nutrition knowledge and skills across different medical courses and that the assessment of nutrition knowledge and skills varies significantly among

universities, with nutrition education being highly dependent on current staff interest [9].

General Practice Registrars Australia (GPRA) is the "peak. . .body" for prevocational doctors and GP registrars in Australia, providing nonmedical information, training, and representation for approximately 70% of GP registrars in the country who are members [10].

There is limited information available on the nutrition knowledge and nutrition training needs of general practitioners in Australia and, to our knowledge, none is available for GP trainees in this country. Registrar members of GPRA were invited to participate in a survey which aimed specifically to assess (1) nutrition knowledge, (2) perceived role of GPs in disseminating nutrition advice, and (3) confidence in their ability to advise on prevention and treatment of cardiovascular diseases through use of evidence-based nutrition practices.

2. Methods

2.1. Study Sample and Survey Administration. An online nutrition survey (SurveyMonkey) was posted on the website of General Practice Registrars Australia (GPRA) registrars between February 22 and June 24, 2013, and was funded by the Almond Board of Australia. GPRA represents over 21,000 medical students and GP members at various stages of their training [10]. At any given time, approximately 6,000 are registrar members (6,123 at time of writing).

GP registrars have completed their basic medical training and are currently enrolled in further specialist GP training which will allow them membership of either the Australian College of Rural and Remote Medicine or the Royal Australian College of General Practitioners. Registrar members can have completed their training up to two years earlier and be working independently.

GP registrars registered with the GPRA were sent an email, inviting them to participate in the anonymous online survey. Participants completing the survey were placed in a draw to win one of five food hampers worth $100 each. The project was approved by the Deakin University Human Ethics Advisory Group: Project number HEAG-H 87_2012.

2.2. Survey Design and Content. The survey took approximately 8–10 minutes to complete. One case study of a patient with elevated risk of cardiovascular disease was included and participants rated the appropriateness of different lifestyle strategies to address this patient's risk. Of the 15 strategies proposed, 11 were nutritional in nature and two of these (avoiding spicy foods and reducing fresh fruit intake) were deliberately included as strategies *not* in line with the Australian dietary guidelines, to check whether students responded appropriately to these. Two further questions related indirectly to the relevant nutrition content (the term used was "lifestyle strategies to reduce cardiovascular risk") taught and assessed during medical training, one question related to nutrition education postgraduation, one assessed attitude regarding the role of the GP as provider of nutrition information and another the self-assessment of confidence in the provision of nutrition advice, and one question each related to nutrition resources and referral practices to other health professionals. Four other questions provided consent to take part in the survey as well as information on demographic characteristics.

2.3. Statistical Analysis. The data was summarized using descriptive statistics, percentages, and graphs.

3. Results

3.1. Demographics. Of the approximately 6,000 GP registrars invited to participate, a total of 93 (2%) completed the online nutrition survey; four of these did not provide demographic information. Of the 89 remaining participants, 23% were male and 77% were female, and 67 (75%) were aged less than 35 years. Sixty-seven percent ($n = 59$) had graduated within the last 2 to 6 years, 16% had graduated within 7–9 years, and 17% had graduated more than 10 years beforehand.

3.2. Responses to Clinical Scenario: Elevated Blood Lipids, Prehypertension, and Overweight. To gain insight into the nutrition knowledge of GP registrars, the following patient scenario was presented: "Mr. Jones, a 50-year-old mid-level manager in a large car manufacturing company, presents to you as a patient as he had a blood lipid check through a workplace screening initiative. His fasting blood lipid results are: total cholesterol 6.30 mmol/L (244 mg/100 mL), LDL cholesterol 4.11 mmol/L (159 mg/100 mL), HDL cholesterol 1.57 mmol/L (61 mg/100 mL), and triglyceride 1.38 mmol/L (122 mg/100 mL). His Body Mass Index (BMI) is 28 kg/m^2 and seated blood pressure is 128/85 mmHg." To answer the question "How appropriate are the following to assist in reducing Mr. Jones' cardiovascular risk?," respondents were required to choose from a list of strategies and indicate the level of appropriateness of each one, namely, "highly appropriate," "somewhat appropriate," "not appropriate," or "do not know" (Figure 1). They were also given space to write comments in their own words.

3.3. Dietary Responses. Almost all respondents (99%) indicated that weight loss was a "highly" (84%) or "somewhat" (15%) appropriate goal, and most of them (98%) indicated that reducing total fat intake was "highly" (59%) or "somewhat" (39%) appropriate. Ninety-nine percent agreed that a reduction in saturated fat was an appropriate strategy, with most of them (90%) indicating this was "highly appropriate." In terms of salt reduction, about half (51%) indicated that "reducing salt intake" was "highly appropriate," and a further 39% chose "somewhat appropriate," but 10% felt salt reduction was "not appropriate." The option of reducing alcohol intake to a maximum of 2 standard drinks per day was well supported: 98% viewed this as "highly appropriate" or "somewhat appropriate." Increasing vegetable intake was rated "highly" (83%) or "somewhat appropriate" (15%) by 98% of respondents. Avoiding all takeaway foods was only "highly appropriate" to 22% of registrars. Fifty-one felt it to be "somewhat" appropriate, while 26% did not agree that it was appropriate at all. The suggestion that Mr. Jones

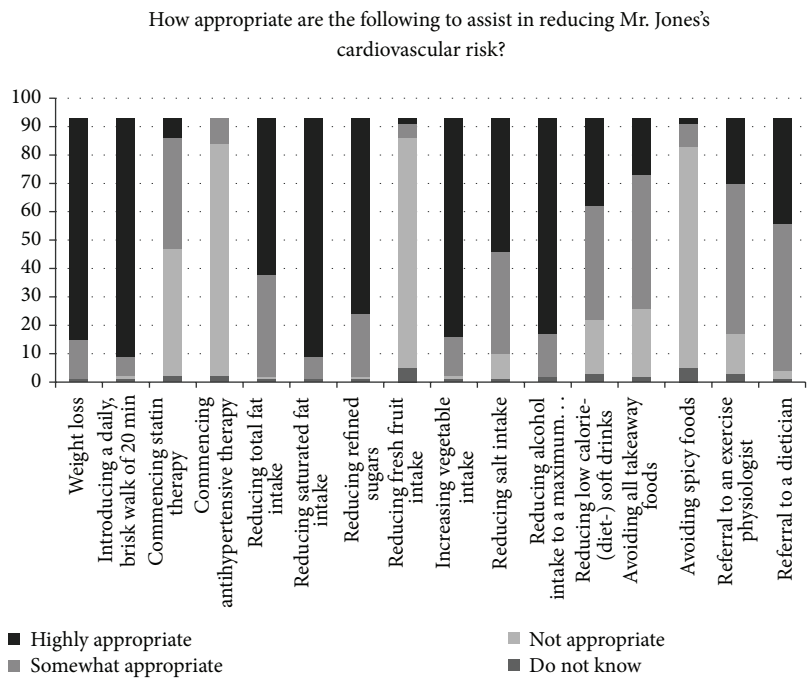

Figure 1: Cumulative perceived appropriateness of strategies to assist cardiovascular risk.

could be referred to a dietitian met with generally strong approval: 96% felt that this would be either "highly" (40%) or "somewhat" (56%) appropriate and only 3% felt that it was "not appropriate." The appropriateness of providing recommendations related to refined sugar intake (reducing refined sugars) was less clear, with 74% indicating that this was "highly appropriate" but one-quarter (24%) indicated that this was only "somewhat" so.

With respect to the two inappropriate strategies included as a challenge, most registrars indicated that it was inappropriate to provide advice to avoid spicy foods (84%) with only 11% choosing this recommendation. Most registrars (87%) ticked that a reduction in fruit intake was "not appropriate" (which is in keeping with the dietary recommendation), whilst 12% either did not know (5%) or rated this as being appropriate to some degree (7%). Reduction of diet-soft drinks drew a mixed response: 76% indicated that this was appropriate to some degree, but 20% indicated that this was not appropriate and 3% did not know.

3.4. Nonnutritional Lifestyle Strategies. Almost all GP registrars (98%) indicated that a daily 20-minute walk would be highly (90%) or somewhat (8%) appropriate. A high proportion of registrars (79%) also indicated that it would be highly (25%) or somewhat (57%) appropriate to refer the patients to an exercise physiologist, but 15% chose "not appropriate" and 3% were unsure.

A free text box was also provided for respondents to answer the question "At the consultation, what specific actions or medications would you suggest that Mr. Jones takes?" Only 19% of respondents wrote that smoking status should be checked or acted on, while 31% specified "lifestyle changes" of some sort, with 90% specifically mentioning exercise.

3.5. Medication Use Suggested by GP Trainees. From the list of given strategies, using some form of statin therapy to lower the patient's cholesterol levels was indicated to be "highly appropriate" by only 8% of registrars but a further 42% chose "somewhat appropriate"; only 2% selected "not appropriate." In contrast, not a single respondent indicated that antihypertensive mediation was "highly appropriate" and only 10% selected "somewhat" so, while 88% indicated that it was "not appropriate" (2% were unsure). Most participants (78%) indicated in their written comments that medication would not be their first course of action.

3.6. Professional Development Relating to Effectiveness of Lifestyle Strategies. Respondents were asked "Have you undertaken any professional development activities related to the effectiveness of lifestyle strategies to reduce cardiovascular risk since graduating from medicine?" Just over half responded in the affirmative ($n = 38$) (54%), whilst the remainder responded negatively (41%) or could not recall (5%).

3.7. Attitudes and Perceived Role of GPs in Provision of Nutrition Advice to Patients. All the registrars responded with "Yes" to the question "Do you think that a General Practitioner has a role to play in the provision of nutrition/lifestyle advice to their patients?" Space was also provided for comments, and 20 participants indicated that they felt GPs had an important role to play, in conjunction with other trained allied health professionals, but time constraints and lack of

Table 1: Confidence in providing nutrition recommendations to patients.

Answer options	Response, percent (N = 93)
Very confident	15%
Moderately confident	51%
Somewhat confident	29%
Little confidence	5%
Not confident at all	0%

nutrition skills were cited as impediments. The attitudes of the GPRs are indicated by the following comments.

(i) *"GPs have a very important role in providing this advice"* (18/20 respondents expressed some version of this view).

(ii) *"...I feel time is a large impediment in the GP's ability to provide complex nutritional advice to patients"* (2/20 respondents expressed this view).

(iii) *"Someone who lacks motivation and has no other support outside their GP is unlikely to succeed in a lifestyle change. I am frequently referring to dietitians and exercise physiologists for patient support and education"* (one respondent).

(iv) *"I think most medical school training needs to increase the emphasis on nutrition and addressing lifestyle risk factors"* (one respondent).

(v) *"...definitely a role but not one that many GPs are well-equipped to carry out specifics of"* (one respondent).

3.8. Confidence in Providing Nutrition Recommendations. Respondents were asked "How confident are you in providing accurate nutrition recommendations to patients?" Most participants (95%) felt at least "somewhat confident" in their ability to pass on accurate nutrition information to patients, with 5% reporting "little confidence" (Table 1). There was no relationship between the treatment options identified correctly as "highly appropriate" and perceived confidence (data not shown).

3.9. Referral to Allied Health Professionals. In the last 12 months, 95% of registrars reported referring patients to a dietitian, 53% to an exercise physiologist, and 27% and 30% to a nutritionist and a nurse (type of nurse unspecified), respectively. Other health professionals utilized were personal trainers (16%) as well as diabetes educators, physiotherapists, and gym classes (all less than 6%). Only three participants indicated that they did not refer to any allied health professionals. One provided the comment that choice for referral was limited due to country location, but the same person had recently referred to a dietitian, nurse, and exercise physiologist.

3.10. Recollection of Curriculum Related to Nutrition to Reduce Cardiovascular Risk during Initial Medical Training. Respondents were asked "Were lifestyle strategies to reduce cardiovascular risk highlighted during your initial medical training?" The majority of registrars (84%) answered "Yes" with only eight (9%) responding "No," whilst seven (8%) could not recall. In response to the question "Did your medical school assessment require you to demonstrate your knowledge of the effectiveness of nutrition/lifestyle strategies to reduce cardiovascular risk?," fewer registrars indicated that they were able to recall being required to demonstrate this knowledge: approximately one-third reported being required to demonstrate their knowledge but two-thirds were either not required to demonstrate nutrition knowledge or not able to recall this (Figure 2).

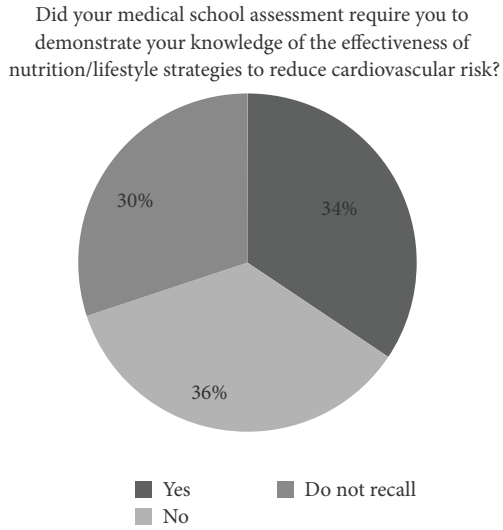

Figure 2: Assessment of knowledge of nutrition/lifestyle strategies to reduce cardiovascular risk by GP's medical school.

4. Discussion

In this survey, Australian GP registrars were presented with the scenario of a patient presenting after a health screening which identified prehypertension, hyperlipidemia, and overweight. It was found that the registrars' nutrition knowledge related to recommended strategies to reduce cardiovascular risk was high for the long-established strategies, including weight loss, increasing vegetables, and limiting alcohol intake. Another long-term strategy, reducing total fat, was rated as being highly appropriate by many (60%) respondents, but more felt that reduction of saturated fat in particular was highly appropriate, in keeping with the recent recommendations by public health agencies [11, 12]. In terms of salt reduction, about half the group indicated that salt reduction was highly appropriate but 10% thought that it was inappropriate, despite the Australian Dietary Guidelines recommendations to "Limit intake of foods and drinks containing added salt" [11] which were particularly relevant to the patient in the scenario with prehypertension. As a comparison, a survey of Australian GPs published in 2005 found that, of the 163 (45%) who completed a questionnaire, only a minority strongly agreed that they

would consider (37%) or provide (22%) nutrition counselling for hypertension [13], while five years later only 34% of patients with hypertension reported receiving advice from GPs to reduce salt intake [7].

Less than one-quarter thought that it was highly appropriate to avoid all takeaway foods and this may reflect the view that some takeaway foods may be nutritionally acceptable or that it is not necessary to avoid all takeaway foods.

In other knowledge areas, reducing refined sugar and the use of diet-soft drinks had varying responses. This was also true to some extent of the recommendation to reduce fruit intake, where the desirable response was that this was "not appropriate"; 7% of respondents suggested that this was appropriate to some extent, while 5% ticked "do not know." This may reflect confusion around these issues and indicates that GP registrars could benefit from receiving clear guidelines on these topical nutrition issues.

It was reassuring that over 95% of GP registrars indicated that they approved (either highly or somewhat) of referral of the patient to a dietitian. This could indicate that, in this group of relatively recent medical graduates, the benefits of a multidisciplinary team-based approach to patient management are supported. Such a conclusion appears to be backed by the similarly high reported rate of referral to other health professionals and aligns with the philosophy that multidisciplinary care is seen as being critical to improving the primary health care of Australia [14, 15].

There is evidence that medical graduates do not receive sufficient training in nutrition throughout the world, including Australia [9, 16, 17]. More than 80% of the registrars in the present study recollected receiving education on nutrition/lifestyle strategies to reduce cardiovascular risk, but it is of concern that only one-third recalled being asked to actually demonstrate their nutrition knowledge. In one other study of GP trainees, in Netherlands, participants agreed that a lack of nutrition training and education was a vital influence on the extent of nutrition information given to patients, the same barriers as for GPs in that country [18]. If medical schools wish to ensure that all graduates exhibit basic nutrition competencies, then it is fundamental that students are provided with assessment opportunities to demonstrate competency.

Policies in the UK clearly acknowledge the core responsibilities of doctors to address nutrition in patient care [19]. It is clear that this group of GP registrars endorses the importance that GPs play in providing basic nutrition and lifestyle advice to their patients, but time and lack of nutrition skills were cited as impediments. Most participants felt at least "somewhat confident" in their ability to pass on accurate nutrition information. These results confirm findings from a recent survey conducted in New Zealand medical students which indicated that this group has positive attitudes towards and moderate confidence in incorporating nutrition care into practice [20]. Strategies to facilitate students' confidence in providing nutrition care are warranted and it is clear that some ongoing nutrition education would be beneficial, given the mixed knowledge of the health benefits of reducing salt, the use of diet-soft drinks, and use of refined sugar.

One key limitation of this study is the low response rate and small numbers of respondents. We suggest that this small sample of GP registrars, who voluntarily completed this questionnaire, probably represents a "nutritionally aware" group not representative of the general population of Australian GP registrars. It seems likely that this select group of relatively recent medical graduates displays greater levels of nutrition knowledge and confidence compared to the general population of GP registrars. There appear to be real challenges to engaging GP registrars' interest in delivering nutrition/lifestyle support to their patients [21, 22].

5. Conclusions

In this study, voluntary participants in a survey of GP registrars in Australia displayed an understanding of many of the key dietary recommendations for reducing cardiovascular risk, but there was a lack of consensus regarding the recommendation for reduction of salt intake. There was also a mixed level of confidence in providing nutrition advice. Appropriate nutrition education prior to graduation and postgraduation is recommended to ensure that GP registrars develop the skills and confidence to support patients in making healthy dietary choices.

Conflict of Interests

The authors declare that they have no conflict of interests regarding the publication of this paper.

References

[1] WHO/FAO, *Diet, Nutrition and the Prevention of Chronic Diseases: Report of the Joint WHO/FAO Expert Consultation 2002*, World Health Organization, Geneva, Switzerland, 2003.

[2] O. T. Cate, L. Snell, and C. Carraccio, "Medical competence: the interplay between individual ability and the health care environment," *Medical Teacher*, vol. 32, no. 8, pp. 669–675, 2010.

[3] A. S. Truswell, G. J. Hiddink, and J. Blom, "Nutrition guidance by family doctors in a changing world: problems, opportunities, and future possibilities," *The American Journal of Clinical Nutrition*, vol. 77, no. 4, pp. 1089S–1092S, 2003.

[4] Australian Medical Council, *Assessment and Accreditation of Medical Schools: Standards and Procedures, 2009*, Australian Medical Council (ACT), Canberra, Australia, 2009.

[5] F. C. Leslie and S. Thomas, "Competent to care. Are all doctors competent in nutrition?" *The Proceedings of the Nutrition Society*, vol. 68, no. 3, pp. 296–299, 2009.

[6] L. Ball, "Nutrition care in general practice: are we waiting for patients to ask?" *Australian Family Physician*, vol. 40, no. 7, p. 463, 2011.

[7] A. O. Booth and C. A. Nowson, "Patient recall of receiving lifestyle advice for overweight and hypertension from their General Practitioner," *BMC Family Practice*, vol. 11, article 8, 2010.

[8] M. Mowe, I. Bosaeus, H. H. Rasmussen et al., "Insufficient nutritional knowledge among health care workers?" *Clinical Nutrition*, vol. 27, no. 2, pp. 196–202, 2008.

[9] C. Nowson, M. Roshier-Taks, and B. Crotty, "Nutrition competencies for the prevention and treatment of disease in Australian

medical courses," *Medical Journal of Australia*, vol. 197, no. 3, p. 147, 2012.

[10] GPRA, *About General Practice Registrars Australia (GPRA)*, 2014, http://gpra.org.au/about-us/.

[11] NHMRC, *Australian Dietary Guidelines: Providing the Scientific Evidence for Healthier Australian Diets*, National Health and Medical Research Council, Canberra, Australia, 2013.

[12] T. B. Walker and M. J. Parker, "Lessons from the war on dietary fat," *Journal of the American College of Nutrition*, vol. 33, no. 4, pp. 347–351, 2014.

[13] L. Nicholas, D. Pond, and D. C. K. Roberts, "The effectiveness of nutrition counselling by Australian General Practitioners," *European Journal of Clinical Nutrition*, vol. 59, supplement 1, pp. S140–S146, 2005.

[14] G. K. Mitchell, J. J. Tieman, and T. M. Shelby-James, "Multidisciplinary care planning and teamwork in primary care," *The Medical Journal of Australia*, vol. 188, no. 8, supplement, pp. S61–S64, 2008.

[15] Department of Health and Ageing, *Primary Health Care Reform in Australia: Report to Support Australia's First National Primary Health Care Strategy*, edited by: Department of Health and Ageing, Australian Government, Canberra, Australia, 2009.

[16] K. M. Adams, M. Kohlmeier, and S. H. Zeisel, "Nutrition education in U.S. medical schools: Latest update of a national survey," *Academic Medicine*, vol. 85, no. 9, pp. 1537–1542, 2010.

[17] M. Chung, V. J. van Buul, E. Wilms, N. Nellessen, and F. J. P. H. Brouns, "Nutrition education in European medical schools: results of an international survey," *European Journal of Clinical Nutrition*, vol. 68, pp. 844–846, 2014.

[18] H. J. S. Maiburg, G. J. Hiddink, M. A. Van't Hof, J. J. Rethans, and J. W. Van Ree, "The NECTAR-Study: development of nutrition modules for general practice vocational training; determinants of nutrition guidance practices of GP-trainees," *European Journal of Clinical Nutrition*, vol. 53, no. 2, pp. S83–S88, 1999.

[19] General Medical Council, *Tomorrow's Doctors: Outcomes and Standards for Undergraduate Medical Education*, General Medical Council, London, UK, 2009.

[20] J. Crowley, L. Ball, D. Y. Han, B. Arroll, M. Leveritt, and C. Wall, "New Zealand medical students have positive attitudes and moderate confidence in providing nutrition care: a cross-sectional survey," *Journal of Biomedical Education*. In press.

[21] R. F. Kushner, "Barriers to providing nutrition counseling by physicians: a survey of primary care practitioners," *Preventive Medicine*, vol. 24, no. 6, pp. 546–552, 1995.

[22] L. E. Ball, B. Desbrow, M. Yelland, and M. D. Leveritt, "Direct observation of the nutrition care practices of australian general practitioners," *Journal of Primary Health Care*, vol. 6, no. 2, pp. 143–147, 2014.

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Research Article

Student Perceptions of Nutrition Education at Marshall University Joan C. Edwards School of Medicine: A Resource Challenged Institution

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Nutrition education is an essential component of medical education if new physicians are to be equipped to address common chronic diseases, including obesity and the associated diabetes, cardiovascular disease, and cancer. Most medical students recognize this need and desire nutrition education; however, finding time in a medical school curriculum and funding are challenging. Available, free online resources and small group exercises can be utilized to provide basic, up-to-date nutrition information to medical students.

1. Introduction

Many of the health care challenges in the United States could be modified by nutrition changes [1]. Poor nutrition and lifestyle choices leading to obesity are a component of risk for many diseases including diabetes, some cancers, osteoporosis, and cardiovascular disease [1]. Improving nutrition and lifestyle choices could lower the morbidity and costs associated with disease.

West Virginia is an example of a state with multiple health care challenges that might be modified by nutrition change. West Virginia is one of only two states in the US with an adult obesity rate of greater than 35% [2]. Additionally, the state records high rates of diabetes and heart disease. In 2012, West Virginia had an age adjusted rate of diabetes of 11.1/100 compared to 9.0/100 in the US [3]. Also, diabetes-associated end stage renal disease was 185/100,000 compared to 164/100,000 in the US in 2011 [3]. West Virginia was 7th in the US for mortality from heart disease at 208.1/100,000 compared to 170.5/100,000 in the US overall [4]. Some of the risk for the statistically high instance of obesity, diabetes, and heart disease in West Virginia could be reduced by preventive care associated with improving the nutritional status of the population.

West Virginia has a high rate of poverty (17.9% of persons live in poverty compared to 15.4% in the US as a whole [5]) and almost 54% of the population lives in rural areas [6]. The additional stress of poverty and the rural character of the state make preventive care both difficult (people tend to not go to the doctor until feeling sick) and critical to the health of West Virginians. Improving the nutritional status could be an effective way to lower the rates of obesity, heart disease, and diabetes in the state and to decrease the resulting medical care costs [7].

Marshall University Joan C. Edwards School of Medicine (JCESOM) is one of 3 medical schools in West Virginia. The mission statement declares that JCESOM seeks to "create a center of excellence in primary care in rural underserved

areas" to serve the needs of West Virginians. JCESOM admits approximately 75 students to medical school each year; on average 60% of these students are residents of West Virginia. The 2010–2014 graduation questionnaires showed that almost 30% of the 2010–2014 graduating classes stated a desire to remain in the state to deliver healthcare to the people of West Virginia.

Family physicians are a logical source for nutritional information and most (72% or more) [8] physicians feel that it is their responsibility to provide nutritional information as they treat their patients with chronic diseases. However, there are barriers to providing nutritional education. These include the limited time of office visits, the lack of reimbursement for nutritional counseling [9], and perceived noninterest or noncompliance of the patient [10]. One survey reported that only about 10% of physicians provided dietary advice to 80% or more of their patients [10]. Another study reported that when knowledgeable physicians counseled their patients about dietary change, there were significant weight losses and reductions of body mass index [11] to reduce the patients' risk for cardiovascular disease. However, many physicians feel inadequate to discuss obesity and related health problems with their patients [12]. Thus, if students are being trained to serve the health care needs of rural populations, then it is important that physicians receive the nutrition training to be able to deliver nutrition education to patients for prevention of prevalent chronic diseases.

In 1998, the NIH funded the first 10 Nutrition Academic Awards (NAA) with the goal of developing and enhancing nutrition curricula for medical students, residents, and practicing physicians [13]. Eleven additional institutions received NAA funding in 2000, with all funding concluded in 2005 [14]. The NAA was successful in the NAA funded schools as all of these schools integrated nutrition education into the curriculum; local and national websites were developed and about 50% of medical students had the perception that nutrition education was adequate [14]. However, in 2004, in the non-NAA institutions, less than 30% of students felt that their nutrition education was adequate [14].

To address the need for nutrition education, the NIH funded Nutrition in Medicine (NIM) Project was developed to provide access to up-to-date nutrition education for medical students [15]. The materials were initially developed as CD ROMs that were distributed free to medical schools. It was found that faculty commitment and training were needed for these modules to be successfully used as a resource [15]. In a further evolution, the modules were adapted to a free website, accessible to all registered medical students [16]. The case based educational modules are complete and do not require specialized faculty members for nutrition education of students, eliminating many of the cost associated barriers to nutrition education.

At JCESOM, we use a combination of nutrition specific lectures and learning exercises, nutrition information integrated into organ system education, and the NIM modules to provide nutrition information in a cost-effective manner. The aim of this research was to identify the nutrition education sessions and the nutrition related competencies that were addressed during medical school and to report the students' perceptions of the adequacy of nutrition education during their medical school career.

2. Methods

The JCESOM curriculum map (which describes the content of all education sessions) was queried and relevant faculty members were interviewed, as needed, to identify nutrition related sessions during medical school years 1 through 4. Additionally, the syllabi of the required basic science and clinical educational activities were reviewed for pertinent nutrition content and the course directors were interviewed to confirm content identified in the syllabi.

The JCESOM Core Competencies were reviewed to identify nutrition related competencies and the expected progression of knowledge during medical school.

A nutrition education survey was designed to identify nutrition attitudes, perceived adequacy of education, and basic nutrition knowledge of current JCESOM medical students. This survey used many of the questions in the survey developed by Walsh et al. [17]; permission from the authors was obtained. The Nutrition Survey was available on SurveyMonkey from 1 December to 18 December, 2014. Requests to participate in the Nutrition Survey were sent by email to all year 1 to year 4 medical students, about 300 in total. Respondents were able to rate their agreement with both positive and negative statements related to their nutrition education on a 5-point Likert scale (strongly disagree, disagree, neutral, agree, and strongly agree).

This study was reviewed and approved as an exempt study by the Marshall University Institutional Review Board. No personal identifying data were collected.

3. Results

3.1. Nutrition Education Sessions during Medical School. Table 1 summarizes the nutrition education sessions, the total hours in each academic year specifically associated with nutrition education, the pedagogy used, and the assessment method of each session.

3.2. Nutrition Related Competencies. Table 2 lists the nutrition related competencies expected of medical students and the increasingly proficient outcomes expected of students at the end of each year of their education.

3.3. The Nutrition Education Survey. A total of 69 students (about 23% of the student population) responded to the survey. Of the respondents, 32.1% were year 1, 22.6% were year 2, 13.2% were year 3, and 32.1% were year 4 medical students. Of students who responded, 18 students (26%) did not respond to the questions related to nutrition knowledge; all 69 students answered the nutrition attitude questions. 53% of the respondents were male while 47% were female.

3.4. Student Perceptions about Nutritional Education (from Survey). The complete results of the attitude questions are

Table 1: Summary of nutrition learning activities during medical school years 1–4 at Marshall University Joan C. Edwards School of Medicine.

Year level	Number of hours	Topic	Pedigogy[1]	Assessment
1	1	Introduction to nutrition	Lecture	Written test
1	1	Vitamins and minerals	Lecture	Written test
1	1	Cancer nutrition	Lecture	Written test
1	1 in class, 2 outside class	Modification of disease by diet[2]	Small group exercise	Presentation to class
1	2 outside class	NIM module: cardiovascular disease: lipoproteins	Independent learning	In-module test
1	1	Clinical correlate: lipids and cardiovascular disease	Lecture	
1	2 outside class	NIM module: diabetes: nutritional mechanisms	Independent learning	In-module test
1	1	Clinical correlate: diabetic ketoacidosis	Lecture	
1	2 outside class	NIM module: nutrition in pregnancy or nutrition and aging: mind and body	Independent learning	In-module test
1	2 outside class	NIM module: module of choice	Independent learning	In-module test
1	2 in class	Clinical correlation: nutrition and obesity	Lecture	
1	2 in class	Obesity as a risk factor for disease[3]	Small group exercise and role play	Presentation to class
1	1	Endocrine histology	Lecture	Written test
1	1	Clinical correlate: lipids and cardiovascular disease	Lecture	
1	1	Diabetes and metabolic syndrome: new information on dietary management	Large group discussion	Participation in discussion
Total year 1	**23**			
2	4	Anemia	Small group	Written test
2	2	Nutritional disorders	Independent learning	In-module test
2	1	Congenital malformation of the nervous system	Case based instruction	Written test
2	1.5	Breast diseases	Lecture	Written test
2	1	Diabetes in adults	Lecture	Written test
Total year 2	**9.5**			
3 or 4	1	Hyperlipidemia (dietary management)	Lecture	Written test
3 or 4	1	Newborn lactation and nutrition	Lecture	Written test
3 or 4	1	Breastfeeding	Lecture	Written test
3 or 4	1	Anticipatory guidance	Lecture	Written test
3 or 4	1	Eating disorders	Lecture	Written test
3 or 4	1	Enteral and parenteral nutrition	Lecture	Written test
Total year 3 or 4	**Up to 6** depending on rotations selected			

[1]Pedagogy used, as defined by Medbiquitous [18].
Case based learning: the use of patient cases (actual or theoretical) to stimulate discussion, questioning, problem solving, and reasoning on issues pertaining to the basic sciences and clinical disciplines.
Independent learning: instructor- or mentor-guided learning activities to be performed by the learner outside of formal educational settings (classroom, lab, and clinic) with dedicated time on learner schedules to prepare for specific learning activities.
Large group: an exchange (oral or written) of opinions, observations, or ideas among a large group [more than 12 participants], usually to analyze, clarify, or reach conclusions about issues, questions, or problems.
Lecture: an instruction or verbal discourse by a speaker before a large group of learners.
Role play: the adopting of or performing the role or activities of another individual.
Small group: an exchange (oral or written) of opinions, observations, or ideas among a small group [12 or fewer participants], usually to analyze, clarify, or reach conclusions about issues, questions, or problems.
[2]Session description: each group must find out the molecular basis of the disease and of the interventions and then design a suitable, affordable diet and identify additional resources accessible to the rural West Virginia patient. Results are presented to the whole class.
[3]Session description: each group must identify molecular contributions of obesity to one of 10 diseases and then role-play a physician office counseling session for the whole class.

Table 2: Medical knowledge nutrition related competencies and progression during years 1–4 of medical school[1].

Competency	Outcome year 1	Outcome year 2	Outcome year 3	Outcome year 4
Explain various causes (genetic, developmental, metabolic, toxic, microbiologic, autoimmune, neoplastic, degenerative, behavioral, and traumatic) of major diseases and conditions and the ways in which they operate on the body (pathogenesis).	Recognize variations of normal development and function of organs and systems due to various causes.	Describe the various causes of disease and how these are manifest in organ system dysfunction.	Explain the pathophysiologic factors underlying the clinical manifestations of common disease	Discuss the pathogenesis of major conditions related to area(s) of specialty/disciplinary interest.
Identify the proximate and ultimate factors that contribute to the development of disease and illness and that contribute to health status within and across populations regionally, nationally, and globally.	Recognize the genetic basis of disease and complex interaction with social conditions and life experiences. Discuss the effects of socioeconomic status, diet, exercise, gender, and age on health and disease.	Describe the determinants of health and disease and provide specific examples of how these determinants influence health outcomes in common/major diseases. Discuss social conditions and behaviors that predispose patients to disease and decreased function (e.g., alcohol addiction and obesity). List major contributors to health and disease in populations including mechanisms of action.	Describe the determinants of disease and health for major clinical situations prevalent in WV (including regional variation), nationally and globally Recognize the influence of common health determinates and illness on patients. Integrate knowledge of social conditions and behaviors that predispose patients to disease and decreased function into the managements plan for individual patients.	Implement interventions to reduce the impact of disease determinants (or improve the likelihood of health improvements) within patient care.
Recognize the medical consequences of common societal problems.	Describe the impact on health of life experiences, poverty, education, race, gender, culture, crime, and the health care system.	Recognize the contribution of social conditions and problems to the health and disease outcomes of patients.	Create discharge/management plans that address the impact of social conditions and problems on patients.	Describe strategies to ameliorate the impact of social conditions and problems on the health and disease outcomes of patients.

[1] From http://jcesom.marshall.edu/media/41654/CoreCompetencies_MK.pdf.

shown in Table 3. Some specific results will be highlighted below.

3.4.1. Attitudes about Presentation of Nutrition Advice to Patient. Questions 1 to 5 show that most (70 to 80%) of students thought that preventive health and nutrition education was an important part of the physicians job and worth the time and effort.

3.4.2. Perceived Competence to Advise Patients. More than half of students did not think they were competent to advise patients about nutrition (question 6). This belief is also reflected in question 9, in that 80% were neutral or thought that physicians were not adequately trained to advise patients in nutritional choices and in the overall score of 65% on the nutrition knowledge questions.

3.4.3. Perceived Influence of Nutrition Attitudes of Patient. Questions 7, 8, and 10–15 address the importance of both physician and patient attitudes toward making nutrition changes. Most students thought that physicians could have a positive influence on adapting healthy lifestyles in their patient.

3.4.4. Adequacy of Nutrition Education (Quantity and Quality). In questions 16 and 17, almost 50% of students indicated dissatisfaction with both the quality and quantity of their nutrition education. JCESOM uses an organ system organization of the curriculum which could make it difficult to recognize nutrition specific material. Students suggested that more nutrition information be integrated into organ system based instruction as well as separate, specific nutrition classes (questions 18 and 19). The amount of online material seems adequate (question 20) but students would have liked

Table 3: Results of the Nutrition Survey.

	Strongly disagree % count	Disagree % count	Neutral % count	Agree % count	Strongly agree % count	Total count	Weighted average
(1) Preventive health care is boring.	43.48% 30	40.58% 28	8.70% 6	2.90% 2	4.35% 3	69	1.84
(2) Nutrition counseling should be part of routine care by all physicians, regardless of specialty.	1.45% 1	8.70% 6	14.49% 10	33.33% 23	42.03% 29	69	4.06
(3) Nutrition counseling is not an effective use of my professional time.	40.58% 28	36.23% 25	15.94% 11	2.90% 2	4.35% 3	69	1.94
(4) I have an obligation to improve the health of my patients including discussing nutrition with them.	2.94% 2	0.00% 0	7.35% 5	42.65% 29	47.06% 32	68	4.31
(5) All physicians, regardless of specialty, should counsel high-risk patients about dietary change.	1.45% 1	7.25% 5	14.49% 10	28.99% 20	47.83% 33	69	4.14
(6) I am confident of my ability to counsel patients about nutrition.	4.35% 3	24.64% 17	30.43% 21	31.88% 22	8.70% 6	69	3.16
(7) Patient motivation is essential to achieving dietary change.	0.00% 0	0.00% 0	4.35% 3	28.99% 20	66.67% 46	69	4.62
(8) A change toward a healthier lifestyle is important at any stage of life.	0.00% 0	1.45% 1	1.45% 1	28.99% 20	68.12% 47	69	4.64
(9) Most physicians are not adequately trained to discuss nutrition with patients.	1.45% 1	13.9% 9	30.43% 21	34.78% 24	20.29% 14	69	3.59
(10) Specific advice about how to make dietary changes could help some patients improve their eating habits.	0.00% 0	1.45% 1	8.70% 6	40.58% 28	49.28% 34	69	4.38
(11) Patients need ongoing counseling following my initial instruction to maintain behavior changes consistent with a healthier diet.	0.00% 0	1.47% 1	13.24% 9	47.06% 32	38.24% 26	68	4.22
(12) Physicians can have an effect on a patient's dietary behavior if they take the time to discuss the problem.	2.90% 2	2.90% 2	13.04% 9	47.83% 33	33.33% 23	69	4.06
(13) For most patients, health education does little to promote adherence to a healthy lifestyle.	7.25% 5	43.48% 30	31.88 22	11.59% 8	5.8% 4	69	2.65
(14) After receiving nutrition counseling, patients with poor eating habits will make major changes in their eating behavior.	10.14% 7	31.88% 22	52.17% 36	4.35% 3	1.45% 1	69	2.55
(15) My patient education efforts will be effective in increasing patients' compliance with nutritional recommendations.	1.47% 1	14.71% 10	39.71% 27	36.76% 25	7.35% 5	68	3.34
(16) I am satisfied with the quantity of my nutrition education.	11.59% 8	37.68% 26	24.64% 17	20.29% 14	5.8% 4	69	2.71
(17) I am satisfied with the quality of my nutrition education.	11.76% 8	36.76% 25	22.06% 15	22.06% 15	7.35% 5	68	2.76
(18) My medical school nutrition curriculum should have had more time specifically dedicated to the topic of nutrition (independent of organ system based studies).	5.80% 4	18.84% 13	15.94% 11	43.48% 30	15.94% 11	69	3.45
(19) My medical school nutrition curriculum should have had more nutrition content formally integrated into the organ system based courses.	1.45% 1	15.94% 11	18.84% 13	44.93% 31	18.84% 13	69	3.64
(20) My medical school nutrition curriculum should have included more online materials available for independent study.	18.84% 13	33.33% 23	28.99% 20	14.49% 10	4.35% 3	69	2.52
(21) My medical school nutrition curriculum should have included more material relevant to my personal health and well-being.	0.00% 0	20.29% 14	24.64% 17	40.58% 28	14.49% 10	69	3.49

Table 3: Continued.

	Strongly disagree % count	Disagree % count	Neutral % count	Agree % count	Strongly agree % count	Total count	Weighted average
(22) My medical school nutrition curriculum should have been more scientifically rigorous.	8.70% 6	33.33% 23	24.64% 17	26.09% 18	7.25% 5	69	2.90
(23) My medical school curriculum had too many hours of nutrition specific education.	20.29% 14	53.62% 37	23.19% 16	1.45% 1	1.45% 1	69	2.10
(24) My medical school curriculum did not have enough nutrition specific education.	1.45% 1	18.84% 13	23.19% 16	44.93% 31	11.59% 8	69	3.46
(25) My medical school curriculum had little or no nutrition education after the first year.	7.25% 5	7.25% 5	40.58% 28	24.64% 17	20.29% 14	69	3.43

more personally relevant material (question 21). Individual analyses of question 25 (nutrition education after the first year) show that 14 of 28 students who responded with a neutral answer were first year students and would not have had knowledge of curriculum in later years.

3.4.5. Nutrition Knowledge. Ten general questions were used to assess basic nutrition knowledge. There was an overall score of 65.6% among the 51 students who attempted the knowledge questions. It seems likely that the 18 students who skipped the knowledge questions did not think they knew the answers. Had they attempted the questions it is likely that the overall average would have further decreased.

3.4.6. Specific Suggestions for Improving Nutrition Education. There were only 5 different suggestions for improving nutrition education. These were (1) clinically relevant nutrition education for weight management and disease process modification which would be beneficial; (2) addressing cultural issues in nutrition. For example, a module comparing "diet fads" and popular trends about which our patients might ask (Atkins, disease specific diets, avoidance of certain food groups in autoimmune conditions, etc.) would be useful information; (3) During our first year we had the program director from Marshall nutrition talk to us. Additional lectures from a dietician with diet information relevant to organ systems would be appreciated; (4) not only nutrition, but advice on exercise regimens. Both are key to a healthy lifestyle. The nutrition education we received as MS1 was all biochemically based. If you want to be proficient for your patients, then you had to independently explore this topic and assess the current literature (which, by the way, is drastically different than what most physicians preach to patients); (5) more accurate and up-to-date information in the lecture material; material should address recent studies about nutrition.

4. Discussion

Many of the health challenges for the US could be modified by changing the diet and exercise practices of the population [7]. Since physicians can be instrumental in changing diet behaviors [11, 19], nutritional information is an important component of medical student training [20, 21]. The resources of JCESOM, as of many medical schools, are, however, limited. Marshall University does have a Dietetics Department within the College of Health Professions. This program offers both Bachelor's and Master's degrees in Dietetics. Still, this school is not part of the medical school; thus access to these nutrition experts for our medical students is limited. As a courtesy, the Chair of the Dietetics Department does present an obesity lecture to our first year medical students. The remainder of the nutrition related material during the first block of the first year is presented by Biochemistry Faculty. As can be seen in Table 1, most of the focused nutrition information is taught during the first year of medical school.

Table 1 also highlights the variety of pedagogy used to present nutrition content. The varied pedagogy is intentional and is meant to enhance learning. Results of other researches indicate that a mix of pedagogical styles better meets the needs of various learning styles of students [22]. Typically, lectures are used to introduce material and provide background for clinical relevance. The use of the Nutrition in Medicine materials enables us to present high quality, up-to-date nutrition education without the presence of nutrition experts on School of Medicine faculty [23]. The Nutrition in Medicine web-based materials also contribute to the development of "life-long learning" skills. By assigning modules especially applicable to specific health topics (diabetes, cardiovascular disease, nutrition in pregnancy, or aging) and allowing selection of a module of interest, all students get both basic and individually tailored nutrition education. Students learn better if they are motivated, actively engaged, and personally invested. The use of independent learning pedagogy is based on three core elements: presenting the information in small bites, making learning self-paced by the learner, and providing immediate feedback to the learner using the built in self-assessment. The independent learning method of teaching, reinforced with immediate question/answer feedback, helps build a knowledge base and critical thinking skills [21].

Clinical correlate lectures by physicians allow students to ask questions, obtain response from clinicians, and provide reinforcement of the NIM material. The use of small group and role playing exercises enhances learning using peer teaching, a technique beneficial to both "teacher" and "learner" [24].

Almost 50% of students were dissatisfied with both the quantity and quality of their nutrition education during medical school. While somewhat alarming, this also means that 50% of the students were neutral or thought that the quantity and quality of their nutrition education were adequate, a fraction similar to that after completion of the NAA in schools that received that award and much better than the 30% of satisfied students in schools that did not receive the award [13].

Our students largely agreed with previous studies of practicing physicians in that they felt that a physician could influence a patient's nutrition choices [11] but that they felt inadequate to present nutrition and obesity information to patients [8, 12]. The students also desired more nutrition information during their undergraduate education. As faculty members and curriculum planners, the challenge remains of finding the time to include nutrition education in an already packed medical school curriculum and to help the students recognize the nutrition education that they receive.

5. Conclusions

Limitations of this study are that the conclusions of this study are limited by the restriction to one medical school with a smaller population than many medical schools, the rural environment, and by the limited response of the students. However this study does demonstrate that the nutrition education can occur without incurring large additional costs though time for the sessions must be found within the curriculum.

Medical students realized the need for nutrition education in their medical school curriculum and the need for physicians to provide this information to their patients. Using online resources and small group exercises, basic nutrition education can be addressed by faculty members who are not nutrition experts. Most medical students desire additional nutrition education; however a challenge remains for finding the time to include this information in the medical school curriculum.

Conflict of Interests

The authors declare that there is no conflict of interests for publication of this paper.

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References

[1] D. P. Guh, W. Zhang, N. Bansback, Z. Amarsi, C. L. Birmingham, and A. H. Anis, "The incidence of co-morbidities related to obesity and overweight: a systematic review and meta-analysis," *BMC Public Health*, vol. 9, article 88, 2009.

[2] Center for Disease Prevention and Control, *Obesity and Overweight*, Center for Disease Prevention and Control, 2014, http://www.cdc.gov/obesity/data/prevalence-maps.html.

[3] Center for Disease Prevention and Control, Diabetes, 2014, http://gis.cdc.gov/grasp/diabetes/DiabetesAtlas.html.

[4] Center for Disease Prevention and Control, *Heart Disease*, Center for Disease Prevention and Control, 2012, http://www.cdc.gov/nchs/pressroom/states/HEART_DISEASE_STATE_2012.pdf.

[5] United States Census Bureau, *Quickfacts from US Census Bureau*, United States Census Bureau, 2014, http://quickfacts.census.gov/qfd/states/54000.html.

[6] Urban and Rural Population by State, 2012, http://www.census.gov/compendia/statab/2012/tables/12s0029.xls.

[7] J. Cawley, C. Meyerhoefer, A. Biener, M. Hammer, and N. Wintfeld, "Savings in medical expenditures associated with reductions in body mass index among us adults with obesity, by diabetes status," *PharmacoEconomics*, 2014.

[8] C. B. Eaton, P. E. McBride, K. A. Gans, and G. L. Underbakke, "Teaching nutrition skills to primary care practitioners," *The Journal of Nutrition*, vol. 133, no. 2, pp. 563S–566S, 2003.

[9] R. F. Kushner, "Barriers to providing nutrition counseling by physicians: a survey of primary care practitioners," *Preventive Medicine*, vol. 24, no. 6, pp. 546–552, 1995.

[10] T. E. Kottke, J. K. Foels, C. Hill, T. Choi, and D. A. Fenderson, "Nutrition counseling in private practice: attitudes and activities of family physicians," *Preventive Medicine*, vol. 13, no. 2, pp. 219–225, 1984.

[11] R. Ward, "Talking with your patients about dietary cholesterol, diet and nutrition: best practices for family physicians," *International Journal of Clinical Practice*, supplement 163, pp. 22–27, 2009.

[12] M. Jay, C. Gillespie, T. Ark et al., "Do internists, pediatricians, and psychiatrists feel competent in obesity care?: using a needs assessment to drive curriculum design," *Journal of General Internal Medicine*, vol. 23, no. 7, pp. 1066–1070, 2008.

[13] T. A. Pearson, E. J. Stone, S. M. Grundy, P. E. McBride, L. Van Horn, and B. W. Tobin, "Translation of nutritional sciences into medical education: the Nutrition Academic Award Program," *American Journal of Clinical Nutrition*, vol. 74, no. 2, pp. 164–170, 2001.

[14] L. van Horn, "The nutrition academic award: brief history, overview, and legacy," *The American Journal of Clinical Nutrition*, vol. 83, no. 4, 2006.

[15] K. Cooksey, M. Kohlmeier, C. Plaisted, K. Adams, and S. H. Zeisel, "Getting nutrition education into medical schools: a computer-based approach," *The American Journal of Clinical Nutrition*, vol. 72, pp. 868S–876S, 2000.

[16] K. C. Lindell, K. M. Adams, M. Kohlmeier, and S. H. Zeisel, "The evolution of Nutrition in Medicine, a computer-assisted nutrition curriculum," *The American Journal of Clinical Nutrition*, vol. 83, pp. 956S–962S, 2006.

[17] C. O. Walsh, S. I. Ziniel, H. K. Delichatsios, and D. S. Ludwig, "Nutrition attitudes and knowledge in medical students after completion of an integrated nutrition curriculum compared to a dedicated nutrition curriculum: a quasi-experimental study," *BMC Medical Education*, vol. 11, article 58, 2011.

[18] MedBiquitous Curriculum Inventory Working Group Standardized Vocabulary Subcommittee, "Curriculum inventory standardized instructional and assessment methods and resource types," Tech. Rep., Association of American Medical Colleges, Washington, DC, USA, 2012.

[19] R. A. DiMaria-Ghalili, J. M. Mirtallo, B. W. Tobin, L. Hark, L. van Horn, and C. A. Palmer, "Challenges and opportunities for

nutrition education and training in the health care professions: Intraprofessional and interprofessional call to action," *The American Journal of Clinical Nutrition*, vol. 99, no. 5, 2014.

[20] L. Ball, J. Crowley, C. Laur, M. Rajput-Ray, S. Gillam, and S. Ray, "Nutrition in medical education: reflections from an initiative at the University of Cambridge," *Journal of Multidisciplinary Healthcare*, vol. 7, pp. 209–215, 2014.

[21] K. Cooksey, M. Kohlmeier, C. Plaisted, K. Adams, and S. H. Zeisel, "Getting nutrition education into medical schools: a computer-based approach," *The American Journal of Clinical Nutrition*, vol. 72, no. 3, pp. 868S–876S, 2000.

[22] J. R. van Doorn and J. D. van Doorn, "The quest for knowledge transfer efficacy: blended teaching, online and in-class, with consideration of learning typologies for non-traditional and traditional students," *Frontiers in Psychology*, vol. 5, article 324, 2014.

[23] K. M. Adams, M. Kohlmeier, M. Powell, and S. H. Zeisel, "Nutrition in medicine: nutrition education for medical students and residents," *Nutrition in Clinical Practice*, vol. 25, no. 5, pp. 471–480, 2010.

[24] K. L. Bene and G. Bergus, "When learners become teachers: a review of peer teaching in medical student education," *Family Medicine*, vol. 46, pp. 783–787, 2014.

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Research Article

Nutri One-on-One: The Assessment and Evaluation of a Brief One-on-One Nutritional Coaching in Patients Affected by Metabolic Syndrome

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Nutri One-on-One was a program with the aim to positively modify medical clinic patients' nutritional habits and lifestyles through a brief one-on-one health coaching session. Each session was conducted by utilizing motivational interviewing techniques to allow for tailored nutrition education and goal setting. These sessions were followed by a phone call to participants at 1 month following the session. The outcomes assessed were participant perception of achieving personal nutrition and lifestyle goals, retention of knowledge, and participants' satisfaction with the program. Physicians working in the clinic were assessed for satisfaction with the program. Most of the physicians were generally satisfied with the program and found it to be an asset to their practice. Participants perceived that they achieved their goals, were pleased with the program, and retained knowledge.

1. Introduction

Obesity is a major health problem across the world, currently affecting two-thirds of U.S. adults [1]. The continual rise in obesity indicates a need for radical change. Currently, there are a variety of factors contributing to the issues of obesity; however, lack of knowledge about nutrition, poor portion control, lack of self-efficacy, and lack of access to nutrition education seem to be the main contributors especially among the low income populations [2]. Therefore, interventions are needed in low socioeconomic, underserved communities.

Evidence shows that providing lifestyle change education and dietary modifications have a notable effect on health outcomes and specifically obesity rates [3]. Primary health-care settings are ideal locations for addressing the issues of obesity and its comorbidities [4]. Primary care physicians are well situated for effective lifestyle counseling and nutritional education provision. However, a U.S. national survey reveals that "there is a continuing failure to incorporate weight management into clinical medicine practice, especially that of primary care" [4].

Interventions need to be tailored specifically to the individual and nutritional counseling needs to be directed in a way that each participant can adequately address his or her habits, nutritional knowledge, perceived obstacles, self-efficacy, confidence, motivation, and physical concerns in order to be successful [2]. The quality of education and counseling is more important than the quantity or length of the intervention. In fact, evidence shows that even brief meetings with physicians or healthcare professionals show promising lifestyle change effects and "even interventions as short as three minutes can significantly increase change" [3]. However, when addressing duration of interventions it is important that the counseling session is long enough to address client needs, barriers, knowledge deficits, and individual goals [5].

Coach-led one-on-one interventions demonstrate statistically significant effectiveness. This is exemplified by the Ma et al. study where 7% of the initial target weight loss goal was achieved by 37% of the one-on-one coach-led intervention participants compared to only 14.4% of the self-led

participants [4]. In addition, many studies from USA, Netherlands, Republic of Korea, UK, Germany, and Australia evaluate the continual promising effects of one-on-one intervention on health behavior and the effective elements of brief intervention overall [2–10].

Effective goal setting uses the "SMART framework: mutually establishing behavioral goals that are specific, measurable, achievable, rewarding, and timely" within a one-on-one setting [11]. It is important that the goals determined by the individual are achievable. It is the responsibility of the health coach or healthcare professional to make sure that each goal is connected to outcomes and a reasonable time frame for achievement is established.

Motivational interviewing is a behavior change approach that has been used to promote weight loss and embraces the 5As model. This model is comprised of "five key components: ask, assess, advise, agree, and assist. The model implements a process of counseling that is rooted in the theories of behavior change such as self-management support, readiness assessment, behavior modifications, and self-efficacy enhancement. Motivational interviewing is an evidence-based interviewing method that utilizes patient-driven behavior change to sustain ideal outcomes [11]." The motivational interviewing technique has shown to result in a 1.6 kg greater weight loss within the first three months of counseling, than in participants who do not receive the motivational interviewing [1]. Therefore, motivational interviewing is an effective method to implement during obesity and nutrition counseling.

Perkins-Porras et al. suggest that behavioral counseling will have different effects or outcomes depending on the baseline stage of readiness in the individual [2]. In order to provide tailored and effective intervention methods specific to the individual, the baseline stage must be determined. The stage of readiness of a person to change dictates which behavior change strategies to use. Motivational interviewing works particularly well for those who are least ready to change.

Glanz et al. state the following: "a comprehensive nutrition intervention in the community requires a multistep approach, including changing social norms and organizational and environmental factors." Therefore, visible and quantifiable change can be expected to come with time [12]. This study of medical clinic patients focused on the effects of one-on-one counseling with a follow-up on achieving their health goals, nutritional knowledge, and overall medical clinic visit satisfaction.

2. Methods and Materials

The Nutri One-on-One nutrition education sessions were conducted at four of the Philadelphia College of Osteopathic Medicine (PCOM) healthcare centers, which primarily provide services to the medically underserved populations. The attending physicians at these healthcare centers volunteered to identify and recruit their patients with metabolic syndrome for this study and to fill out a survey at the end of the study. The overall study subjects included adults over the age of eighteen years in healthy mental capacity and exhibiting one of the five major complications of metabolic syndrome. Subjects were informed of the goals and purpose for the Nutri One-on-One study, asked to give verbal consent to participate, and given the opportunity to withdrawal from the study at any time. This project was approved by the Institutional Review Board of PCOM with ethical considerations.

Table 1: Readiness scores.

	Score given
Not Ready	1
Moderately Ready	2
Ready	3
Currently Making Change	4
Actively Making Change and Pursuing New Change	5

During nutrition education sessions the health coach gave a brief introduction, explaining the major goals of the study. The subjects were informed of what was expected and of the length of time it would require to complete the session. Participating subjects were also informed of their opportunity to withdraw at any time during the intervention including the one-month follow-up. After the subjects consented, the health coach began to discuss the subject's lifestyle and major health concerns in the one-on-one environment. A personal health and social history was obtained. This information was then used and discussed by both the health coach and the subject to isolate any major health, nutrition, or lifestyle concerns. Then a health form was filled out that included the subject's primary health goal, readiness score, and three health actions. The subjects were encouraged and guided by the health coach to set one primary health goal. This goal was to be relevant to the subject's medical conditions and deemed obtainable by both the subject and the health coach. No specific criteria were set in deeming a health action as "personally obtainable"; however, through discussion with the subject the health coach and subject agreed that the health actions were attainable.

A readiness score value was determined for each subject (Table 1). The stages of change model, which addresses the readiness to change in individuals, was first utilized to treat alcoholism and has recently been applied to dietary behavior. The model consists of "five distinct stages: precontemplation (unaware, not interested in change); contemplation (thinking about change); preparation or decision (making definite plans to change); and action (actively modifying and preventing relapse)" [12]. People vary in their readiness for behavior change in relation to attempting dietary change over time; therefore, methods and steps used to promote healthy changes need to evolve with the individual's progression on the readiness scale.

This score gave a baseline stage of readiness for each participant. The health coach then assessed the health form, subject's health issues, metabolic complications, and primary goal to determine which nutrition education lesson plan to give.

There were ten nutrition education lesson plans available to each subject: Eat Better, Eat the Right Salt, Healthy Portions, Holiday Healthy Eating, Get Active, Lowering

Cholesterol, Stop Smoking, Eat the Right Carbs, Cooking Class, and Lowering Caloric Intake. The nutrition education lesson plan took approximately fifteen to twenty minutes to deliver and tailor to each individual subject. The nutrition education lesson plan the subject chose was used as a basis for collaboratively determining three health actions associated with his or her primary goal. The health coach then guided the subject by ensuring that the health actions were reasonable, would result in observable positive outcomes, and were perceived as obtainable by the subject.

After completion of the goal setting and health action activities the subject was given a take home flyer relevant to the nutrition education lesson plan received. At the conclusion of the session, the subject was asked to complete a Patient Satisfaction Survey. The survey contained five questions addressing the patient's overall satisfaction with the initial session experience. Participating subjects were asked to report a score, one (strongly disagree) to five (strongly agree), reporting their perception of whether they learned something new, received valuable information, could apply what they learned to achieve a goal, thought the session was long enough to encourage change, and considered the session to be an asset to their doctor's visit.

A follow-up telephone call was conducted approximately one month after the initial session, when the health coach discussed the patient's perceived progress towards his or her overall primary goal, questions, concerns, and obstacles encountered by the subject. The purpose of the one-month follow-up telephone call was to provide continued support and accountability for each subject. The health coach asked the subject to assess how well he or she accomplished each of their three health actions. This was a self-reported score given on a scale of 1 (10% completion of the health action goal) to 10 (100% completion of the health action goal) for each action. The health coach then asked the subject if completing his or her health actions and primary goal were still a priority.

Next the health coach instructed the subject to evaluate the value and effectiveness of the Nutri One-on-One Program. The subject gave his or her response to a Likert scale, 1 (not at all valuable) to 5 (extremely valuable). The health coach asked the subject to evaluate his or her overall success in obtaining the three health actions set at the initial session. This self-reported score was also given on a scale, 1 (not at all valuable) to 5 (extremely valuable). The health coach then asked the subject if he or she had taken any other additional actions towards improving his or her health. This yes or no response allowed the health coach to assess how motivated for healthy change the patient was and again answer any questions the subject might have concerning nutrition or further implementation of new goals. At the end of the follow-up the health coach delivered a five-question multiple-choice quiz to the subject. Each of the five questions directly corresponds to one of the five major key messages learned in the nutritional education lesson plan that the subject received during the initial session. The purpose of the educational assessment was to address the key topics learned in the initial session, reinforce the knowledge with the subject, and correct any misconceptions he or she might have. With every question the health coach explained why the answer given by the subject was correct or incorrect, ensuring that the information was thoroughly understood and properly applied to the subject's nutritional habits and knowledge.

Table 2: Educational lesson plans.

Lesson given	Frequency (%)
Eat Better	2 (3%)
Eat the Right Salt	5 (7%)
Healthy Portions	55 (75%)
Holiday Eating	0
Get Active	1 (1%)
Lower Cholesterol	7 (10%)
Stop Smoking	0
Reduce Sugar	0
Cooking Class	3 (3%)
Lower Your Calories	1 (1%)

At the conclusion of the Nutri One-on-One study, the participating PCOM physicians were given two weeks to fill out an anonymous Physician Satisfaction Survey. The survey addressed the perceptions and attitudes the attending physicians had towards the study, their perceived success of the Nutri One-on-One program, the benefit provided to the patients, and the benefit provided to the healthcare center.

In summary, there were four assessment tools used throughout the Nutri One-on-One study. These were as follows: (1) Patient Satisfaction Survey, (2) educational assessment, (3) subject goal setting and readiness assessment, and (4) Physician Satisfaction Survey. A fifth assessment tool, subjects lab values, was omitted before the start of the study due to inability to schedule clinical follow-ups during this study to obtain anthropometric values after the initial meeting.

3. Results

A total of 74 subjects participated in the Nutri One-on-One study, 48 (65%) were female and 26 (35%) male. The age range was 21 to 79 years of age with an average subject age of 52 years and a standard deviation of ±0.13. A majority of the subjects were hypertensive (77%) and/or obese (86%). Diabetes type 2 (53%) was also prevalent among the population, but only 11% of the subjects suffered from heart disease. Of the educational lesson plans a majority (75%) of the subjects chose the "Healthy Portions" lesson plan (Table 2).

Through collecting information for the health form in the personal health and lifestyle history, it was observed that a majority of the participants had good knowledge of healthy foods and how to cook them. Many of the participants (53%) suffered from Diabetes type 2 and were enrolled in diabetic nutritional classes by their health care insurance companies prior to the study. The number of participants previously enrolled in nutritional classes was not collected, nor was their preexisting nutritional knowledge measured; the nutritional coach purely used this information to further individualize the lesson plan.

Table 3: Patient perceived intervention value.

	Frequency (%)
Not Valuable	0
Very Small Value	0
Somewhat Valuable	6 (12%)
Moderately Valuable	14 (27%)
Extremely Valuable	31 (61%)
Total # of Subjects	51 (100%)

A readiness score was assigned to each subject at the intervention. Only 9% of the subject population were not ready to make any nutrition change. The remaining 91% of the subject population were ready to make varying degrees of nutritional change. The average readiness to change score was a 3, ready to make change (on a scale of 1–5).

The Patient Satisfaction Survey assessed patient satisfaction. 86% of subjects reported that the information received was very valuable to their overall health, 80% stated that they could utilize the information received to ensure successful outcomes for their set goals, and 88% of the subject population reported that the intervention was long enough to create a positive behavioral change.

At the follow-up telephone calls, the percentages of the goals met were determined. At 100% all of the subjects' set goals would have been achieved and fulfilled. This is a self-reported and self-rated score given at the one-month follow-up. The participants rated their success for each goal from 0% (none) to 100% (all) and an overall average was obtained from all three health goals. On average, subjects met their three health action goals at 63% ± 5%. One subject achieved his goals only to 17% and another felt that she had achieved her set goals to 97%. The study did not collect objective data on indices to measure their accomplishment of the goals. It solely asked the participant how they perceived their achievement of the goals. A total of 22 subjects were lost after the intervention due to inability to reach them for the follow-up telephone call.

The subjects related how they felt about goal priority at the follow-up call. 98% of participants reported that their health goals were still a priority one month after the intervention. Table 3 shows the participants perceived overall value of the intervention at the one-month follow-up session. 100% of the subject population found the intervention to have some value in facilitating nutrition change.

When asked during the follow-up telephone call if their primary health goal was achieved, 90% of subjects reported some success in achieving their goals and only 10% reported not being successful at all with goal attainment. A nutrition education assessment was also administered at the follow-up telephone call. Each subject was asked five questions corresponding to their specific nutritional education lesson plan. Each of the five questions addressed one of the five major key messages from the lesson, and each question was composed as a multiple-choice question with five possible answer choices. The educational piece assessed the amount of knowledge retained from the lesson plan and provided a percent score that was given for number correct out of 5. The participant population as a whole was able to correctly recall 75% of the five key messages for their specific lesson plan received.

Table 4 shows a five-question Likert scale based Physician Satisfaction Survey which was given at the end of the eight-month long study. All of the physicians ($n = 9$) who participated in the study filled out the Survey. There were 5 physicians who reported that the program had a positive effect on office flow (defined by time allotted for each patient's visit), 3 reported that it had no effect on office flow, and 1 reported the program had a negative effect on office flow. The second question addressed how the attending physicians felt the Nutri One-on-One Program affected the patient's nutrition habits, behavior, and lifestyles. All physicians responded neutrally as they were unable to gain good insight at the time concerning the effects of the program on patients. Eight out of nine (89%) of the physicians felt that the program was an asset to the services offered at the healthcare centers. 89% of the physicians stated that the program was extremely valuable to the patients. Lastly, 89% of the physicians felt the Nutri One-on-One program had benefits for their patients.

4. Discussion

The Nutri One-on-One study focused on knowledge attainment and goal setting to address obesity and its comorbidities [13]. Generally participants were willing to create goals and implement change in their lifestyles to promote positive health lifestyle changes. Toft et al. showed that setting weight loss goals was effective and achievable, which is consistent with the approach of Nutri One-on-One [14, 15].

The benefit that the Nutri One-on-One coaching had on the patients was readily apparent throughout the study. During follow-up, subjects commented on notable changes such as weight loss, more energy, and a motivation to keep focusing on achieving personal health goals. They seemed to understand that if they continued, the results would progress further into a greater quality of life, increased longevity, and decreased health expenses. It is important to note that only subjective data on perceived attainment of health goals were obtained.

The readiness score helped focus the health coach on the appropriate method of action for each participant. Ronda et al. have stated that, by defining a readiness score, the overall efficacy and benefit of the program were increased because the health coach addressed change on a level that the subject was willing to implement [16]. In this program 91% were interested in making varying levels of change; this was most likely due to the fact that they willingly consented to the program. 57% of participants were interested to learn about the "Healthy Portions" lesson plan during the initial session meeting. This was primarily due to the fact that the majority of subjects were eating their meals at home and had taken multiple nutrition classes giving them a good understanding of which foods were healthy, what foods to avoid, and how to cook in a healthy manner.

Table 4: Physician Satisfaction Survey.

Questions	Strongly Disagree, Negative, No Change Not Valuable	Neutral	Strongly Agree, Positively Large Change, Very Valuable
Clinical value in nutritional coaching and goal setting	0	1	8
Effects of nutritional counseling on office flow	1	3	5
Observed a noticeable change in patients habits and behavior	0	9	0
Nutri One-on-One an asset to services offered	1	0	8
Perceived Nutri One-on-One value to patients	0	1	8

The 5As model was utilized during this intervention. The intervention proved to be successful for 63% of the subjects who were motivated by their initial success and results of their health actions so that they personally decided to take additional health actions. Also, 80% of the participants planned to take additional actions in the future. This was anticipated as Vallis et al. state small success leads to further nutritional motivation in nutritional interventions [11].

Allowing the subjects to set their own health goals in the Nutri One-on-One study ensured that the participant was interested in achieving the goal and taking beneficial actions. The study by Sacerdote et al. established that individual goal setting is effective [8]. During the goal setting, it was important for the health coach to only intervene when the health goal or health actions were unobtainable, not effective, or going to cause harm to the health of the subject. Consistent with Helmink et al., the health coach often recommended keeping goals small during the initial session, so that the goals did not become overwhelming or too extreme for the participant to implement. Many common health goals were seen in the subject population [5]. Among the most prevalent were wanting to lose weight, getting more active, practicing better portion control and meal planning, taking medications more regularly, quitting smoking (a prevalent health goal, yet no participant showed interest in obtaining information on smoking cessation), stopping skipping meals, stopping drinking soda, cooking healthier at home, stopping eating at restaurants, and increasing daily fruits and vegetable intake. The primary health goals and three action plans were all individualized to the participant, therefore, only the overall nutritional education lesson plan data was collected and recorded to give perspective on big picture goals.

The follow-up telephone call was more successful than anticipated, with 80% of participants successfully contacted. This may be due to the participants' initial willingness to participate in the study, as well as, their preexisting desire for change. This finding coincides with the Glanz et al. study stating that willingness and desire result in change [12].

The attending physicians were all supportive of the project's aim in referring patients and encouraging them to participate in the Nutri One-on-One study, just as Helmink et al. stated that "general practitioners support the notion of these programs" [5]. Nine of the 11 participating attending physicians filled out the physician's survey. Physicians expressed varied perceptions on the success and the effects of the program within the primary healthcare centers; however, specific statements as to why a physician felt positively, negatively, or neutrally toward the Nutri One-on-One program were not discussed. The study indicated benefit to each of the four participating PCOM healthcare centers. Through evaluation of the Patient Satisfaction Survey, patients reported an overall improvement in their primary care visit due to the participation in the Nutri One-on-One study.

There were two key elements presented for the educational assessment portion of the study: the nutritional education lesson plan and the follow-up educational assessment multiple-choice questionnaire. Participants were receptive of the tailored nutritional information; however, the majority of the participants seemed to already have a good idea of what foods were healthy, how to cook in a healthy manner, and how to reduce sodium. Due to 53% of participants being diagnosed with type 2 Diabetes, a majority of this population had previously participated in diabetes nutrition classes and learned about healthy foods, lowering carbohydrate intake, and avoiding processed foods. Although this knowledge was taught in the class, many did not understand how to apply it to their daily lives specifically, the concepts of portion control, or the importance of meal planning.

There were some limitations of this study such as a large study dropout rate (65%) during November and December and many subjects expressed that the holidays were too hard to implement change due to stress, travel, and holiday eating. Therefore, it would be wise to address holiday stress and eating in sessions given around the holiday months. In addition, because the study did not look at changes in diet quality in terms of the Healthy Eating Index (HEI), in the future studies parameters such as HEI should be used to examine food habits [17].

A retrospective study would provide valuable insight concerning the impact of the Nutri One-on-One program on its participants. Subjects could be followed up several times up to a year after the initial session about their overall goal achievement, health interest, and nutritional knowledge and be supported through continued motivation for health success. Collecting before and after lab values and anthropometric measurements would give the physicians objective data to evaluate the effectiveness of the program on their patients' nutrition habits and behaviors, long-term results

of the program and its effects on the metabolic syndrome, and goal maintenance. It would strengthen the study with numerical data not solely reliant on participant self-rated success.

Childhood obesity proved to be very prevalent at the four PCOM healthcare centers. Many families could benefit from family nutritional education. Further work addressing the pediatric population would be necessary and would require parental involvement and action. Therefore, the Nutri One-on-One program may target an entire family's nutritional habits by extending the duration of this program. Multiple follow-up sessions would offer further motivation and support for an overall long term change. This extension of care and nutritional education would provide continual monitoring of the patient's progress and would have a greater effect on weight loss maintenance for the entire family.

In conclusion, personalized nutritional health coaching through the Nutri One-on-One study has proven to be successful and significant, because an increase in patient primary care visit satisfaction was stated and considerable achievements in self-reported health goals through patient health actions were documented. The program was positively received by both the participating subjects and the physicians, providing evidence that a program such as Nutri One-on-One has a place in the clinical setting that elicits change and is effective for integrative medicine. It also has the potential to have a disseminated effect on the healthcare cost, as 75% of the US healthcare dollars are currently being spent on diseases caused by obesity. Change needs to begin by employing nutritional education, proper weight loss methods, and maintenance practices that the population can readily use [18].

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

References

[1] D. Laddu, C. Dow, M. Hingle, C. Thomson, and S. Going, "A review of evidence-based strategies to treat obesity in adults," *Nutrition in Clinical Practice*, vol. 26, no. 5, pp. 512–525, 2011.

[2] L. Perkins-Porras, F. P. Cappuccio, E. Rink, S. Hilton, C. McKay, and A. Steptoe, "Does the effect of behavioral counseling on fruit and vegetable intake vary with stage of readiness to change?" *Preventive Medicine*, vol. 40, no. 3, pp. 314–320, 2005.

[3] K. Y. Son, C. M. Lee, B. Cho et al., "Effect of aditional brief counselling after periodic health examination on motivation for health behavior change," *Journal of Korean Medical Science*, vol. 27, no. 11, pp. 1285–1291, 2012.

[4] J. Ma, V. Yank, L. Xiao et al., "Translating the diabetes prevention program lifestyle intervention for weight loss into primary care: a randomized trial," *JAMA Internal Medicine*, vol. 173, no. 2, pp. 113–121, 2013.

[5] J. H. M. Helmink, J. J. M. Meis, I. de Weerdt, F. N. Visser, N. K. de Vries, and S. P. J. Kremers, "Development and implementation of a lifestyle intervention to promote physical activity and healthy diet in the Dutch general practice setting: the BeweegKuur programme," *International Journal of Behavioral Nutrition and Physical Activity*, vol. 7, article 49, 2010.

[6] S. J. W. Robroek, F. J. Bredt, and A. Burdorf, "The (cost-) effectiveness of an individually tailored long-term worksite health promotion programme on physical activity and nutrition: design of a pragmatic cluster randomised controlled trial," *BMC Public Health*, vol. 7, article 259, 2007.

[7] T. P. Wycherley, P. Mohr, M. Noakes, P. M. Clifton, and G. D. Brinkworth, "Self-reported facilitators of, and impediments to maintenance of healthy lifestyle behaviours following a supervised research-based lifestyle intervention programme in patients with type 2 diabetes," *Diabetic Medicine*, vol. 29, no. 5, pp. 632–639, 2012.

[8] C. Sacerdote, L. Fiorini, R. Rosato, M. Audenino, M. Valpreda, and P. Vineis, "Randomized controlled trial: effect of nutritional counselling in general practice," *International Journal of Epidemiology*, vol. 35, no. 2, pp. 409–415, 2006.

[9] W. R. Archer, M. C. Batan, L. R. Buchanan et al., "Promising practices for the prevention and control of obesity in the worksite," *The American Journal of Health Promotion*, vol. 25, no. 3, pp. e12–e26, 2011.

[10] S. C. Bischoff, A. Damms-Machado, C. Betz et al., "Multicenter evaluation of an interdisciplinary 52-week weight loss program for obesity with regard to body weight, comorbidities and quality of life—a prospective study," *International Journal of Obesity*, vol. 36, no. 4, pp. 614–624, 2012.

[11] M. Vallis, H. Piccinini-Vallis, A. M. Sharma, and Y. Freedhoff, "Modified 5 As: minimal intervention for obesity counseling in primary care," *Canadian Family Physician*, vol. 59, no. 1, pp. 27–31, 2013.

[12] K. Glanz, R. E. Patterson, A. R. Kristal et al., "Stages of change in adopting healthy diets: fat, fiber, and correlates of nutrient intake," *Health Education Quarterly*, vol. 21, no. 4, pp. 499–519, 1994.

[13] Centers of Disease Control and Prevention, *About BMI for Adults*, Centers of Disease Control and Prevention, 2013.

[14] A. L. Marshall, "Challenges and opportunities for promoting physical activity in the workplace," *Journal of Science and Medicine in Sport/Sports Medicine Australia*, vol. 7, no. 1, pp. 60–66, 2004.

[15] U. N. Toft, L. H. Kristoffersen, M. Aadahl, S. L. von Huth, C. Pisinger, and T. Jørgensen, "Diet and exercise intervention in a general population—mediators of participation and adherence: the Inter99 study," *The European Journal of Public Health*, vol. 17, no. 5, pp. 455–463, 2006.

[16] G. Ronda, P. van Assema, and J. Brug, "Stages of change, psychological factors and awareness of physical activity levels in the Netherlands," *Health Promotion International*, vol. 16, no. 4, pp. 305–314, 2001.

[17] P. M. Guenther, S. I. Kirkpatrick, J. Reedy et al., "The healthy eating Index-2010 is a valid and reliable measure of diet quality according to the 2010 dietary guidelines for Americans," *The Journal of Nutrition*, vol. 144, no. 3, pp. 399–407, 2014.

[18] J. M. Olsen and B. J. Nesbitt, "Health coaching to improve healthy lifestyle behaviors: an integrative review," *American Journal of Health Promotion*, vol. 25, no. 1, pp. e1–e12, 2010.

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Review Article

University Education in Human Nutrition: The Italian Experience—A Position Paper of the Italian Society of Human Nutrition

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As a broad range of professionals in clinical and nonclinical settings requires some expertise in human nutrition, the university system must offer academic courses tailored to these different specific needs. In the Italian university system there is still uncertainty with regard to the learning objectives regarding human nutrition. In the ministerial decrees defining the criteria for establishing university courses, the indications about education in human nutrition are rather inconsistent, sometimes detailed, but often just mentioned or even only implied. Education in human nutrition requires both an appropriate duration (number of university credits included in the degree format for different disciplines) and course units that are designed in order to achieve specific expertise. The university system should appropriately design and distinguish the nutritional competencies of the different types of graduates. Physiology and biochemistry are the academic disciplines mostly involved in teaching fundamentals of human nutrition, while the discipline sciences of applied nutrition and dietetics more strictly focuses on applied nutrition and clinical nutrition. Other academic disciplines that may contribute to education in human nutrition, depending on the type of degree, are internal medicine (and its subspecialties), hygiene, endocrinology, food technologies, food chemistry, commodity science, and so forth.

1. Introduction

The aim of this document, prepared by a group of experts on behalf of the Italian Society of Human Nutrition (SINU), is to present an opinion on education in human nutrition, as accessible in the Italian university system in first-cycle (first-level) and second cycle (second-level) degrees. Further position papers are needed to define in detail the indications for each of the degrees considered with respect to format, learning objectives, and learning outcomes.

The Italian university system includes first-cycle degrees (Degree, Laurea, L) and second-cycle degrees (Magister Degree, Laurea Magistrale, LM) and thereafter advanced training courses, masters, specialization courses, and Ph.D.'s [1]. The overall purpose is to give students the opportunity to acquire a specific cultural, scientific, and professional profile by achieving different academic diplomas. University education has been progressively adapting to the concepts proposed by the *Qualification Framework for the European Higher Education Area* [2] and the *Italian Qualification Framework for the Higher Education* [1], with the latter defining the learning outcomes of the Italian first-cycle degree courses and second-cycle degree courses.

First-Cycle. Qualifications that signify completion of the first cycle are awarded to students who

> have demonstrated knowledge and understanding of a field of study that builds upon their general secondary education and is typically at a level that,

whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study;

can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation and have competencies typically demonstrated through devising and sustaining arguments and solving problems within their field of study;

have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific, or ethical issues;

can communicate information, ideas, problems, and solutions to both specialist and nonspecialist audiences;

have developed those learning skills that are necessary for them to continue to undertake further study with a high level of autonomy.

Second-Cycle. Qualifications that signify completion of the second cycle are awarded to students who

have demonstrated knowledge and understanding that is founded upon and extends and/or enhances that typically associated with the first cycle and that provides a basis or opportunity for originality in developing and/or applying ideas, often within a research context;

can apply their knowledge and understanding and problem solving abilities in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study;

have the ability to integrate knowledge and handle complexity and formulate judgments with incomplete or limited information but that include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgments;

can communicate their conclusions and the knowledge and rationale underpinning these to specialist and nonspecialist audiences clearly and unambiguously;

have the learning skills to allow them to continue to study in a manner that may be largely self-directed or autonomous.

These frameworks can be used to evaluate the quality of academic courses and provide a better understanding of the relationships between learning process and knowledge, skills, and competencies. More specifically, the *European Qualification Framework* (EQF) for lifelong learning [3] focuses on the learning outcomes using an eight-level reference system: the Italian first-cycle degrees and second-cycle degrees correspond, respectively, to level 6 and level 7.

2. Establishment of Degree Courses in Italy

The ministerial decrees [4, 5] provide definition and characteristics of 43 types (referred to as classes) of first-cycle degrees (L/1 to L/43) and 94 second-cycle degrees (LM/1 to LM/94). There are, in addition, 4 classes of first-cycle degrees and 4 classes of second-cycle degrees for health-related professions [6, 7] and also a small number of single-cycle degrees such as medicine, dentistry, and pharmacy.

The ministerial decrees [4–7] indicate the educational objectives and the fundamental learning activities for each type of degree. In addition, they provide an outline of professional objectives and potential employment opportunities. For each degree the learning activities, expressed as university credits, are partitioned according to different subject areas, with each of which including several academic disciplines (defined as SSD, Settori Scientifico-Disciplinari). The total number of expected university credits is 180 for first-cycle degrees, 120 for second-cycle degrees, and 240 or 300 for single-cycle degrees (60 university credits per year).

The courses established by each university have their own format and unit program. Each university chooses the academic disciplines to be included in the academic course among those listed in the ministerial decrees. An academic discipline can, therefore, provide no course unit or one or more units, with a variable number of university credits. The academic courses that belong to the same type of degree share the same educational objectives and confer equal legal qualification but can differ greatly in their teaching contents.

3. Education in Human Nutrition

Human nutrition, as a body of knowledge, skills, competence, and professional activities, is an interdisciplinary area covering chemical, molecular, genetic, biochemical, physiological, psychological, cognitive-behavioural, statistical-epidemiological, clinical, food-related, technological, educational, economic, political, and social aspects.

The following paragraphs focus on the university degrees for which education in nutrition is essential (Table 1), with the aim to identify and analyse the role of human nutrition in relation to the learning objectives set out by the ministry, the learning paths of the degree, and the professional profiles.

Two degrees are specifically related to human nutrition: a first-cycle degree in dietetics and nutrition and a second-cycle degree in nutrition sciences. Other academic fields considered are food science and technologies, biological sciences, pharmaceutical sciences, medical sciences, and sport sciences.

3.1. Food Science and Technologies. Human nutrition is a key subject in the field of food sciences and technologies, particularly with regard to food quality and nutritional characteristics of foods; nutrition labelling and health claims; design of novel foods and foods for special medical purposes; catering; industry's role in improving the nutritional quality of foods. The relationship between food science and technologies and human nutrition also emerges by considering food-based dietary guidelines or legislation on foodstuffs, as

Table 1: First-cycle and second-cycle Italian university degrees in which education in human nutrition is essential or very useful.

	First-cycle degrees (L)	
L-2	Biotecnologie	Biotechnology science
L-13	Scienze Biologiche	Biological sciences
L-22	Scienze Delle Attività Motorie e Sportive	Science of physical activity and sport
L-26	Scienze e Tecnologie Alimentari	Food science and technologies
L-29	Scienze e Tecnologie Farmaceutiche	Pharmaceutical sciences and technologies
L/SNT3	Laurea in Professioni Sanitarie Tecniche–Dietista	Technical health professions–dietitian
L/SNT1	Professioni Sanitarie Infermieristiche e Professione Sanitaria Ostetrica	Health care nursing professions and healthcare obstetric profession
	Second-cycle degrees (LM)	
LM-6	Biologia	Biology
LM-7	Biotecnologie Agrarie	Agricultural biotechnology
LM-13	Farmacia e Farmacia Industriale	Pharmacy and Industrial pharmacy (single-cycle degree)
LM-41	Medicina e Chirurgia	Medicine (single-cycle degree)
LM-61	Scienze Della Nutrizione Umana	Science of human nutrition
LM-67	Scienze e Tecniche Delle Attività Motorie Preventive e Adattate	Sciences and techniques of preventive and adaptive physical activity
LM-68	Scienze e Tecniche Dello Sport	Sport sciences and techniques
LM-70	Scienze e Tecnologie Alimentari	Food science and technologies

L: Laurea (degree); LM: Laurea Magistrale (magister degree).

well as numerous scientific publications in journals of the ISI categories *Nutrition and Dietetics* and *Food Science and Technologies*. In addition, there are several research units on human nutrition in university departments and research institutions of food science and technologies.

The ministerial decrees [4, 5] define in Italy a first-cycle degree L/26 (*food science and technologies*) and a second-cycle degree LM/70 (*food science and technologies*). The learning objectives related to human nutrition for the degree L/26 are ensuring nutritional quality of foods; use of diet for promoting health; implementation and supervision of food catering; assessment of dietary habits. Further indications for the degree LM/70 are management and promotion of food quality and safety and highly specialised skills for quality control and food safety. Biochemistry, physiology, science of applied nutrition, food chemistry, and hygiene are the scientific disciplines which may be involved in the education in human nutrition.

3.1.1. Professional Profile. Food technologists are involved in the production, processing, and distribution of food products and in the related activities of analysis, inspection, certification, and so forth, as well as in quality improvement and promotion of food products. In addition, they work in the catering industry, the retail distribution industry, and the agritourisms. Food technologists may collaborate in nutritional consulting, planning of menu, and research and development in the area of applied nutrition.

3.1.2. Comments. Course units related to human nutrition are found in many, but not all, academic courses in food science and technologies, including those focusing on catering or food and wine industry.

As far as education in human nutrition is concerned, in addition to the physiological role of nutrients other issues of particular interest are laboratory analyses related to the nutritional quality of food products (raw or processed), nutritional characteristics of the food groups, and changes due to food processing, design of novel foods, assessment of food habits, nutrition labelling, and educational tools. For catering and the food and wine industry, skills are required with regard to applied nutrition and public health nutrition. Cross competencies with areas such as food technology and food microbiology are also of particular interest.

3.2. Biological Sciences. Since nutrients and food components have a major role in biological processes from the molecular level to the whole organism, not surprisingly, biologists are usually involved in laboratory research on nutrition, as well as in the evaluation of nutritional status.

In this academic field there are a first-cycle degree L/13 (*biological sciences*) and an interrelated second-cycle degree LM/6 (*biology*) [4, 5]. The degree L/13 highlights the need for a basic as well as for a job-oriented education, whereas the degree LM/6 aims at teaching more specific aspects of biology, in the presence of an academic learning path (among others) focused on human nutrition. The scientific disciplines involved in education in human nutrition are in particular biochemistry, physiology, science of applied nutrition, and hygiene.

3.2.1. Professional Profile. As advanced professional expertise (also according to a formal opinion of the Italian National

Health Board), the registration as biologist provides the legal qualification for evaluating nutritional status and assessing nutritional needs and to plan optimal diets. Biologists with specific interest in human nutrition are involved in laboratory evaluation of food safety and quality, assessment of nutritional status and diet adequacy, nutritional counselling, planning of diet for individuals and communities, and promotion of healthy foods.

3.2.2. Comments. In Italy education in human nutrition is not usually considered among the learning objectives of the university courses in biological sciences and is therefore not taken into consideration in their unit programs. Instead, universities should evaluate the opportunity to activate personalised paths aimed at attaining more specific competencies in human nutrition.

Education in human nutrition provides competencies that are often essential to the biologists. All students should be guaranteeing the chance to improve their own nutritional skills. At least the fundamentals of nutritional biochemistry and physiology should be taught in the degree L/13, together with a general overview on metabolism. In the degree LM/6, if the aim is in an in-depth teaching on human nutrition, attention must be paid to nutrition in physiological and pathological conditions.

3.3. Dietetics and Nutrition. Public health nutrition and clinical nutrition are major topics in the field of dietetics and nutrition. Dietitians are usually involved in research in this area.

The first-cycle degree L/SNT-3 (*health professions-dietitian*) aims at achieving both knowledge and technical/practical skills and competencies [6]. Education in human nutrition involves scientific disciplines such as physiology, biochemistry, sciences of applied nutrition, hygiene, food science and technologies, food chemistry, and commodity science. In addition, clinical disciplines examine the role of human nutrition in the prevention and treatment of acute and chronic diseases. The format of academic courses also offers activities of practice and internship.

3.3.1. Professional Profile. The professional role of the dietitian is clearly recognized. According to the ministerial decree [6], dietitians work in private practices, community organizations, and medical settings. Dietitians organize and coordinate specific activities related to applied nutrition and clinical nutrition; they cooperate in the control of food safety; they plan diets (prescribed by a physician) and are involved in the dietary treatment of patients; they cooperate with other professionals in the treatments of eating disorders; they organize catering for communities; they carry out activities related to nutritional education. In addition, the dietitian may play a key role in research, especially in the assessment of the nutritional status.

3.3.2. Comments. The courses in dietetics and nutrition should guarantee a balanced approach to knowledge and activities of practice. Understanding the fundamentals of human nutrition ensures a correct approach to applied nutrition and clinical nutrition, while clinical teachings should be oriented towards the role of human nutrition in both prevention and therapy. The internship sets a connection between advanced skills and competencies at a higher level. Finally, interpersonal and communication skills with healthy subjects or patients are to be considered of great importance.

3.4. Pharmaceutical Sciences. Human nutrition and pharmaceutical sciences both share a strong interest for the effects of food components on health, the healthy impact of food supplements and enriched/fortified foods, and so forth. Research in pharmacology is mostly focused on bioactive molecules found in foods. Journals that synthesise this approach are found in the ISI categories: *Nutrition and Dietetics, Pharmacology, Food Science* and *Technologies and Toxicology.*

In Italy, two degrees are related to the academic field of pharmaceutical sciences [4, 5]: the first-cycle degree L/29 (*pharmaceutical sciences and technologies*) and the single-cycle (five years) degree LM/13 (*pharmacy and industrial pharmacy*). With respect to human nutrition, graduates in L/29 are expected to have competence in the formulation, production, and quality control of nutritional products (including those tailored for specific goals and needs) and nutritional supplements. Graduates in LM/13 may be involved in the development and production of foods for special medical purposes and supplements, as well as in nutritional counselling. Physiology and biochemistry are the disciplines expected to teach the fundamentals of human nutrition, whereas the discipline sciences of applied nutrition is considered among the core disciplines of the degree LM/13.

3.4.1. Professional Profile. The graduates in the degree L/29 may carry out the formulation, the production, and the quality control of nutritional products, as well as the inspection and the preparation of supplements. The pharmacists (graduates in the degree LM/13) can operate as specialists of dietetic and herbal products. In addition, they have also been qualified as nutritional counsellors, as attested by the Italian National Health Board. On the other hand, pharmaceutical sales representatives are interested in nutrition with respect to the treatment of metabolic disorders and nutrition-related diseases. Finally, pharmacists play a key role in managing enteral nutrition and in the preparation of parenteral nutrition.

3.4.2. Comments. Human nutrition, with a few exceptions, is not adequately considered in the academic courses of pharmaceutical sciences.

Education in human nutrition is needed in both the first-cycle and the second-cycle Degrees. Skills and competencies of graduates in the degree L/29 are selective. For graduates in the degree LM/13 more advanced competencies are required regarding the use of food supplements, foods for special medical purposes, and enteral nutrition for the treatment of nutrition-related diseases; nutrition education; preparation of parenteral nutrition.

3.5. Medical Sciences. Nutrition plays a primary role in prevention and therapy of both noncommunicable chronic diseases and other organ-related diseases. Thus, not surprisingly, an impressive number of articles related to human nutrition have been published in the field of medical sciences in categories such as *cardiac and cardiovascular systems*, *gastroenterology*, *nephrology*, and *paediatrics*.

Indeed, the role of nutrition to promote health in all age groups is very often ignored by the National Health System. For example, obesity and malnutrition are often not identified or considered. This erroneous attitude is reflected also in the learning objectives indicated by the ministerial decree [5] for the degree in medicine (LM/41), which describes the medical profession as a holistic approach to preserve and restore health. Nutrition is not mentioned at all, whereas metabolism is just cited in brief.

Indeed, the disciplines which are possibly involved in the education in human nutrition are biochemistry, physiology, and science of applied nutrition. The role of human nutrition in the prevention and treatment of acute and chronic diseases can also be examined by disciplines such as hygiene, internal medicine, endocrinology, gastroenterology, cardiology, nephrology, and paediatrics.

3.5.1. Professional Profile. With respect to human nutrition, physicians are the only professionals qualified to diagnose nutrition-related diseases and prescribe diets. They should also promote healthy lifestyles (including healthy food habits) in the general population and at-risk groups. In addition, they should also demonstrate an inclination to collaborate with other professionals with competencies in human nutrition.

3.5.2. Comments. Human nutrition, with a very few exceptions, is not considered in the academic courses of medicine. Education in human nutrition has to be always included in the courses of the degree in medicine. Knowledge of metabolism and the nutritional role of food components constitutes an essential scientific background which should be combined with more advanced expertise in nutritional diagnosis and therapy.

Overall, graduates in medicine should attain adequate skills and competencies with respect to relationships among food, nutrition, health, and well-being; nutritional role of food components; nutrient requirements in physiological or pathological conditions; human nutrition in prevention and treatment; nutrition surveillance in the general population; appropriate use of tools for assessing nutritional status; food and nutrition information; basic principles of nutritional therapy; cooperation with other professionals with specific nutritional competencies.

3.6. Sport Sciences. Sport sciences and human nutrition both focus on the optimal nutrition for athletes and the relationship of physical activity with health and wellness. In addition, physical activity plays also a significant role in the treatment of nutrition-related diseases (obesity, diabetes, etc.).

In Italy there are three degrees [4, 5] belonging to this academic area: the first-cycle degree L/22 (*physical activity and sport*) and the subsequent second-cycle degrees LM/67 (*sciences and techniques in preventive and adapted physical activity*) and LM/68 (*sport sciences and techniques*). The degree LM/67 focuses on the promotion of healthy lifestyles (including diet) in the general population and the physically disabled, while the education in sports nutrition (i.e., nutrition and physical performances) is mentioned among the learning objectives of the degree LM/68.

3.6.1. Professional Profile. Graduates in sports sciences should be able to plan, organize, and manage physical activity programs and sport activities (also at a competitive level), as well as the activities of developing, preserving, and recovering physical fitness and the related psychophysical well-being. Related professional profiles are educators in the prevention of sedentary lifestyle, overweight, and obesity; educators in adaptive activities aimed at the achievement of physical fitness.

3.6.2. Comments. With respect to education in human nutrition, graduates in sports sciences (especially in the degrees LM/67 and LM/68) are expected to acquire general knowledge of the nutritional role of food components and nutrient requirements and more specific information on sports supplements. Moreover, they must acquire competence in the assessment of body composition, the promotion of a healthy diet as a major component of a healthy lifestyle, and the support in dietary planning for athletes. They should also demonstrate an inclination to collaborate with other professionals with competencies in human nutrition.

3.7. Science of Human Nutrition. The rationale of the second-cycle degree in science of human nutrition (LM/61) can be found in the increasing value recognized to nonclinical areas of human nutrition. The degree in science of human nutrition is not directly related to any first-cycle degree [5]. Students usually come from areas such as dietetics and human nutrition, biological sciences, food sciences and technologies, pharmacy, and biotechnologies. As a consequence, due to this heterogeneity, there could be problems in teaching to students with very different academic careers.

The learning objectives of the degree L/61 aim at the achievement of advanced knowledge, skills, and competencies in the biochemical and nutritional role of nutrients and other substances of nutritional interest; the evaluation of energy and nutrient requirements in individuals and communities; the assessment of nutritional status (laboratory tests and measurements in vivo); the influence of foods and diet on health and well-being; food processing, including functional foods and foods for special medical purposes; food regulation and legislation.

3.7.1. Professional Profile. Because of its own characteristics, the degree in science of human nutrition enriches the professional skills of graduates who have already acquired competencies in different academic fields. Actually, graduates in LM/61 work in different settings such as public health, sports nutrition, the media, food industry, catering industry, education, and research, often collaborating with other professionals with specific nutritional competencies.

3.7.2. Comments. The courses in science of dietetics and human nutrition have been established in different Italian universities through the cooperation between departments of medicine, biological sciences, food sciences and technologies, pharmacy, biotechnology, and so forth. Actually, they differ to a significant extent with respect to learning objectives, formats, and course unit programmes.

The professional profile is therefore strongly influenced by the curriculum of each student. In general terms, the graduates in LM/61 should attain advanced expertise in laboratory analyses and the evaluation of the nutritional quality of food products (raw or processed); design, production, and distribution of functional foods, foods for special medical purposes, and supplements; use of nutrition claims and health claims; assessment of nutritional status; planning of diet in different physiological and pathological conditions; catering; nutrition education; consultancy in human nutrition. In addition, the achievement of LM/61 enables the registration as biologist (see above).

The primary objective of the degree LM/61 is to give students the opportunity to reach advanced competencies in human nutrition. The course programme has to guarantee the balanced presence of the different scientific and cultural fields related to human nutrition (especially to applied nutrition) as well as of other fields such as biochemistry, statistics, epidemiology, hygiene, food safety, and food technologies. Clinical disciplines are also indispensable to describe both the relationships of food components, foods and diet with health and well-being, and the pathogenesis and treatment of nutrition-related diseases.

3.8. Other Degrees. Education in human nutrition may also be somewhat considered in other degrees such as the degrees in biotechnology [4, 5] and those for health professionals [6, 7]. Nurses, for example, must acquire expertise in nutritional screening and the management of enteral and parenteral nutrition. On the other hand, professional profiles such as the obstetrician are specifically involved in providing health advice and promoting healthy eating.

4. Remarks

As already observed in other countries [8–13], there is still uncertainty in Italy with regard to how and to which extent human nutrition should be taught in the different university degrees. In the ministerial decrees that define the general criteria for establishing university degrees [4, 7] indications about education in human nutrition are sometimes detailed, but usually little more than mentioned or even only implied. Human nutrition is the scientific and cultural core of both the first-cycle degree in dietetics and nutrition and the second-cycle degree in sciences of human nutrition and significantly contributes to the learning objectives set for the degree in food science and technologies. In other cases, nutritional aspects are shortly mentioned (pharmacy and industrial pharmacy and sport sciences) or cannot be drawn at all from the learning objectives indicated by the ministerial decrees (biology and medicine).

As previously mentioned, academic courses are organised by each university according to the criteria set by the ministerial decrees. As a consequence, education in human nutrition may be absent also in those courses where it is highly needed. With the exception of the two degrees specifically related to human nutrition, the definition of knowledge, abilities, and competencies tends often to be incomplete and learning objectives regarding human nutrition are frequently overlooked. Finally, there are important differences with respect to education in human nutrition (learning objectives, number of units, etc.) among courses belonging to the same class of degree.

As far as the nutritional training of health professionals is concerned, it should be noted that graduates in dietetics and nutrition at the end of the course take the degree and pass a government exam to be licensed as dietitians. There is no path to reach any further legal qualification similar to that of registered dietitian. In addition, there is a medical specialisation course (4 years) in human nutrition and dietetics. Human nutrition may also be taught (in an inconsistent way) in other medical specialisation courses (e.g., in internal medicine or gastroenterology), while biologists may attend the course (4 years) in human nutrition and dietetics (with slightly different learning objectives). Finally, postdoctoral masters in human nutrition and also research doctorates are poorly recognised as legal and professional qualifications for health professionals.

The training programme appears to be sufficient for the degree in human nutrition and dietetics (500–700 graduates per year) and the specialisation course in human nutrition and dietetics (25–30 specialized medical doctors per year), but it is quite absent for medical doctors and other health professionals. Overall, as already reported [14], the national health service is not capable of meeting the needs for public health nutrition and clinical nutrition. Unfortunately, no data are available on how this impacts on both the health of the general population and health care cost and utilisation in Italy.

5. Position

Human nutrition is a highly interdisciplinary cultural-scientific discipline with a well-defined identity with respect to clinical and nonclinical issues. As a broad range of professionals in different settings requires some expertise in this area, the university system must offer academic courses tailored to specific needs.

In first-cycle and second-cycle academic degrees, the university system must appropriately define the nutritional competencies of the different types of graduates, preserving a reasonable consistency among the university courses belonging to the same type of degree.

Education in human nutrition must be structured according to the learning objectives and expected outcomes of each type of degree; knowledge, skills, and competencies should be clearly defined. Not only should the inputs be taken into consideration (length and characteristics of the learning activities, theoretical contents of the discipline, etc.), but the same should be also said about the actual knowledge

and skills graduates acquire. The learning objectives of an academic course must be compatible with the expected activities. Teaching should focus first on the nutritional role of nutrients and other substances of nutritional interest and their metabolism and on the relationship of food components and diet with health and well-being. As a further step, the nutritional competencies specific to each type of graduate may be implemented, including those shared with other cultural and scientific fields.

Education in nutrition is interdisciplinary but not fragmentary. It requires both an appropriate duration (number of university credits for each discipline) and course units that are clearly designed in order to achieve specific expertise. Physiology and biochemistry are academic disciplines mostly involved in teaching fundamentals of human nutrition, while the discipline of sciences of applied nutrition and dietetics more strictly focuses on nutrition and diet in the general population and at-risk groups, as well as on clinical nutrition. Depending on the type of degree, other academic disciplines that may significantly contribute to education in human nutrition are internal medicine (and its subspecialties), hygiene, endocrinology, food technologies, food chemistry, commodity science, and so forth.

Special attention must be paid to the education in human nutrition of physicians and other health professionals. For instance, in the degree of medicine there should be at least one unit concerning the fundamentals of human nutrition and another one on applied nutrition and clinical nutrition are expected. For some professional profiles a supervised training in clinical nutrition is mandatory.

The different types of graduates to some extent share a number of nutritional competencies and job opportunities. Indeed, graduates with different nutritional expertise can usefully collaborate in either the clinical or nonclinical setting. Nutrition can serve as a model for the type of interprofessional education that is needed to a broad range of health care professionals to meet today's health care needs.

Due to the educational organization of the Italian university System, curricular changes are proposed and implemented by the university departments, which supervise the different courses. The availability of shared documents on education in human nutrition (especially if focused on specific areas) and the interaction between nutrition societies and colleges of academic disciplines may help reaching changes at a local level. It appears much more difficult to modify the national regulation on university courses.

University education should carefully consider current regulations concerning professional profiles, in order to better collaborate with the corresponding professional orders.

Expertise in human nutrition must undergo continuous updating and retraining programs. The specialisations in nutritional sciences, masters, and advanced training courses are of great relevance. For the nonuniversity education it is important to mention the continuing medical education, CME.

The labour market should be stimulated to examine graduates' curriculum vitae taking into consideration not only legal qualifications but also knowledge, skills, and competencies which have been actually obtained.

The purpose of this position paper is to provide some general principles and suggestions to be considered for setting specific recommendations related to education in human nutrition within the different degrees. As stated in Introduction, however, further documents are needed to define in detail the indications for each considered degree with respect to format, learning objectives, and learning outcomes and to identify the curricular changes that could be implemented to provide a model for the type of interprofessional education that is needed to equip a broad range of health care professionals to meet today's health care needs.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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References

[1] QTI, Qualification Framework for the Higher Education, http://www.quadrodeititoli.it.

[2] Bologna Process, European Higher Education Area, http://www.ehea.info/.

[3] EQF, European Qualification Framework for lifelong learning, https://ec.europa.eu/ploteus/content/descriptors-page.

[4] Ministerial Decree, "Determination of classes of first-cycle degrees," Official Gazette of the Italian Republic no. 153, 2007.

[5] Ministerial Decree, "Determination of classes of second-cycle degrees," Official Gazette of the Italian Republic no. 155 of July 6th, 2007, and -OG no. 122 of May 28th, 2009, 2007.

[6] Ministerial Decree dated February 19th, 2009. Determination of classes of health profession degrees, Official Gazette of the Italian Republic, no. 119 of May 25th, 2009.

[7] Ministerial Decree, "Determination of classes of second-cycle health profession degrees," Official Gazette of the Italian Republic no. 122, 2009.

[8] P. M. Kris-Etherton, S. R. Akabas, P. Douglas et al., "Nutrition competencies in health professionals' education and training: a new paradigm," *Advances in Nutrition*, vol. 6, pp. 83–87, 2015.

[9] R. F. Kushner, L. Van Horn, C. L. Rock et al., "Nutrition education in medical school: a time of opportunity," *American Journal of Clinical Nutrition*, vol. 99, no. 5, supplement, pp. 1167S–1173S, 2014.

[10] C. M. Lenders, D. D. Deen, B. Bistrian et al., "Residency and specialties training in nutrition: a call for action," *The American Journal of Clinical Nutrition*, vol. 99, no. 5, supplement, pp. 1174S–1183S, 2014.

[11] L. Ball, J. Crowley, C. Laur, M. Rajput-Ray, S. Gillam, and S. Ray, "Nutrition in medical education: reflections from an initiative at the University of Cambridge," *Journal of Multidisciplinary Healthcare*, vol. 7, pp. 209–215, 2014.

[12] S. Ray, C. Laur, P. Douglas et al., "Nutrition education and leadership for improved clinical outcomes: training and supporting junior doctors to run 'nutrition awareness weeks' in

three NHS hospitals across England," *BMC Medical Education*, vol. 14, article 109, 2014.

[13] P. M. Kris-Etherton, S. R. Akabas, C. W. Bales et al., "The need to advance nutrition education in the training of health care professionals and recommended research to evaluate implementation and effectiveness," *The American Journal of Clinical Nutrition*, vol. 99, no. 5, pp. 1153S–1166S, 2014.

[14] H. Cena, C. Roggi, L. Lucchin, and G. Turconi, "Health nutrition practice in Italy," *Nutrition Reviews*, vol. 68, no. 9, pp. 556–563, 2010.

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Research Article

Developing Research Competence in Undergraduate Students through Hands on Learning

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Evidence-based practice is the foundation of nutrition and dietetics. To effectively apply evidence-based practice, health professionals must understand the basis of research. Previous work has identified the lack of involvement of dietitians in research. As part of a curriculum redevelopment in undergraduate nutrition and dietetics courses, research skill teaching was enhanced. This study evaluated the effect of a new, year two level nutrition research methods unit on the perceived research skills of students. The unit consisted of two key components: a student-led class research project and a small group systematic literature review. Prior to commencement and on completion of the course, students completed a modified version of the Research Skills Questionnaire. Results demonstrated that self-perceived competence increased by a small degree in a set of specific research skills as well as in broader skills such as information gathering and handling, information evaluation, ability to work independently, and critical thinking. The new research unit was also evaluated highly on a student satisfaction survey. Despite these positive findings, students indicated that their general feelings towards research or a career in research were unchanged. In summary, this unit enhanced students' perceived research skills. Further exploration of students' attitude towards research is warranted.

1. Introduction

Health professionals are increasingly working within the evidence-based practice paradigm to support the provision of safe and quality care for their patients. Evidence-based practice is defined as the careful and considered use of up to date best evidence in making plans to improve the health of individuals and populations [1]. To be able to successfully implement evidence-based practice, health professionals must first understand research methodology to enable informed critique of relevant evidence. Despite evidence-based practice being a core standard for all health professionals, few health practitioners are engaged in research [2].

Nutrition and dietetics are a health profession concerned with the treatment and prevention of nutrition and lifestyle related diseases of individuals, groups, and populations, by influencing eating behaviors and the wider food environment affecting sustainable and nutritious, food supply, policy, and intake. Previous work has identified the lack of involvement of dietitians in research [3] and a range of barriers reported as factors influencing this level of commitment [4]. Together with perceptions and attitudes towards evidence-based practice, knowledge of research, years of experience, and mandate for research within job role have been shown to be the greatest predictors for dietitians involvement in and capacity for research [5–7]. A recent randomized controlled trial demonstrated that involvement in tailored education, regardless of format, increased research self-efficacy of dietitians [8]. For dietitians to be able to more effectively contribute to improvements in health, there is a need for greater investment in research capabilities [9]. Little is known about what predicts research outcomes for nutrition professionals not involved in patient care.

The development of research skills for many health professions commences in undergraduate education yet there is limited evidence regarding effective research teaching and learning approaches. In nutrition and dietetics, the literature suggests that hands on, real life, independent research experiences are valued by students [10] and that personal interest, leadership from role models, and supervisors influence

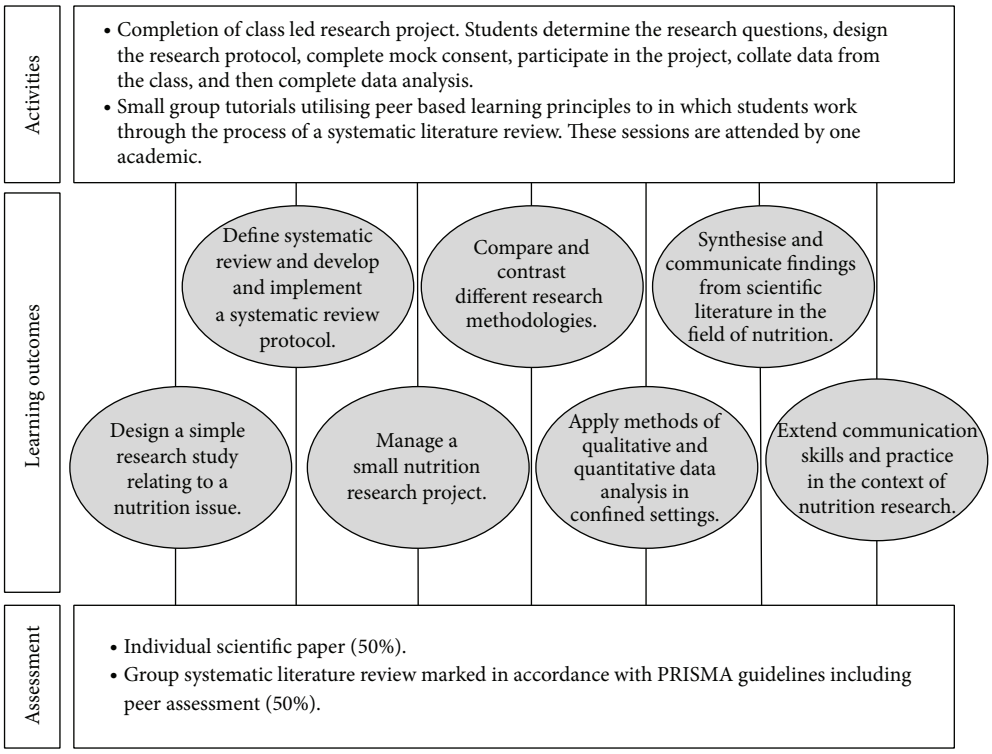

Figure 1: Unit blueprint detailing learning outcomes and associated teaching activities and assessment.

attitudes towards research [11]. It has been suggested that research skill development for dietitians should commence early in undergraduate training, be contextualized, and involve real experiences [11]. With growing student numbers, providing "real" experiences is challenging and so unique teaching and learning approaches must be developed.

This research aimed to evaluate the effect of a new, undergraduate year two level, nutrition research methods unit on research skills ability of students. The unit aimed to increase students' ability to design, conduct, and communicate a research study in nutrition and develop and implement a systematic literature review.

2. Methods

2.1. Teaching and Learning Approach. As part of a curriculum redevelopment at the study university in an undergraduate nutrition and dietetics course, research skill teaching was enhanced. Based on a review of the evidence, research skills teaching and learning were integrated across all years of the curricula focusing on early yet contextualized research methods learning and hands on experiences (Table 4). This study is focused on one of the subjects implemented in year two of the integrated curriculum: Applied Research Methods in Nutrition. The unit is compulsory for all students enrolled in the Bachelor Nutrition and Dietetics and Bachelor Nutrition Science.

The detailed unit blueprint is illustrated in Figure 1. The course consisted of two key components: (i) students leading a class research project whereby they developed a set of research questions and subsequently an appropriate study design, participated in the study as subjects, collected and collated class data, analyzed data, and prepared a scientific paper; (ii) a group systematic review of the literature. The theoretical underpinnings of the teaching and learning approach were based on Kolb's experiential learning theory [12]. Through the purposive design, students were invited to partake in the whole research process, with their peers, in a safe and supportive classroom setting, yet solving a realistic priority nutrition issue. Two academics, both early career researchers themselves (Zoe Davidson and Claire Palermo), coordinated the unit in tandem.

The class research project was designed and implemented by the students. Academic staff provided the broad topic area (low FODMAP (fermentable oligosaccharides, disaccharides, monosaccharides, and polyols) diets) from which research questions will be developed. The students chose a randomized, crossover controlled study, with qualitative semistructured interviews to answer their research questions. Teachers guided the students through the research process in a two-hour whole of class group discussion each week. For example, one of the teachers would remind students of content learnt in the previous year, such as developing a research question, and then students would work in small groups to brainstorm elements for their study, feedback to the whole group, and then the teacher would facilitate discussion to achieve consensus on how the whole group wished to proceed to the next step of the research process. Students were briefed in the introductory lecture that this unit required them to show initiative and independence and that without their input in class the study would not be a success. The learning from

this experience was summatively assessed via an individual student scientific paper submission, whereby students chose one of the class research questions to write up as a journal article following style guides common of a nutrition and dietetics journal.

Students also completed a systematic review of the literature in groups of five. The systematic review process was completely independent of the class research project, with students completing the review in an area decided with their tutor. The review process was facilitated by department academics in a series of student led tutorials incorporating peer based learning principles [13]. Academics identified a broad research question/topic whith the students and then developed into a more structured question before beginning the process of searching, identifying, extracting, synthesizing, and communicating evidence to answer the question. Student groups participated in a single one-hour tutorial once per week for the 12 week semester with their tutor. Academics and students were provided with a tutorial manual which outlined key tasks to achieve each week in order to ensure completion of the review process within the semester. Students were provided with formative feedback in week four regarding their question and search strategy. The learning from the systematic review was summatively assessed via a group paper submitted in accordance with the PRISMA guidelines on reporting the systematic literature reviews [14].

As a part of the systematic review component of the unit, students participated in a peer assessment process, using the principles of effective peer assessment [15] whereby students were empowered to take responsibility for their performance and learning [16]. In the first tutorial of semester, each small group set criteria to which they would assess their peers on. At the end of semester, students completed an assessment of each member of their group and provided this to their tutor. The collated peer assessment for each student was used to adjust the group's mark to provide an individual systematic review mark. For example, if a group received 42/50 for their systematic review paper and as student received a collated peer assessment of 8/10, their individual mark was determined as 80% of 42/50 = 34/50.

2.2. Evaluation. All students enrolled in the unit in 2013 (n = 55) were invited to participate in this research and informed consent was obtained. Ethics approval was granted by the relevant university human research ethics committee (approval number: CF13/703-2013000306).

A pre-post evaluation was used to measure change in self-perceived research knowledge and skills. Prior to commencement of the course, all students completed a modified version of the Research Skills Questionnaire (RSQ) developed by Centre for Excellence in Applied Undergraduate Research Skills at the University of Reading [17]. Students were then asked to complete the same survey on completion of the unit. The survey required students to rate their self-perceived competency in both broader/transferable (11 items) and specific (7 items) research skills on a scale of 1 to 10, with 1 representing the lowest level of competence and 10 the highest. Attitudes toward research were assessed on a scale of 1 to 7. Students were also asked to qualitatively describe their understanding of research and their general feelings towards research such as motivation, interest, involvement, and stimulation and if they would consider a career in research after graduation.

In addition to the questionnaire, students' satisfaction with the unit was evaluated using the university's student evaluation questionnaire. This 10-item questionnaire asked students to rate their satisfaction with elements of teaching and learning on a scale of one to five where one corresponds to strongly disagree and five equates strongly agree. The evaluation explores the ability of the teaching and learning to allow students to achieve learning objectives, its intellectual value, and appropriateness of resources, feedback, and effectiveness of staff (Table 3).

Only students who completed both pre- and postsurveys were included in the analysis to assess change in perceived research skills. Wilcoxon Signed Ranks Test was used to assess if there was a difference between self-perceived competence in research skills and attitudes towards research prior to and following the completion of the unit. In order to establish if those who completed the pre- and postsurvey were different from those who completed the presurvey only, we also statistically evaluated if there was a difference in the above variables of interest between these two groups using Mann Whitney-U tests. Significance was considered at $P < 0.05$. Qualitative text responses were analyzed using a content analysis approach [18] by Claire Palermo, guided by qualitative description methodology [19], whereby text was coded and the most common codes developed into the main ideas from the data which was later verified by the other authors (Zoe Davidson). All students who responded to unit evaluation questionnaire were included in the analysis and descriptive statistics reported for each item on the questionnaire.

3. Results

There were 46 respondents to the survey at the commencement of the unit. Twenty-two students responded to the post-RSQ; however, only 17 students completed the survey in its entirety. Forty students responded to the unit evaluation questionnaire. In the 46 initial respondents, the average age of the group was 22 years which included 43 (93%) females, 35 (76%) students of Australian nationality, and seven students (15%) who had completed a degree prior to their current program of study.

There was no significant difference between the students who completed both the pre- and postsurvey (n = 17) compared to those who completed the presurvey only (n = 26) with the exception of two areas. Students who completed both surveys had a higher perceived competence in time management (median (IQR): 8 (7, 8) versus 7 (6, 7); P 0.013) and from an attitude perspective felt more involved with research (3 (1, 4) versus 4 (3, 5); P 0.006).

The analysis revealed that the teaching and learning strategies increased self-perceived competence in all of the specific research skills assessed (Table 1); however, these increases were small often representing an increase of 1 point in the 10-point scale. The unit also resulted in small improvements in self-perceived competence in several broader skills

Table 1: Self-perceived competency in broader and specific research skills prior to and following the completion of a nutrition research methods unit.

	Before		After					
	Median (IQR)	Range	Median (IQR)	Range	P	Improved (n)	No change (n)	Decrease (n)
Broader/transferable self-perceived research skills (n = 17)								
Communication skills, writing	7 (6, 7)	2–9	7 (6, 8)	5–9	0.053	8	8	1
Communication skills, oral	7 (6, 8)	5–8	7 (6, 8)	6–9	0.285	7	6	4
Information gathering, handling	6 (6, 7)	2–8	7 (6, 8)	5–10	**0.015**	10	5	2
Information evaluation	6 (6, 7)	3–8	7 (6, 8)	5–9	**0.024**	11	4	2
Numeracy	7 (6, 8)	6–9	7 (7, 9)	5–10	0.582	5	8	4
Teamwork	8 (8, 9)	5–10	8 (8, 9)	6–10	0.791	6	7	4
Ability to work independently	8 (8, 9)	7–10	9 (8, 10)	8–10	**0.020**	6	11	0
Project management skills	7 (7, 9)	5–10	8 (8, 9)	7–10	0.064	11	2	4
Time management skills	8 (7, 9)	6–10	8 (7, 8)	6–10	0.836	5	7	5
Problem-solving	8 (7, 8)	5–10	8 (7, 8)	6–10	0.796	5	7	5
Critical thinking	6 (6, 8)	5–8	7 (7, 8)	6–10	**0.039**	9	5	3
Specific self-perceived research skills (n = 18)								
Designing a study	6 (5, 6)	1–9	7 (6, 8)	5–10	**0.002**	14	2	2
Study sampling	6 (4, 6)	1–8	7 (6, 8)	5–10	**0.002**	13	3	2
Participant recruitment	5 (4, 6)	1–8	7 (6, 8)	5–9	**0.002**	13	3	2
Data collection	7 (5, 7)	1–9	8 (7, 8)	6–10	**0.003**	13	3	2
Biological statistics	6 (4, 6)	1–7	7 (6, 8)	4–10	**0.002**	13	3	2
Paper preparation/reporting	6 (5, 7)	2–8	7 (6, 8)	6–10	**0.004**	12	3	3
Paper presenting to an audience	6 (4, 7)	1–8	6 (6, 8)	5–9	**0.025**	11	2	5

Bold text $P < 0.05$. Competency assessed on a scale of 1 to 10 with 1 representing the lowest level of competency and 10 the highest. P obtained from Wilcoxon Signed Ranks Test comparing pre- and post-self-perceived competency in each respective skill.

including information gathering and handling, information evaluation, ability to work independently, and critical thinking. There were no reported changes in self-perceived communication, literacy, numeracy, project management, teamwork, or problem-solving skills (Table 1). There were also no changes in attitudes towards research following completion of the unit (Table 2).

Similarly, qualitative analysis revealed that there was no change in any of the general feelings towards research or a career in research after participation in the unit. However, the student's definition and understanding of the discourse of research changed marginally from a broad understanding of research with a focus on using existing evidence and collection of data to a more specific understanding that included the collection of data by conducting research rather than relying on existing evidence. Prior to commencement of the unit, students described research as a systematic process used to test hypothesis and gather information on a topic for which there is a need to know more about. At the conclusion of the semester, students described research as a process whereby they can discover something new by undertaking a study or using existing evidence. They also saw the value of research in contributing to answering the questions that arise out of practice more after completing the unit:

> *gathering [existing] evidence in a systematic way in order to address a question.* (student number 19, prequestionnaire)

> *. . . [research] can either be undertaking new studies or compiling and extracting data from previous studies to answer a new question.* (student number 9, postquestionnaire)

The unit was rated highly by students with median scores for all assessed items ranging from 4.3 to 4.8 out of a possible five (Table 3). Of particular note was the students' satisfaction with how this unit built upon previous units in the course (4.78 out of 5) which fulfills the university criteria of "outstanding" for a unit evaluation result.

An unintended evaluation was the number of groups progressing their systematic literature review to publication in a peer-reviewed journal. At the time of submission, one of

Table 2: Student attitudes towards research prior to and following the completion of a nutrition research methods unit.

	PRE		POST		P	Improved (n)	No change (n)	Decrease (n)
	Median (IQR)	Range	Median (IQR)	Range				
Motivated (1) to unmotivated (7)	3 (2, 4)	1–5	2 (2, 3)	1–4	0.223	6	7	4
Interested (1) to uninterested (7)	3 (2, 4)	1–6	2 (1, 3)	1–3	0.056	7	7	3
Involved (1) to uninvolved (7)	3 (1, 4)	1–4	3 (2, 3)	1–6	0.974	6	3	8
Not stimulated (1) to stimulated (7)	5 (4, 7)	3–7	5 (5, 6)	3–7	0.942	3	9	5
Do not want to study it (1) to want to study it (7)	5 (5, 6)	4–7	5 (5, 6)	3–7	0.557	4	9	4
Inspired (1) to uninspired (7)	3 (2, 4)	1–5	2 (2, 3)	1–6	0.295	9	4	4
Unchallenged (1) to challenged (7)	6 (5, 7)	5–7	6 (6, 7)	5–7	0.166	7	7	3
Un-invigorated (1) to invigorated (7)	5 (4, 6)	3–7	5 (5, 6)	3–7	0.317	8	4	5
Unenthused (1) to enthused (7)	5 (5, 6)	3–7	6 (5, 6)	4–7	0.166	7	7	3
Excited (1) to not excited (7)	3 (2, 5)	1–6	3 (2, 4)	1–5	0.409	8	3	6
Aroused (1) to not aroused (7)	3 (3, 4)	1–4	3 (3, 5)	1–7	0.088	4	5	8
Not fascinated (1) to fascinated (7)	6 (5, 6)	3–7	6 (5, 7)	4–7	0.166	7	7	3
Dreading it (1) to look forward to it (7)	5 (4, 6)	3–7	5 (5, 6)	3–7	0.428	8	4	5
Important (1) to unimportant (7)	2 (1, 2)	1–5	1 (1, 2)	1–3	0.206	5	10	2
Useful (1) to useless (7)	2 (1, 2)	1–5	1 (1, 2)	1–3	0.096	5	11	1
Helpful (1) to harmful (7)	2 (1, 2)	1–6	1 (1, 2)	1–3	0.096	5	11	1

P obtained from Wilcoxon Signed Ranks Test comparing pre- and postattitudes towards research.

Table 3: Applied research methods in nutrition student evaluation results.

Item	Median score	Range
The unit enabled me to achieve its learning objectives	4.59	2–5
I found the unit to be intellectually stimulating	4.63	3–5
The learning resources in this unit supported my studies	4.37	2–5
The feedback I received in this unit was useful	4.53	2–5
Overall I was satisfied with the quality of this unit	4.31	2–5
I was sufficiently aware of the organizational and/or professional requirements to be met for this unit	4.47	2–5
The content and objectives of the unit build upon previous units in the course	4.78	2–5
The practical activities in this unit were related to the content and learning objectives described in the unit manual	4.65	3–5
The staff for this unit were aware of my learning requirements	4.65	3–5
The criteria used to assess student work were made clear	4.50	3–5

$n = 40$. Competency assessed on a scale of 1 to 5 with 1 representing the lowest level of satisfaction and 5 the highest.

the ten groups has had their manuscript accepted for publication; one is under review; and two are in the final stages of drafting their manuscript for of publication.

4. Discussion

This research aimed to evaluate the effect of a year two undergraduate research methods unit on research skills of students. We found that the unit increased self-perceived competence in designing, sampling, recruiting, collecting, analysis, and communicating research. The unit also increased information gathering, handling, and evaluation and the students self-perceived ability to think critically and work independently. Despite the statistical significance of these changes, the effect size was relatively small with self-perceived competence in research skills increasing in most variables by 1 point on the 10-point scale. Of note, however, is the shift in the range of scores, with the minimum increasing across many variables by up to 5 points indicating that those with the lowest perceived competence in research skills may benefit more from this teaching and learning strategy. There is also inherent difficulties with using ordinal scales, in that it is difficult to fully understand the impact of a change in 1 point in perceived confidence. More tangible and "real world" outcomes such as publications arising from the unit are perhaps more concrete indicators of skill development.

The sample demographics, while drawn from one institution, are representative of nutrition and dietetics students

Table 4: Blueprint of research skills teaching in nutrition and dietetics curricula.

Unit name/year level	Learning objectives	Summative assessment related to research skill development
Year 1: evaluating the evidence, nutrition, and population health	(1) Interpret the demographics of the Australian population including indigenous, minority, and disadvantaged groups (2) Summarize the Australian health system and the political system and its operation at a national state and local level and outline the roles of the major bodies that provide government with scientific advice relating to food and also to health (3) Identify and describe the main socio-cultural, economic, environmental, and political determinants of health (4) Define public health and discuss the origins and nature of public health as a discipline (5) Compare and contrast the social versus the medical model of health and explain primary, secondary, and tertiary prevention paradigms and strategies for individuals and populations (6) Explain and compare the main study designs used in population health and nutrition research and explain the findings of key population health studies on the relationship between diet and chronic disease (7) Perform basic methods of qualitative and quantitative data collection and analysis (8) Search the scientific literature related to common questions on nutrition and health (9) Explain common methods used to survey the nutrient intake and the nutritional status of populations	Evaluation of indigenous health program or policy 20% Critical analysis of scientific paper using quality assessment 20% Argumentative essay using the evidence, for example, "The solution to childhood obesity is prevention not cure. Discuss." Midsemester test 10% End of semester exam 30%
Year 2: applied research methods in nutrition	(1) Design a simple research study relating to a nutrition issue (2) Define the process of systematic review (3) Develop and implement a systematic review protocol (4) Apply methods of qualitative and quantitative data analysis in confined settings (5) Compare and contrast different research methodologies (6) Apply principles of nutrition research project management via a hypothetical model (7) Synthesize and communicate findings from the scientific literature in the field of nutrition (8) Extend communication skills and practice in the context of nutrition research (9) Extend critical appraisal and enquiry skills	Group systematic literature review 50% Individual scientific report 50%
Year 3: food for dietetic practice (dietetics students only)	(1) Integrate food composition and practical food knowledge to a range of therapeutic applications to support dietetic practice (2) Compare and contrast food service systems across healthcare settings including key regulatory and accreditation systems relevant to food service management (3) Develop and communicate plans to provide safe and nutritious food in food service settings (4) Implement, evaluate, and disseminate results of activities that support delivery of quality nutrition and food standards within a food service (5) Apply research practice skills and innovative problem-solving to food service management challenges (6) Apply the principles of management in food service including organizational management, human resource management, and production management (7) Utilize reflection, professional, and personal communication and teamwork skills	Food service quality improvement project report (group) 35%

Table 4: Continued.

Unit name/year level	Learning objectives	Summative assessment related to research skill development
Year 3: evidence-based nutrition (nutrition science students only)	(1) Apply appropriate research methods in order to carry out scientific research and recognize the significance and relevance of the data and results obtained (2) Integrate knowledge in the identification, description, analysis, and solution of a research problem in the field of human nutrition (3) Articulate clear research aims, methods, and rationale (4) Show appropriate skills in applying methods and techniques relevant to your chosen project (5) Show initiative and independence, and manage your time and resources effectively to complete a project within allocated time scales (6) Utilize relevant information sources for the planning, conduct, and writing up of a project (7) Maintain accurate, accessible records of data collection, decisions made, and their rationale in a reflective workbook (8) Utilize suitable software packages for data manipulation and the preparation of typewritten documents (9) Evaluate the experimental approach adopted and recognize its strengths and limitations, and compare and integrate your project findings with findings from previous work reported in the literature or elsewhere (10) Prepare a structured, coherent project submission, via a series of drafts that are subject to repeated improvement and updating (11) Engage in critical discussion of the conduct of your project and the significance of its findings in an oral defence (three-minute thesis)	Oral presentation on research 10% Research proposal 20% Research scientific paper 50% Reflective workbook or laboratory notebook 10% Supervisor report 10%
Year 4: practice and research in dietetics (dietetics students only)	(1) Critically review nutrition and dietetic practice, identifying gaps in knowledge, and apply valid and relevant conclusions and recommendations for practice improvement (2) Utilize research, leadership, communication (including negotiation, advocacy, and conflict resolution), and management principles and skills in approaching solutions to practice problems. (3) Work effectively as a member of a team creating innovative solutions to nutrition and dietetics practice problems (4) Apply the principles of human resource management, budgeting, and risk management to project management and research (5) Synthesize and analyze information/data collected from practice and communicate scientifically (6) Plan and evaluate own personal and professional development in preparation for entry into the profession	Scientific paper 40% Peer review 10% Small grant proposal 20%

across Australia, young and predominately female [20], and therefore the findings may be generalizable to another undergraduate nutrition education. The findings show that this simulated, classroom based, nonresource intensive learning experience had the capacity to develop the research skills of students. It adds to the minimal literature in nutrition on teaching and learning strategies to promote research skill development and may also be of benefit to other health professions with similar student demographics.

The findings are congruent with previous research in nutrition students that has shown the enjoyment and development of research skills through experiencing research itself [21, 22]. The approach presented in this study offers a scaffold from which to create strong foundation for applied research prior to when students are in practice. This has the potential to enhance their real world research experience by preparing them more effectively.

Comparison of RSQ measures to the other literatures demonstrates that medical students self-perceived broader/transferable research skills were similar at baseline to our cohort but their specific self-perceived research skills were lower than the nutrition and dietetics students at baseline [17]. This is perhaps further evidence of the successful scaffolding of research teaching and learning between years one and two of the curriculum. The limitations of self-assessment of capability are acknowledged [23]. In this study, self-assessment of research skills was used to facilitate reflection and learning rather than summative assessment. When used for these purposes, self-perception is an important component of learning [24]. Measuring actual participation in research is needed. Future research may follow this cohort longitudinally and use validated measures of involvement in research [25] to assess the impact of this undergraduate learning experience on their work practice.

The finding that this learning experience did not alter students' self-perceived skills in communication, teamwork, and project management may relate to the fact that these learning outcomes were not made explicit to students. Other evidences from dietetics students' experiences of research suggest that it improved project management skills [22]. There is an opportunity to build in formative assessment into Applied Research Methods in Nutrition to highlight the learning that may be occurring around communication, teamwork, and project management as a result of this experience.

This study is limited in that it reports outcomes from only a single small sample of students from the one university. This was due to a poor response rate to the postquestionnaire. This research was conducted during semester, so competing demands of students such as assignments and exams as well as completion of unit evaluations most definitely hindered our response rate. Also the method of administration likely influenced the follow-up response rate. There were 46 respondents to the survey at the commencement of the unit. This presurvey was administered in class time. Only 17 of these respondents submitted completed surveys at the follow-up which was administered outside of class time.

The comparison of self-perceived research skills and attitudes towards research between those students who completed both surveys and those who completed the presurvey only highlighted some important differences between these students. Those who completed both surveys perceived that they were slightly more confident in time management. Considering the competing demands on the students at the time of the postsurvey, these students may have felt they had more time to complete the survey. The other difference between these two groups of students was that those who completed both surveys reported that they felt more involved in research at the pre survey. This could indicate that we have captured those students who were more engaged and who potentially had the best learning outcomes. However, there was no difference in the multiple other research skills or attitudes assessed at the presurvey.

There is an opportunity to follow these students longitudinally to measure the further development of their research skills through practical placement and other learning activities as well as their involvement with research following their degree. This longitudinal evaluation will assist with providing tangible outcomes regarding the development of research skills. In addition, the answers to the qualitative component of the RSQ lacked appropriate depth to sufficiently describe changes in students' attitudes towards research. Students' answers may have also been influenced by the timing of the survey (end of semester). Future research should incorporate focus groups to enable in-depth exploration of this topic and also account for discourses among student views. Ultimately, we seek to understand not just how to train evidence-based practitioners but also how to motivate future researchers.

5. Conclusion

Our new, year two level research methods unit appeared successful in enhancing students' research skills. Further exploration of learner attitudes towards research is needed with consideration of how these might be addressed in future research skills teaching.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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References

[1] D. L. Sackett, W. M. C. Rosenberg, J. A. M. Gray, R. B. Haynes, and W. S. Richardson, "Evidence based medicine: what it is and what it isn't. It's about integrating individual clinical expertise

and the best external evidence," *British Medical Journal*, vol. 312, no. 7023, pp. 71–72, 1996.

[2] N. Taylor, "Research experience and research interests of allied health professionals," *Journal of Allied Health*, vol. 38, no. 4, pp. e107–e111, 2009.

[3] J. A. Harrison, A. M. Brady, and E. Kulinskaya, "The involvement understanding and attitudes of dietitians towards research and audit," *Journal of Human Nutrition and Dietetics*, vol. 14, no. 4, pp. 319–330, 2001.

[4] K. Whelan and S. Markless, "Factors that influence research invovlement amoung Registered Dietitians working as university faculty: a qualitative interview study," *Journal of the Academy of Nutrition and Dietetics*, vol. 112, no. 7, pp. 1021–1028, 2012.

[5] A. J. Howard, M. Ferguson, P. Wilkinson, and K. L. Campbell, "Involvement in research activities and factors influencing research capacity among dietitians," *Journal of Human Nutrition and Dietetics*, vol. 26, supplement 1, pp. 180–187, 2013.

[6] L. D. Byham-Gray, J. A. Gilbride, L. B. Dixon, and F. K. Stage, "Evidence-based practice: what are dietitians' perceptions, attitudes, and knowledge?" *Journal of the American Dietetic Association*, vol. 105, no. 10, pp. 1574–1581, 2005.

[7] L. D. Byham-Gray, J. A. Gilbride, L. B. Dixon, and F. K. Stage, "Predictors for research involvement among registered dietitians," *Journal of the American Dietetic Association*, vol. 106, no. 12, pp. 2008–2015, 2006.

[8] C. King, L. Byham-Gray, J. S. Parrott, J. O'Sullivan Maillet, M. M. Roberts, and P. Splett, "Applying social cognitive career theory to registered dietitian research involvement: a randomized controlled trial," *Journal of Allied Health*, vol. 43, no. 4, pp. 201–211, 2014.

[9] A. Brotherton and K. Whelan, "Improving the evidence base in clinical nutrition, public health nutrition and epidemiology, nutritional science and dietetic professional practice," *Journal of Human Nutrition and Dietetics*, vol. 25, no. 1, pp. 1–2, 2012.

[10] K. Whelan, J. E. Thomas, and A. M. Madden, "Student research projects: the experience of student dietitians, university faculty members and collaborators," *Journal of the American Dietetic Association*, vol. 107, no. 9, pp. 1567–1574, 2007.

[11] C. Palermo, A. Fitzgerald, and D. Nestel, "Student and faculty perceptions of research in nutrition and dietetics: a qualitative investigation," *Critical Public Health*, vol. 2, no. 1, pp. 34–44, 2014.

[12] D. Kolb, R. Boyatzis, and C. Mainemelis, "Experiential learning theory: previous research and new directions," in *Perspectives on Congnitive, Learning and Thinking Styles*, R. J. Sternberg and L. F. Zhang, Eds., Lawrence Erlbaum, Hillsdale, NJ, USA, 2000.

[13] D. F. Wood, "ABC of learning and teaching in medicine: problem based learning," *British Medical Journal*, vol. 326, no. 7384, pp. 328–330, 2003.

[14] PRISMA, *Preferred Reporting Items for Systematic Reviews and Meta-Analyses*, Prisma, 2014, http://www.prisma-statement.org/statement.htm.

[15] D. R. Sadler, "Beyond feedback: developing student capability in complex appraisal," *Assessment & Evaluation in Higher Education*, vol. 35, no. 5, pp. 535–550, 2010.

[16] J. Pearce, R. Mulder, and C. Baik, *Involving Students in Peer Review: Case Studies and Practical Strategies for University Teaching*, Centre for the Study of Higher Education, The University of Melbourne, Melbourne, Australia, 2009.

[17] L. N. Burgoyne, S. O'Flynn, and G. B. Boylan, "Undergraduate medical research: the student perspective," *Medical Education Online*, vol. 15, no. 5212, 2010.

[18] P. Liamputtong, *Research Methods in Health. Foundations for Evidence Based Practice*, Oxford University Press, South Melbourne, Australia, 2010.

[19] M. Sandelowski, "What's in a name? Qualitative description revisited," *Research in Nursing & Health*, vol. 33, no. 1, pp. 77–84, 2010.

[20] R. Hughes and B. Desbrow, "Aspiring dietitians study: a pre-enrolment study of students motivations, awareness and expectations relating to careers in nutrition and dietetics," *Nutrition & Dietetics*, vol. 62, no. 2-3, pp. 106–109, 2005.

[21] K. Whelan, J. Thomas, and M. Madden, "Undertaking a research project improves student dietitians' confidence in their research skills," *Journal of Human Nutrition and Dietetics*, vol. 19, pp. 474–475, 2006.

[22] B. Desbrow, M. Leveritt, M. Palmer, and R. Hughes, "Evaluation of a curriculum initiative designed to enhance the research training of dietetics graduates," *Nutrition and Dietetics*, vol. 71, no. 1, pp. 57–63, 2014.

[23] C. P. M. van der Vleuten, "The assessment of professional competence: developments, research and practical implications," *Advances in Health Sciences Education*, vol. 1, no. 1, pp. 41–67, 1996.

[24] R. M. Epstein, D. J. Siegel, and J. Silberman, "Self-monitoring in clinical practice: a challenge for medical educators," *Journal of Continuing Education in the Health Professions*, vol. 28, no. 1, pp. 5–13, 2008.

[25] K. Whelan, E. Copeland, L. Oladitan, T. Murrells, and J. Gandy, "Development and validation of a questionnaire to measure research involvement among registered dietitians," *Journal of the Academy of Nutrition and Dietetics*, vol. 113, no. 4, pp. 563–568, 2013.

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Research Article

Making an IMPACT: The Story of a Medical Student-Designed, Peer-Led Healthy Eating and Physical Activity Curriculum

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Despite the importance of healthful dietary choices in combating the childhood obesity epidemic, neither primary and secondary schools nor medical schools provide adequate nutrition education. In 2005, two medical students at the University of North Carolina started the Improving Meals and Physical Activity in Children and Teens (IMPACT) program, which utilized a peer-educator model to engage medical students and high school students in teaching 4th graders about healthy eating and physical activity. Over the years, medical student leaders of IMPACT continued the program, orienting the curriculum around the 5-2-1-0 Let's Go campaign, aligning the IMPACT curriculum with North Carolina state curricular objectives for 4th graders and engaging and training teams of health professional students to deliver the program. The IMPACT project demonstrates how medical and other health professional students can successfully promote nutrition and physical activity education for themselves and for children through community-based initiatives. Ongoing efforts are aimed at increasing family participation in the curriculum to maximize changes in eating and physical activity of IMPACT participants and ensuring sustainability of the organization by engaging health professional student participants in continuing to improve the program.

1. Introduction

Rates of childhood obesity have tripled in recent decades with estimates that 30% of American children will be obese by 2030 if the epidemic is not stopped [1]. Despite the increasingly apparent relationship between certain eating behaviors, obesity, and chronic disease and death [2, 3], less than half of American medical schools are providing the recommended amount of nutrition education [4]. Nutrition education for medical students is especially important because, in the authors' experience, medical students can make important contributions to improving nutrition and physical activity and improving community health even very early in their careers.

In the fall of 2004, two of the authors (Avik Chatterjee and Natalie D. Muth) started medical school at the University of North Carolina at Chapel Hill (UNC). At that time, before the *Let's Move* campaign [5] and the 2013 United States Department of Agriculture school food guidelines [6], childhood obesity was already an epidemic problem nationally [7] and in North Carolina [8]. As a former high school teacher (Avik Chatterjee) and a registered dietitian with training in public health (Natalie D. Muth), both saw the potential for a school-based intervention to improve eating behaviors [9, 10] and recognized the power of peer teaching to improve health behaviors among children [11]. Together they developed a healthy eating and physical activity education curriculum for elementary school students led by high school students. They named this curriculum IMPACT—Improving Meals and Physical Activity in Children and Teens.

2. The IMPACT Intervention

In the spring of 2005, Avik Chatterjee and Natalie D. Muth partnered with UNC School of Medicine Pediatric faculty

and a local school district. Working closely with the Director of Healthy Living of the school district the team identified an elementary school and a high school located within short walking distance of each other. Concurrently, Avik Chatterjee and Natalie D. Muth applied for and received the Albert Schweitzer fellowship to support their intervention.

The IMPACT curriculum consisted of twelve-hour-long, once-weekly lessons [12]. Approximately half of each lesson was designated for nutrition education and half for physical activity. The nutrition education and physical activity materials were assembled from nutrition education programs (such as MyPyramid) [13] and physical activity programs (such as the CDC's VERB program) [14] that were available online at that time.

Avik Chatterjee and Natalie D. Muth worked closely to establish and nurture partnerships among the school district, medical school, students and families, and local communities. At the high school they worked closely with health education teachers to recruit and train high school student educators to deliver the curriculum. In the community they established relationships with local businesses, including an athletic club to provide the space for the trainings and gym memberships as incentives to high school student educators. Local grocery stores and other vendors also generously provided assistance with healthy snacks for the curriculum sessions. Elementary school teachers and 4th-grade teachers allowed the intervention into two of their classrooms. The students and families were also highly involved. Each week, students had a homework assignment that required family involvement, and at the end of the curriculum students and families came together at the school for a celebration with healthy snacks.

Evaluation was an important aspect of the program. Students in the two intervention classes and two control classes had body mass index (BMI) measured and filled out surveys about their knowledge, attitudes, and behaviors on certain target eating behaviors. The intervention went exceptionally smoothly and was well-received by high school student peer educators and 4th-grade participants. While there was no significant difference in the change in BMI percentile for age between the intervention and control groups (−1% in the intervention students compared to control students; $P = 0.59$), in a difference-in-differences analysis students in the intervention group were more likely to know how many servings of fruits and vegetables they should eat (+20% compared with controls; $P = 0.01$) and also reported eating more fruits and vegetables (+0.85 servings/day compared with controls; $P = 0.05$). All P values are for the interaction term between the outcome and the presence of the intervention in a linear regression model adjusted for sex, age, baseline value of the variable, and BMI percentile, except in the case where BMI percentile itself is the outcome [12].

3. IMPACT over Time

As authors Natalie D. Muth and Avik Chatterjee progressed in their medical education, the IMPACT curriculum took varying forms. After a brief hiatus, UNC medical students revamped and relaunched the curriculum with a focus on the intervention in elementary schools.

The IMPACT Program was revived in 2012 by authors Julia Nugent and Lindsey M. Rose with the goals of providing education on healthful living to elementary children in order to be involved in community-wide preventative medicine. Upon entering medical school at UNC in 2012, Julia Nugent was invigorated by the idea of IMPACT, especially with a background in biochemistry and strong interest in nutrition. As a former 5th-grade teacher who saw how unhealthful living negatively affected her students and community, Lindsey M. Rose sought out IMPACT. Since IMPACT was not active, they reinstated this important program as a means of both promoting additional nutrition education for health professional students and providing a meaningful way to interact with the community in which they lived.

Under the guidance of an experienced faculty mentor at UNC School of Public Health, IMPACT made significant changes to the curriculum, incorporating the 5-2-1-0 recommendations as the foundation of the curriculum, teaching teams of health professional students to provide direct education to 4th-grade elementary students, and providing lecture series for health professional student-teachers focused on clinical nutrition.

The backbone of IMPACT's lessons is the 5-2-1-0 message, a component of the Let's Go initiative first implemented in Portland, Maine, in 2006 [16–19]. The creators of Let's Go reasoned that a consistent message, in addition to on-the-ground promotion, could raise awareness of healthy lifestyles and begin to address the childhood obesity problem in their community. The 5-2-1-0 mnemonic presents four daily recommendations: "eat 5 or more fruits and vegetables," "limit screen time to two hours or less," "participate in 1 hour of physical activity," and "aim for 0 sugary drinks" [20]. When this message was taught in 56 school settings in Portland, Maine, in addition to systematic changes and community, participants were found to consume more fruits and vegetables and less sugary drinks and report that they were more aware of the 5-2-1-0 model [21]. Students are encouraged to follow the 5-2-1-0 program via weekly trackers and paper communication with their parents.

Fourth-grade classrooms in North Carolina were specifically targeted because their science curriculum includes learning about healthful living as well as specific disease processes that are more common in people with poor diet and exercise habits. IMPACT lessons were designed to align with the North Carolina Essential Standards for Nutrition and Physical Activity and Science (Table 1).

The IMPACT program utilizes teaching teams comprised of health professional students (medical students, dental students, nursing students, pharmacy students, and public health students) who work with the fourth-grade teams of two local elementary schools to lead a six-week-long program. The students, mostly medical students, are recruited through activity fairs, student government newsletters, and an introductory interest meeting. Classroom group assignments are made considering past experience in classrooms or working with this age group as well as volunteer preference in forming their own teaching groups. Weekly teaching groups

Table 1: North Carolina Essential Standards and Clarifying Objectives for 4th-grade nutrition and physical activity and science addressed by the IMPACT curriculum [15].

NC Essential Standard	Objective addressed
4.NPA.1: Apply tools (MyPlate, Food Facts Label) to plan healthy nutrition and fitness.	4.NPA.1.1: Plan meals using MyPlate. 4.NPA.1.3: Use the Food Facts Label to plan meals and avoid food allergies.
4.NPA.2: Understand the importance of consuming a variety of nutrient dense foods and beverages in moderation.	4.NPA.2.1: Compare unhealthy and healthy eating patterns, including eating in moderation. 4.NPA.2.2: Explain the effect of eating healthy and unhealthy breakfasts and lunches.
4.NPA.3: Understand the benefits of nutrition and fitness to disease prevention.	4.NPA.3.1: Explain how nutrition and fitness affect cardiovascular health. 4.NPA.3.2: Summarize the association between caloric intake and expenditure to prevent obesity.
4.L.2: Understand food and the benefits of vitamins, minerals, and exercise.	4.L.2.1: Classify substances as food or nonfood items based on their ability to provide energy and materials for survival, growth, and repair of the body. 4.L.2.2: Explain the role of vitamins, minerals, and exercise in maintaining a healthy body.

NPA: nutrition and physical activity.
L: life science.

consist of three to four teachers, and there is typically a pool of substitute volunteers that are contacted as needed. Before entering the classroom, all volunteers attend a training session in order to review the curriculum and discuss classroom management strategies. Throughout the program they are encouraged to collaborate and tailor the lessons to best suit their respective classrooms. Lessons follow a similar basic structure over a six-week timeline, beginning with a brief interactive lecture followed by a variety of small group exercises to reinforce key lesson concepts. Lessons culminate with a physical activity, such as a "Dance Off," to reinforce the emphasis on exercise.

Evaluation continued to be an important part of IMPACT. Pre- and postprogram exams were given to evaluate IMPACT's efficacy; the tests consisted of 6 multiple choice questions, one evaluating a main point of each of the six lessons. The mean, standard deviation, standard error of the mean, and a two-tailed t-test with unequal variance calculated in Microsoft Excel (Durham, NC) were used to statistically evaluate the efficacy of the IMPACT program. A trend towards improvement in exam score was seen but, in paired t-test analysis, did not reach statistical significance (Figure 1; preprogram test score 77% SD 9.2, postprogram test score 84% SD 2.9; P value 0.13, $n = 30$). The accumulated data in addition to feedback from the elementary school teachers identified areas for curriculum improvement. Another important source of evaluation was the informal feedback from the IMPACT volunteers. Their reports help guide future lesson planning to benefit both the students and the volunteer teachers.

In addition to elementary school outreach, the IMPACT organization provides supplemental nutrition education for motivated UNC health professional students with seminars provided by UNC faculty members focused on topics with clinical and public health relevance. Presentations entitled "Nutrition Myths," "Nutrition in Oncology," "Adolescent Eating Disorders," and "How to Counsel Parents of the Obese Child" have stimulated valuable interdisciplinary discussions on nutrition in medicine.

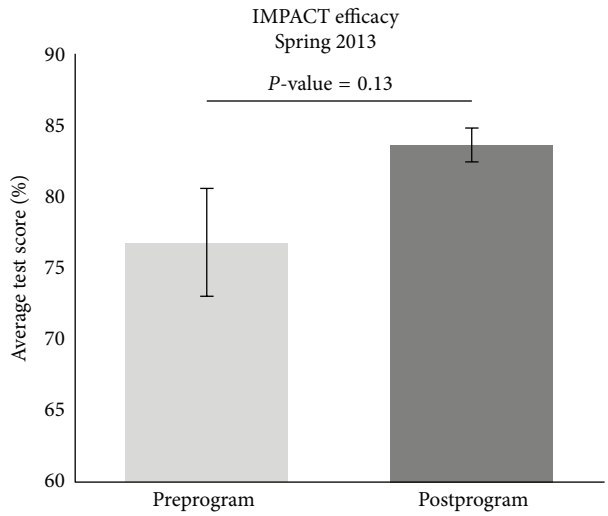

Figure 1: Average test scores and standard errors of a 6-question multiple choice test given before and after IMPACT program, evaluating the efficacy of the program in teaching key lesson concepts ($n = 30$). P value is for a paired t-test.

4. Lessons Learned

The IMPACT experience provides a model of how medical students, with the right support and mentorship, can create and implement a successful intervention to improve eating behaviors and physical activity in the community. Combining

nutrition education and physical activity, peer education, and family and community engagement are the cornerstones of IMPACT's continued success.

However, a current limitation of the IMPACT curriculum is the lack of parental involvement in lessons. Parental nutrition education can be a strong determinant in a child's health habits [22, 23], and therefore increased parental involvement has become a major goal of current co-president authors Thomas N. Rusher and Kenneth W. Herring for improvement of IMPACT. While there are constraints to only address a small subset of 4th graders without broader parental and community involvement, there is intrinsic value for these students and their families to think about their own health and nutrition within the framework of an organized curriculum.

Throughout the years, another important lesson that the IMPACT story has illustrated is the challenge and value in establishing a sustainable organization. Therefore, an essential goal of IMPACT has been to address sustainability as an organization by gaining official recognition with the university administration, establishing organization bylaws and philosophy, and creating Standard Operating Protocols to ensure smooth transition between leaders. Every member of IMPACT team has contributed substantially to the program, making the importance and privilege of its continued existence even more apparent.

As obesity and other nutrition-related conditions and diseases continue to affect children and adults in America, nutrition education that allows medical students to engage in prevention will be increasingly important. Furthermore, with a call for increased nutrition and exercise education in the medical school curriculum [24], the value of teaching in solidifying one's own understanding, and the growing need for clinic-community integration [25], programs such as the IMPACT program provide a unique and fulfilling opportunity for medical students to gain competencies required for physicians to solve today's greatest health challenges.

The IMPACT program at UNC will continue during the 2014-2015 academic year and, we predict, for years to come. The authors and the members of the IMPACT team will share curriculum materials and their experience with others interested in organizing similar initiatives.

Conflict of Interests

The authors have no conflict of interests to declare.

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References

[1] K. M. Flegal, D. Carroll, B. K. Kit, and C. L. Ogden, "Prevalence of obesity and trends in the distribution of body mass index among US adults, 1999–2010," *The Journal of the American Medical Association*, vol. 307, no. 5, pp. 491–497, 2012.

[2] A. Bellavia, S. C. Larsson, M. Bottai, A. Wolk, and N. Orsini, "Fruit and vegetable consumption and all-cause mortality: a dose-response analysis," *The American Journal of Clinical Nutrition*, vol. 98, no. 2, pp. 454–459, 2013.

[3] A. Pan, Q. Sun, A. M. Bernstein, M. B. Schulze, J. E. Manson, and M. J. Stampfer, "Red meat consumption and mortality: results from 2 prospective cohort studies," *Archives of Internal Medicine*, vol. 172, no. 7, pp. 555–563, 2012.

[4] K. M. Adams, K. C. Lindell, M. Kohlmeier, and S. H. Zeisel, "Status of nutrition education in medical schools," *The American Journal of Clinical Nutrition*, vol. 83, no. 4, pp. 941S–944S, 2006.

[5] Let's Move!, 2014, http://www.letsmove.gov/.

[6] USDA, *USDA Unveils Historic Improvements to Meals Served in America's Schools New Standards Will Improve the Health and Wellbeing of 32 Million Kids Nationwide*, USDA, Fairfax, Va, USA, 2012, http://www.usda.gov/wps/portal/usda/usdahome?contentid=2012/01/0023.xml.

[7] C. L. Ogden, M. D. Carroll, B. K. Kit, and K. M. Flegal, "Prevalence of obesity and trends in body mass index among US children and adolescents, 1999-2010," *Journal of the American Medical Association*, vol. 307, no. 5, pp. 483–490, 2012.

[8] Percentage of Overweight and Obese Children through Years of Age, NC-NPASS 1995—2012, 2011, http://www.eatsmartmovemorenc.com/Data/Texts/Chart_Obesity_Overweight trends 1995-2012.pdf.

[9] F. T. Shaya, D. Flores, C. M. Gbarayor, and J. Wang, "School-based obesity interventions: a literature review," *Journal of School Health*, vol. 78, no. 4, pp. 189–196, 2008.

[10] M. Sharma, "School-based interventions for childhood and adolescent obesity," *Obesity Reviews*, vol. 7, no. 3, pp. 261–269, 2006.

[11] A. R. Mellanby, J. B. Rees, and J. H. Tripp, "Peer-led and adult-led school health education: a critical review of available comparative research," *Health Education Research*, vol. 15, no. 5, pp. 533–545, 2000.

[12] N. D. Muth, A. Chatterjee, D. Williams, A. Cross, and K. Flower, "Making an IMPACT: effect of a school-based pilot intervention," *North Carolina Medical Journal*, vol. 69, no. 6, pp. 432–440, 2008.

[13] MyPyramid [Internet], Wikipedia, 2014, http://en.wikipedia.org/wiki/MyPyramid.

[14] CDC, *VERB: CDC's Youth Campaign*, CDC, 2014, http://www.cdc.gov/youthcampaign/.

[15] North Carolina Essential Standards: Health Education—Grades 3–5 [Internet], 2011, http://www.dpi.state.nc.us/acre/standards/new-standards/.

[16] N. F. Krebs and M. S. Jacobson, "Prevention of pediatric overweight and obesity," *Pediatrics*, vol. 112, no. 2, pp. 424–430, 2003.

[17] C. S. Berkey, H. R. Rockett, A. E. Field et al., "Activity, dietary intake, and weight changes in a longitudinal study of

preadolescent and adolescent boys and girls," *Pediatrics*, vol. 105, no. 4, p. E56, 2000.

[18] A. Must, E. E. Barish, and L. G. Bandini, "Modifiable risk factors in relation to changes in BMI and fatness: what have we learned from prospective studies of school-aged children?" *International Journal of Obesity*, vol. 33, no. 7, pp. 705–715, 2009.

[19] B. A. Swinburn, I. Caterson, J. C. Seidell, and W. P. T. James, "Diet, nutrition and the prevention of excess weight gain and obesity," *Public Health Nutrition*, vol. 7, no. 1, pp. 123–146, 2004.

[20] V. W. Rogers and E. Motyka, "5-2-1-0 Goes to school: a pilot project testing the feasibility of schools adopting and delivering healthy messages during the school day," *Pediatrics*, vol. 123, no. 5, pp. S272–S276, 2009.

[21] V. W. Rogers, P. H. Hart, E. Motyka, E. N. Rines, J. Vine, and D. A. Deatrick, "Impact of let's go! 5-2-1-0: a community-based, multisetting childhood obesity prevention program," *Journal of Pediatric Psychology*, vol. 38, no. 9, pp. 1010–1020, 2013.

[22] K. E. Rhee, C. W. DeLago, T. Arscott-Mills, S. D. Mehta, and R. K. Davis, "Factors associated with parental readiness to make changes for overweight children," *Pediatrics*, vol. 116, no. 1, pp. e94–e101, 2005.

[23] E. M. Perrin, J. C. Jacobson Vann, J. T. Benjamin, A. C. Skinner, S. Wegner, and A. S. Ammerman, "Use of a pediatrician toolkit to address parental perception of children's weight status, nutrition, and activity behaviors," *Academic Pediatrics*, vol. 10, no. 4, pp. 274–281, 2010.

[24] Teaching nutrition and physical activity in medical school: training doctors for prevention-oriented care, 2014, http://greenvillemed.sc.edu/doc/Nutrition-and-Physical-Activity-Initiative.pdf.

[25] W. Dietz and D. Bradley, Integrated Clinical and Social Systems for the Prevention and Management of Obesity, Washington, DC, USA, 2014, http://www.iom.edu/~/media/Files/Activity Files/Nutrition/Obesity-Roundtable/Innovation_Collaboratives/About_the_ICSSPMO_IC.pdf.

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Review Article

A Novel Method of Increasing Medical Student Nutrition Awareness and Education

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Medical nutrition education in most US medical schools is lacking, despite an epidemic of lifestyle related chronic conditions and high rates of malnutrition in hospitals. In a unique response to this deficit, students at Boston University School of Medicine have created a novel student interest group entitled Student Nutrition Awareness and Action Council (SNAAC). This student group is unique in that it focuses on interprofessional collaboration and development of concrete practice skills and works to fill educational gaps. The goal of SNAAC is to increase medical student knowledge, attitude, and skills in medical nutrition through providing extracurricular activities and partnering with official medical school curriculum committees. To accomplish this, SNAAC has developed a multipartite group overseen by a mentoring team composed of a physician nutrition specialist, registered dietitian, and a mental health provider. SNAAC provides nutrition oriented opportunities for members and the student body at large. Participation is high because it fills an educational gap, offers a unique focus on expanding nutrition awareness and education, and provides opportunities for student leadership and professional development. We encourage other medical schools to use the SNAAC student involvement model to increase nutrition awareness and facilitate the incorporation of medical nutrition in their curriculum.

1. Introduction

Nutrition education in medical school, residency and subspecialty medical training is inadequate despite the high prevalence of hospital malnutrition (40–60%) [1] and evidence that nutrition interventions reduce morbidity and mortality [2–5]. Obesity is also highly prevalent and has been identified as the second leading cause of preventable death in the United States [1]. Appropriate knowledge of nutrition is necessary to prevent and treat nutrition conditions from the hospital to the community setting. The United States Preventative Services Task force urged physicians to counsel their patients regarding nutrition and weight management to fulfill the recommendations for 2010 [2]. Therefore physicians graduating from medical school and residency should be able to provide anticipatory nutrition guidance, identify and assess patients at nutrition risk, and refer them appropriately to a dietitian or a multidisciplinary team that includes a dietitian. These skills represent the first step to improving nutrition-related health outcomes, length of hospital stay and cost of care [6].

Despite these recommendations, physician lifestyle counseling declined from 7.8% to 6.2% of all visits from 1995-96 to 2007-08 [7]. The most common barriers stated by primary care physicians to providing nutrition counseling included knowledge deficits, inadequate resources, lack of time, and poor compensation [8]. The knowledge gap is attributed largely to a lack of nutrition education and training in the medical school curriculum. Currently, undergraduate medical nutrition education focuses primarily on the basic scientific understanding of metabolism and vitamin deficiencies, but does not translate into direct patient care and is not driven by current standards of clinical practice.

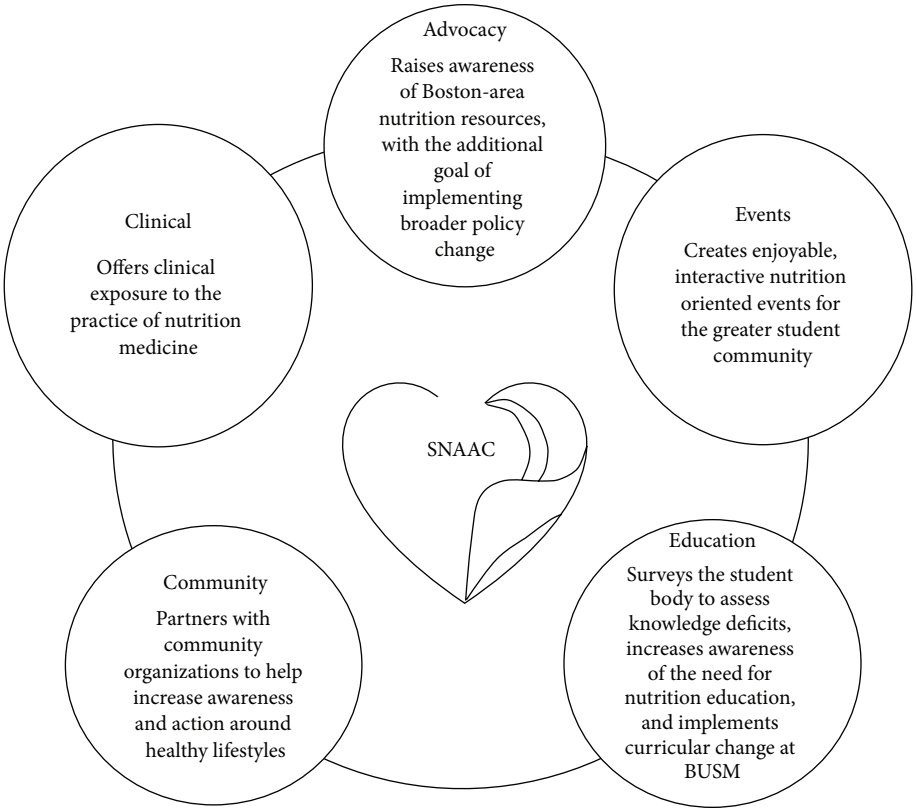

Figure 1: Group structure of SNAAC.

Medical students are aware of this deficit, and frequently express a desire for increased nutrition education in the curriculum [9–11]. To address the need for curricular change at Boston University School of Medicine (BUSM), motivated students created a student-run nutrition interest group entitled the Student Nutrition Awareness and Action Council (SNAAC). The purpose of this paper is to describe the group's composition and experiences in offering nutrition focused extracurricular learning opportunities and curricular change in hope of demonstrating how student-led interest groups following the SNAAC model can be a vehicle for nutrition advocacy in medical schools.

2. Multifaceted Group Structure

The Student Nutrition Awareness and Action Council (SNAAC) was founded in 2009 by two medical students. The primary goal of this group is to improve medical student understanding of nutrition and obesity medicine using extracurricular service-learning projects. Other goals include teaching students how to assess nutritional status and equip them with counseling techniques to treat patients at nutritional risk, as well as creating a base of interested students to advocate for broader nutrition education change. As opposed to the more typical single focus student interest groups, SNAAC has opted for a multifaceted approach that encompasses five key areas (Figure 1, group structure of SNAAC).

Like other student interest groups, two student co-chairs lead the group, but each of the five key areas has an additional dedicated student leader. Another unique feature of SNAAC is the support it gets through a multidisciplinary mentoring team rather than from one advisor. This mentoring team is composed of three faculty members: a physician nutrition specialist, a registered dietitian, and a licensed clinical social worker. When founded in 2009, the group consisted of two students. By the 2012 academic year, there were an average of 29 active members and around 100 participants in SNAAC-sponsored events annually.

The multifaceted approach allows for multiple activities to occur during the same academic year and attracts students with a variety of interest and skills that complement each other. Highlights from the 2012 academic year include the introduction of two new events aimed at increasing medical student awareness of challenges faced by the underserved populations served by Boston Medical Center (BMC) and surrounding network of community health centers. One event is the "Supplemental Nutrition Assistance Program (SNAP) challenge," where students volunteered to limit their weekly grocery spending to the average Massachusetts SNAP benefit for an individual and journal their experience. The other event is the "Test Kitchen," a partnership with Boston Medical Center's (BMC) state-of-the-art demonstration kitchen to familiarize medical students with nutrition resources and skills through attending cost-conscious healthy

Table 1: Compilation of SNAAC activities over the 2012–2014 academic years.

Event	Branch	Description	Participants
SNAP challenge	Advocacy	Students challenged to limit their grocery spending to $33/wk, the average MA SNAP benefit for an individual	17 medical students since 2012
Test Kitchen	Advocacy	Familiarizing medical students with nutrition resources and skills through attending cost-conscious healthy cooking demos	24 medical students since 2012
Nutrition for Life (NFL) Clinic observation	Clinical	Providing medical students with early exposure to outpatient specialty multidisciplinary pediatric weight management	Approximately 30 medical students since 2010
BMSCoN, Nutrition Lecture Series	Community outreach	Creating a city-wide network of nutrition oriented medical students to increase networking and nutrition education resources	4 BUSM students active in leadership, attendance of ~20 BUSM students per lecture. 7 other Boston medical students from Tufts and Harvard also active in group leadership
Wellness fair for Spanish speaking elders	Community outreach	Provided nutrition counseling, education materials, and healthy snack demonstration for wellness fair attendees	4 Spanish speaking SNAAC members assisted in this collaborative project
Nutrition module, 1st and 2nd years	Education	Incorporated 2 mandatory online modules into the first and second year curriculums that focus on taking a diet history and evaluating popular diet trends, with the aim of increasing positive attitudes to physician lifestyle counseling	Mandatory participation of BUSM class of approximately 175 students
Nutrition module, 4th year	Education	Aimed at students entering all specialties, this will combine online instruction with in-class practice of basic nutrition and behavioral health counseling	Mandatory for each BUSM 4th year class, approximately 175 students
Orientation bus tour	Education	To introduce first year medical students to the food and fitness environment of Boston neighborhoods during the orientation bus tour	4 SNAAC members participated in the orientation, which was attended by 175 1st year BUSM students at the start of medical school
DI/MS match	Events	Pairing dietetic interns and medical students to share knowledge and build interdisciplinary approaches to healthy lifestyle counseling	57 medical students and 57 dietetic interns since 2010
Walk for hunger	Events	Raising awareness of food insecurity by participating in the Boston-wide event	10 students
Lunch talks	Events	Providing educational, nutrition-focused talks that will meet a wide range of interests in the medical student body	Attendance of around 25–50 medical students per lecture; ~4 lectures per academic year

cooking classes. Both activities enhance student understanding and empathy for the population they serve and give them concrete skills to draw upon. As a result, their confidence and ability to counsel patients regarding healthy lifestyles increase. For a more complete listing of SNAAC's accomplishments, please see Table 1: Compilation of SNAAC activities over the 2012–2014 academic years.

3. Multidisciplinary and Interprofessional Approach

SNAAC is also set apart by its efforts to increase communication and collaboration across professions. In light of the current movement in education reform, the Association of American Medical Colleges (AAMC) has provided recommendations to implement interprofessional education and collaborations in order to enable future physicians to provide better team care and reduce error [12–14]. There is increasing evidence that interprofessional collaboration helps students understand their role and that of others in the health care team [15], thus improving care. In fact, Karnieli-Miller agrees that experiences of communicating and working within teams are the best method for learning about professionalism [16].

Unique to SNAAC is the dietetic intern/medical student (DI/MS) match. Through this program, students are able to work one-on-one with dietetic interns, a unique opportunity for many future physicians. Dietetic interns counsel medical students about their diet and lifestyle habits and share information about nutritional management of disease. Medical students share their knowledge in medical assessment and drug treatments of disease. One of the activities includes a trip to the grocery store, where students learn to better understand food access issues, read labels, and be smarter

consumers. Since its creation in 2010, there have been more than one hundred student participants in the DI/MS match. Medical students have reported gaining a better understanding of the important role that dietitians play in the health care system, a finding observed in other interprofessional student activities [17, 18]. In an era where health care is increasingly team based and multidisciplinary, these are valuable lessons for future clinicians.

SNAAC has also been instrumental in providing early clinical exposure to a team-based approach to weight management. This is done by providing all first and second year students the opportunity to observe a family-centered team approach to pediatric obesity at the Nutrition and Fitness for Life (NFL) clinic at BMC. During the clinical visit, a team comprised by a physician nutrition specialist, a registered dietitian, and a licensed social worker conduct a medical, dietary, and mental health assessment of an obese child or adolescent and provide a comprehensive treatment plan. The faculty advisors of SNAAC offer an Elective in Advanced Pediatric Nutrition, open to all fourth year medical students, which provides more team-based opportunities in both the inpatient and outpatient setting.

More recently, SNAAC has partnered with other nutrition student interest groups from Tufts Medical School and Harvard Medical School to create the Boston Medical Students Committee on Nutrition (BMSCoN). Students have organized and attended city-wide lectures focusing on important nutrition topics. Notable area dietitians, physicians, and public health scientists have given the lectures, which meet the group's objective of increasing nutrition knowledge, awareness, and networks through interprofessional partnerships across the city. In addition to these educational events, BMSCoN sponsors one community event each year to increase student involvement in the community.

4. Agent of Change and Sustainability

One of the long-term goals for SNAAC is to encourage and help implement broader curricular change for medical students in nutrition medicine. Without a consistent nutrition curriculum, students and residents have been shown to develop less positive attitudes towards providing lifestyle counseling and report lower confidence in their counseling ability as their education continues [19, 20].

To address the need for curricular change at BUSM, the Nutrition Vertical Integration Group (VIG) was formed in 2007. The objectives of this collaboration between faculty and students from various departments are to assess the status of nutrition education, identify areas for improvement, integrate nutrition into the medical school curriculum, and enhance nutrition related clinical skills. The nutrition VIG model is centered on medical students to assess gaps, integrate medical nutrition, and sustain change. Since joining the VIG in 2009, SNAAC members have been essential in strengthening curricular change.

The alignment of SNAAC and the Nutrition VIG has allowed for more in depth assessment of the curriculum, leading to additional hours of nutrition in the medical school curriculum ranging from an introduction in the preclinical years to nutrition counseling in the fourth year curriculum. Currently, curriculum review and feedback from course directors indicates that BUSM offers about 27 hours of nutrition education throughout the preclinical curriculum and another 12 hours throughout mandatory rotations in the clinical curriculum (Table 2). While this meets the formal requirement of 25 hours of nutrition education set forth by the National Academy of Science [21], most of the hours of education are still found in the basic sciences, which do not directly inform the management of hospitalized patients and the lifestyle counseling skills required of modern physicians in clinical practice.

As active participants in the Nutrition VIG, SNAAC participants have addressed this deficit by helping to create a dietary self-assessment module, as well as adding cases and components to several introductory clinical courses. Most recently, a pilot education project of four hours of formal didactics about the dietary guidelines, basics of nutrition counseling, and practical approaches to prevention and treatment of obesity have been introduced into the preclinical biochemistry course. Mandatory online modules accompany the lectures, as well as optional readings that reinforce important concepts. In the 4th year, a nutrition and health behavior counseling module is being piloted in the required ambulatory medicine block. As there are many factors that are subject to change when determining medical school curriculum, continual assessment of the efficacy of these interventions is needed.

5. Professional Development

Because of the multipartite group structure, there are more opportunities for student leadership and advocacy than most other medical student groups. Student leaders are continually gaining skills in communication, organization, grant applications, and sharing of ideas through presentations and manuscripts. The professional skills that student leaders are equipped with are invaluable and will be useful for the remainder of their professional careers in medicine.

Another area of professional development available to interested students is formal assessment of the efficacy of a given intervention. For example, members of SNAAC continue to actively assess the knowledge of the student body in order to affect curricular change. A student member and a dietitian faculty mentor from SNAAC recently conducted an electronic survey to assess the medical student body's knowledge and confidence to refer to dietitians and community resources across the four-year curriculum. Preliminary data from this survey was presented locally and at the Experimental Biology meetings of the American Society of Nutrition [22]. Further examples of students' professional accomplishments are listed in Table 3.

6. Discussion

Most examples of educational reform focus solely on educational change through formal curricular development and enhanced information-based modules. An example of this approach is Adams et al., who developed the Nutrition

Table 2: Breakdown of the location of nutrition education at BUSM.

Years 1 & 2	Year 3	Year 4
Biochemistry *includes medical nutrition with a multidisciplinary approach (6 h)* **Physiology** includes lectures on appetite regulation, fuel metabolism, diabetes, and insulinoma (3.5 h) **Human Behavior in Medicine** includes a lecture on obesity & eating disorders (1 h) ***Introduction to Clinical Medicine*** *includes a dietary intake self-assessment module developed with an RD (1 h)* **Introduction to Clinical Medicine** has a seminar on nutrition and cancer taught by an RD (40 minutes) **Disease &Therapy: Endocrine** covers obesity, type 2 diabetes, Syndrome X and popular diets, and modules developed with an RD (9 h) **Disease &Therapy: Gastroenterology** covers malabsorption and other GI conditions (6 h)	**Family Medicine** rotation offers case studies & uses motivational interviewing techniques (3 h) **Pediatrics** core conference has a lecture series on nutrition needs of children during growth (3 h) **Obstetrics/Gynecology** rotation requires 4 case-based learning topics (e.g., prenatal care, diabetes) and includes a module addressing patients' nutritional assessment and access to food (4 h)	**Nutrition Support in Clinical Practice Elective** includes nutrition support and managing adult obesity **Advanced Pediatric Nutrition Elective** covers aspects of breastfeeding, childhood obesity, failure to thrive, community resources, and nutrition support. **Pediatric Endocrine and Neonatal Electives** include work with an RD **Geriatrics** rotation has a lecture on primary prevention of osteoporosis (1 h) ***Ambulatory*** *a modulecovering basic nutrition with a focus on type 2 diabetes, obesity, and health behavior counseling (1 h)*

Updated from the Nutrition Academic Award Grant website [24].
Curriculum created or modified with involvement from SNAAC members highlighted in italics.

Table 3: List of major accomplishments by SNAAC members (2009–2014).

Type of accomplishment	Details
Internships	2 students taking the Advanced Pediatric Nutrition Elective went on to obtain internships through the American Society of Nutrition
Posters	>10 posters presented by involved SNAAC members at notable forums including Weight of the Nation in 2012, Experimental Biology, and John McCahan Educational Day at BUSM
Presentations	>5 presentations at Experimental Biology and John McCahan Educational Day at BUSM. Most notably, one SNAAC leader was invited to speak at the Bipartisan Policy Center's forum entitled "Teaching Nutrition and Physical Activity in Medical School: Training Doctors for Prevention-Oriented Care" in Washington DC
Publication	Student-written manuscript entitled "A Novel Nutrition Medicine Education Model: the Boston University Experience" published in Advances in Nutrition [29]
Participation	SNAAC members have been invited to participate in the New England Summit of Nutrition Medicine Education (2011), the Institute of Medicine Nutrition Meetings (2013), and the Bipartisan Policy Center's Forum on Nutrition and Physical Activity in Medical School (2014)
Awards	Two students received "Best Student Presentation" at BUSM's John McCahan Educational Day

in Medicine (NIM) curriculum for medical students and residents [23]. This online program contains 29 modules that can be incorporated into a 4-year medical school curriculum. A handful of these modules have been used by many US Medical Schools [23, 24] and residencies [25] with encouraging results.

However, increasing nutrition knowledge alone is insufficient to develop competent clinicians. SNAAC has a novel approach to nutrition education reform by providing both formal curricular development and extracurricular programming that focuses on development of practical knowledge and skills. Skills such as motivational interviewing and obtaining a dietary history can be taught and practiced through events such as the DI/MS match or through early shadowing experiences in the NFL clinic. This is in line with the findings from Vetter et al., who suggested placing more emphasis on nutrition skills teaching in medical education [9]. Furthermore, by participating in activities such as the SNAP challenge, students gain a more practical understanding of the barriers to healthy eating many patients face. This allows future clinicians to appreciate the difficulties of implementing nutrition counseling in a clinical setting.

SNAAC is set apart from other student groups by its focus on interdisciplinary collaboration and education. With

"health care reorganizing around high-functioning teams" composed of multidisciplinary providers [26, 27], collaborative skills are crucial for future physicians. These skills include the ability to work on multidisciplinary teams as well as early and appropriate referral to other health care professionals [28]. SNAAC has been successful in creating a number of partnerships with students and faculty from a variety of professional backgrounds, including registered dietitians, social workers, and case managers. Experiences with successful interdisciplinary partnerships, such as through the DI/MS match and the pediatric weight management clinic, help medical students better understand roles within a care team, as well as appreciating the expertise of their fellow health care professionals.

7. Limitations

SNAAC faces multiple barriers related to funding, leadership, and program continuity, as well as faculty availability. Limited funding currently comes from the medical school and faculty grants. While grant writing can be a useful exercise for some students, it can shift the focus away from the development of and participation in SNAAC programming activities. Due to academic time constraints, student participation is often limited to the preclerkship years of medical school. This results in a fast rate of leadership turnover and may affect program opportunities and achievements. SNAAC is currently guided by a small diverse group of nutrition professionals interested in promoting student medical nutrition education and training. Therefore, developing a network of student nutrition interest groups could open up additional opportunities and resources by increasing the number of students and pool of mentoring faculty interested in nutrition and available to collaborate.

8. Future Directions

The success of SNAAC's nutrition initiatives can best be attributed to several factors, including but not limited to (1) support from the medical school administration for curricular changes and student interest groups; (2) faculty involvement in curricular changes and mentoring students; (3) funding for select activities; and (4) student professional development. Future directions for SNAAC include continuing to develop medical nutrition programs and improving the curriculum at BUSM, participating in research, and creating a regional network of student nutrition interest groups to facilitate incorporation of effective clinical nutrition education into medical school curriculum nationally.

Abbreviations

AAMC: Association of American Medical Colleges
BMC: Boston Medical Center
BMSCoN: Boston Medical Student Committee on Nutrition
BUMC: Boston University Medical Center
BUSM: Boston University School of Medicine
DI/MS: Dietetic intern/medical student
NAA: Nutrition Academic Award
NFL Clinic: Nutrition and Fitness for Life Clinic
NIM: Nutrition in Medicine
SNAAC: Student Nutrition Awareness and Action Council
SNAP: Supplemental Nutrition Assistance Program
VIG: Vertical Integration Group.

Disclosure

Cynthia Schoettler has obtained the M.P.H. degree, and was a medical student at Boston University School of Medicine at the writing of this paper; Jennifer N. Lee, was also a medical student at Boston University School of Medicine at the writing of this paper; Kathy A. Ireland, M.S., R.D., LDN, degrees holder, Clinical Dietitian and Coordinator, Nutrition and Fitness for Life Program, Boston Medical Center, Instructor of Pediatrics at Boston University School of Medicine; Carine M. Lenders, M.D., M.S., and Sc.D., degrees holder, is an Associate Professor of pediatrics at Boston University School of Medicine, Director of the Division of Pediatric Nutrition Support Services, Medical Director, Nutrition and Fitness for Life Program, and Physician Scientist at the Division of General Academic, Pediatrics Department of Pediatrics, Scientist Boston Medical Center.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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References

[1] J. M. McGinnis and W. H. Foege, "Actual causes of death in the United States," *The Journal of the American Medical Association*, vol. 270, no. 18, pp. 2207–2212, 1993.

[2] Centers for Disease Control and Prevention, "Health plan implementation of U.S. Preventive Services Task Force A and B recommendations—Colorado, 2010," *Morbidity and Mortality Weekly Report*, vol. 60, no. 39, pp. 1348–1350, 2011.

[3] E. S. Ford, M. M. Bergmann, H. Boeing, C. Li, and S. Capewell, "Healthy lifestyle behaviors and all-cause mortality among adults in the United States," *Preventive Medicine*, vol. 55, no. 1, pp. 23–27, 2012.

[4] S. McGuire, "Institute of Medicine. 2012. Accelerating progress in obesity prevention: solving the weight of the nation. Washington, DC: the National Academies Press," *Advances in Nutrition (Bethesda, Md.)*, vol. 3, no. 5, pp. 708–709, 2012.

[5] L. C. McGuire, T. W. Strine, C. A. Okoro, I. B. Ahluwalia, and E. S. Ford, "Healthy lifestyle behaviors among older U.S. adults with and without disabilities, Behavioral Risk Factor Surveillance System, 2003," *Preventing Chronic Disease*, vol. 4, no. 1, article A09, 2007.

[6] P. E. Smith and A. E. Smith, "High-quality nutritional interventions reduce costs," *Healthcare Financial Management*, vol. 51, no. 8, pp. 66–69, 1997.

[7] J. L. Kraschnewski, C. N. Sciamanna, H. L. Stuckey et al., "A silent response to the obesity epidemic: decline in US physician weight counseling," *Medical Care*, vol. 51, no. 2, pp. 186–192, 2013.

[8] K. M. Kolasa and K. Rickett, "Barriers to providing nutrition counseling cited by physicians: a survey of primary care practitioners," *Nutrition in Clinical Practice*, vol. 25, no. 5, pp. 502–509, 2010.

[9] M. L. Vetter, S. J. Herring, M. Sood, N. R. Shah, and A. L. Kalet, "What do resident physicians know about nutrition? An evaluation of attitudes, self-perceived proficiency and knowledge," *Journal of the American College of Nutrition*, vol. 27, no. 2, pp. 287–298, 2008.

[10] L. M. Gramlich, D. L. Olstad, R. Nasser et al., "Medical students' perceptions of nutrition education in Canadian universities," *Applied Physiology, Nutrition and Metabolism*, vol. 35, no. 3, pp. 336–343, 2010.

[11] R. L. Weinsier, J. R. Boker, E. B. Feldman, M. S. Read, and C. M. Brooks, "Nutrition knowledge of senior medical students: a collaborative study of southeastern medical schools," *American Journal of Clinical Nutrition*, vol. 43, no. 6, pp. 959–968, 1986.

[12] D. M. Irby, M. Cooke, and B. C. O'Brien, "Calls for reform of medical education by the Carnegie Foundation for the advancement of teaching: 1910 and 2010," *Academic Medicine*, vol. 85, no. 2, pp. 220–227, 2010.

[13] J. Frenk, L. Chen, Z. A. Bhutta et al., "Health professionals for a new century: transforming education to strengthen health systems in an interdependent world," *The Lancet*, vol. 376, no. 9756, pp. 1923–1958, 2010.

[14] A. V. Blue, M. Mitcham, T. Smith, J. Raymond, and R. Greenberg, "Changing the future of health professions: embedding interprofessional education within an academic health center," *Academic Medicine*, vol. 85, no. 8, pp. 1290–1295, 2010.

[15] D. R. Bridges, R. A. Davidson, P. S. Odegard, I. V. Maki, and J. Tomkowiak, "Interprofessional collaboration: three best practice models of interprofessional education," *Medical Education Online*, vol. 16, p. 6035, 2011.

[16] O. Karnieli-Miller, T. R. Vu, R. M. Frankel et al., "Which experiences in the hidden curriculum teach students about professionalism?" *Academic Medicine*, vol. 86, no. 3, pp. 369–377, 2011.

[17] L. Young, P. Baker, S. Waller, L. Hodgson, and M. Moor, "Knowing your allies: medical education and interprofessional exposure," *Journal of Interprofessional Care*, vol. 21, no. 2, pp. 155–163, 2007.

[18] C. P. MacDonnell, S. V. Rege, K. Misto, R. Dollase, and P. George, "An introductory interprofessional exercise for healthcare students," *The American Journal of Pharmaceutical Education*, vol. 76, no. 8, article 154, 2012.

[19] E. H. Spencer, E. Frank, L. K. Elon, V. S. Hertzberg, M. K. Serdula, and D. A. Galuska, "Predictors of nutrition counseling behaviors and attitudes in US medical students," *The American Journal of Clinical Nutrition*, vol. 84, no. 3, pp. 655–662, 2006.

[20] K. Y. Foster, N. S. Diehl, D. Shaw et al., "Medical students' readiness to provide lifestyle counseling for overweight patients," *Eating Behaviors*, vol. 3, no. 1, pp. 1–13, 2002.

[21] Comittee on Nutrition in Medical Education, Food and Nutrition Board, Comission on Life Sciences, and National Research Council, Eds., *Nutrition Education in U.S. Medical Schools*, National Academies Press, 1985.

[22] K. Ireland, E. Keefe, J. Robins, and C. Lenders, "Evaluation and teaching: nutrition education and knowledge of medical students," in *Presented at the Experimental Biology*, San Diego, Calif, USA, April 2014.

[23] K. M. Adams, M. Kohlmeier, M. Powell, and S. H. Zeisel, "Nutrition in medicine: nutrition education for medical students and residents," *Nutrition in Clinical Practice*, vol. 25, no. 5, pp. 471–480, 2010.

[24] K. M. Adams, M. Kohlmeier, and S. H. Zeisel, "Nutrition education in U.S. medical schools: latest update of a national survey," *Academic Medicine*, vol. 85, no. 9, pp. 1537–1542, 2010.

[25] B. J. Kaplan, C. Karkowsky, M. Kohlmeier, A. K. Dayal, C. Chazotte, and E. Landsberger, "Nutrition in medicine: effectiveness of a web-based curriculum for obstetrics and gynecology residents," *The FASEB Journal*, vol. 27, p. 47, 2013, Meeting Abstract Supplement.

[26] P. M. Kris-Etherton, S. R. Akabas, C. W. Bales et al., "The need to advance nutrition education in the training of health care professionals and recommended research to evaluate implementation and effectiveness," *The American Journal of Clinical Nutrition*, vol. 99, no. 5, pp. 1153S–1166S, 2014.

[27] M. Rhea and C. Bettles, "Future changes driving dietetics workforce supply and demand: future scan 2012–2022," *Journal of the Academy of Nutrition and Dietetics*, vol. 112, no. 3, supplement, pp. S10–S24, 2012.

[28] C. M. Lenders, D. D. Deen, B. Bistrian et al., "Residency and specialties training in nutrition: a call for action," *The American Journal of Clinical Nutrition*, vol. 99, no. 5, pp. 1174S–1183S, 2014.

[29] C. M. Lenders, K. Gorman, H. Milch et al., "A novel nutrition medicine education model: the Boston University experience," *Advances in Nutrition*, vol. 4, no. 1, pp. 1–7, 2013.

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Research Article

Analysis of Nutrition Education in Osteopathic Medical Schools

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Purpose. Describe nutrition education at US colleges of osteopathic medicine; determine if it meets recommended levels. *Method*. We surveyed 30 US colleges of osteopathic medicine (US COM) with a four-year curriculum about the amount and form of required nutrition education during the 2012/13 academic year. The online survey asked about hours of required nutrition across all 4 years and also in what types of courses this instruction occurred. We performed descriptive statistics to analyze the data. *Results*. Twenty-six institutions (87% response rate) completed the survey. Most responding US COM (22/26, 85%) do not meet the recommended minimum 25 hours of nutrition education; 8 (31%) provide less than half as much. Required nutrition instruction is largely confined to preclinical courses, with an average of 15.7 hours. Only 7 of the 26 responding schools report teaching clinical nutrition practice, providing on average 4.1 hours. *Conclusions*. Most US COM are inadequately preparing osteopathic physicians for the challenges they will face in practice addressing the nutritional concerns of their patients. Doctors of osteopathy cannot be expected to properly treat patients or guide the prevention of cardiovascular disease, obesity, cancer, diabetes, and metabolic syndrome if they are not trained to identify and modify the contributing lifestyle factors.

1. Introduction

Seven of the top 10 causes of death in the US are chronic diseases [1]. Most of those (heart disease, cancer, stroke, and diabetes) have a strong nutrition component as a contributing factor, with risk increasing as BMI or waist circumference increases. Therefore, a large amount of the observed premature morbidity and mortality in the US is due to lifestyle habits related to nutrition and exercise habits [2]. Nutrition and lifestyle treatment strategies are integral to the care of patients with obesity, cardiovascular disease, diabetes, and cancer, as well as a multitude of other conditions, including anemia, malnutrition, gastrointestinal disease, and kidney disease. Physicians, especially primary care providers, play a critical role in overseeing the nutrition care and related concerns of their patients, by assessing nutrition risks, providing lifestyle counseling, and referring to other healthcare providers, such as registered dietitian nutritionists, who can aid the patient in achieving dietary and other lifestyle goals. Moreover, nutrition continues to be a leading topic of fraud and deception for consumers; everything from weight loss to cancer therapies is susceptible to nutrition-related misinformation [3]. It is critically important that physicians understand how to prevent and treat nutrition-related conditions by separating high quality nutrition evidence from quackery to complement patient care needs and help reduce the high rates of lifestyle-related morbidity and mortality. Primary care practitioners thus face a number of barriers to providing nutrition care to their patients who could benefit from it [4]. Proper nutrition care improves patient outcomes and reduces costs [5]; without evidence-based nutrition education for physicians professional in training, there is no guarantee that every practitioner will obtain the essential competencies [6, 7].

Despite the importance of nutrition to health, nutrition education at US medical schools remains a very part of medical school curricula, and time spent covering nutrition lags far behind most other science topics. Most medical students

unfortunately receive little training on how to make sense of applied nutrition topics during their medical training. The most commonly cited reason for these deficiencies is the already-packed undergraduate medical school curricula [8]. Calls for changes to this approach have been published many times over [2, 8–10], and in spite of nutrition being historically inseparable from medicine [11], it continues to receive little attention throughout the traditional four years of medical school. In fact, most US and European allopathic medical schools are failing to provide even the minimum of the 25 hours of nutrition instruction during a 4-year undergraduate medical program as recommended by the National Academy of Sciences and reported elsewhere in this supplement [10, 12].

Osteopathic medical training, founded in the US over 130 years ago, emphasizes patient-centered whole-person care. Osteopaths account for almost a quarter of all US medical school graduates, and more than 60% of osteopathy graduates become primary care providers [13]. Osteopathic physicians have full practice privileges in more than 65 countries around the world [14]. Osteopathy training in the US is similar to allopathic medical training in many ways. Both doctors of osteopathy (DOs) and allopathic physicians (MDs) need to have a four-year degree prior to entering medical school; both complete four years of medical school with a curriculum that primarily teaches basic sciences during the early months or years, while clinical training in the major medical specialties (family medicine, internal medicine, pediatrics, surgery, etc.) occurs in rotations (i.e., clerkships) throughout the latter years; both are required to pass state medical licensing exams if they want to practice medicine; both may prescribe medications and perform medical/surgical procedures after they passed licensing exams; and both work in a variety of health care settings from hospitals to long-term care facilities to private practices. During their clinical clerkships, osteopathic medical students are more likely than allopathic medical students to have required rotations in community settings such as rural clinics, rather than academic or tertiary care medical teaching centers. More osteopathic graduates pursue primary care practice specialties [15–17]. The biggest difference between these two medical degrees is that DO students receive training in manipulative medicine, typically throughout their first two years during osteopathic principles and practice (OPP), osteopathic manual medicine (OMM), or osteopathic manipulative treatment (OMT). Manipulative medicine involves a hands-on approach to diagnosis and treatment of patients in a primary or adjunctive way [18]. The tenets of osteopathic medicine recognize that the human body is capable of self-healing, self-regulation, and health maintenance [19]. Thus, nutrition education fits nicely within the osteopathic philosophy and practice framework.

For decades, many osteopathic medical schools have been attempting curriculum transformation or reformation, without any substantial changes overall [20–22]. Changes at some osteopathic schools have lagged behind those of allopathic medicine, despite the recognition that change is needed [23]. Many schools undertake curriculum reform in an effort to maximize real-world relevance and early clinical experiences, while reducing the isolated nature of basic versus clinical science courses. Nutrition is frequently taught in this environment under the auspices of biochemistry or physiology courses [24] although nutrition as an applied science overlaps with topics in biochemical, physiological, behavioral, clinical, and psychosocial courses.

The Nutrition in Medicine (NIM) Program, fully described elsewhere [25], is a web-based nutrition curriculum administered through the University of North Carolina at Chapel Hill's Department of Nutrition. The evidence-based, free online modules for medical students, residents, and physicians include learning objectives, visually appealing graphics, short video-vignettes, and quizzes. Currently more than 120 US medical schools and colleges of osteopathic medicine take advantage of at least one of these online modules. The NIM team has conducted and published four nutrition education surveys at four-year intervals since 2000 [10, 24, 26]. The NIM team collected data from osteopathic schools as part of these surveys; however, this is the first published report of any of the data from osteopathic schools, and, to the best of our knowledge, the first published analysis of nutrition education at US osteopathic medical schools.

The purpose of this study was to collect survey data on the required nutrition education at US colleges of osteopathic medicine during the academic year 2012/13 and gauge how well these schools met the recommendation of the National Research Council to include a minimum 25 hours of nutrition education in the curriculum [27].

2. Methods

Schools and colleges accredited by the Commission on Osteopathic College Accreditation (COCA) that had graduated a class of students by the summer of 2013 were surveyed by emailing nutrition educators and curriculum administrators. A hyperlink for easy survey access was included in the email. If schools did not respond to the initial email request, the NIM team made follow-up phone calls and emails. At the time of our survey origin, 28 schools were accredited by COCA. We also included two campuses that were in vastly different geographic locations (different states) from their parent school since their nutrition offerings were not necessarily representative of the parent institution. Therefore, a total of 30 campuses were asked to respond to the survey.

Except for the most recent addition of questions directly assessing obesity-related teaching, the NIM survey has remained the same since 2000. The survey contained 17 questions and a general comments section. For most answers, respondents were able to enter free text, to allow us to capture descriptions of unique and sometimes complex curricula. The first two questions asked about the size of the medical school and whether nutrition instruction was required, optional, or not offered. Questions 3–4 asked respondents to estimate the total number of required nutrition contact hours, specifying in which years the instruction was provided (1st/2nd years or 3rd/4th years combined), and to indicate the type of course in which the nutrition content was taught (nutrition, physiology/pathophysiology, biochemistry, integrated, etc.). Questions 5–6 inquired about the use of the NIM curriculum at that institution, and questions 7–9 asked about

Table 1: Nutrition instruction hours in various contexts at US colleges of osteopathic medicine that required nutrition education during the 2012/2013 academic year*.

Course/context	Nutrition	Integrated	Biochemistry	Physiology	Clinical practice
Number of schools	4	16	12	6	7
Number of hours of nutrition instruction in this context, average (SD)	14.0 (8.8)	16.3 (12.3)	6.9 (5.6)	3.3 (1.8)	4.1 (2.9)
Total 4-year nutrition curriculum hours at schools using nutrition instruction in this form, average (SD)	16.5 (10.0)	20.7 (12.8)	16.0 (7.0)	15.8 (8.0)	22.2 (19.2)
Percentage of total instruction provided in that context, average (SD)	79 (25)	74 (27)	49 (34)	31 (25)	18 (8)

*26/30 colleges of osteopathic medicine responded to a survey that began in 2012. Most schools that provided nutrition education did so in more than one type of course or context. SD indicates standard deviation.

the respondent's teaching assignments. Questions 10–17 inquired about required and optional obesity and weight management education, contact hours addressing obesity, and a ranking of the barriers to expanding obesity education. Participation in our survey was voluntary. The institutional review board at the University of North Carolina at Chapel Hill made the determination that this project was exempt. The survey data was collected between November 2012 and November 2014, but the survey itself asked about the nutrition education offered during the 2012/13 academic year only.

We performed calculations based on several predefined parameters. We specified zero hours of required nutrition instruction if a respondent indicated only optional nutrition education was offered at an institution. If someone gave a range of hours (e.g., 10–20 hours) in a survey response, we used the midpoint of the range in all calculations (e.g., 15 hours). In the rare case where respondents provided incomplete information, we performed basic calculations wherever possible, such as totaling the amount of nutrition education over four years. We did not predefine for respondents or place any limits on what qualifies as a "nutrition course." Educators and administrators themselves determined whether their schools provided nutrition in the various course categories.

We converted the dataset from the survey responses into a spreadsheet software program (Excel 2013, Microsoft Corp., Seattle, Washington) to perform the calculations. We calculated means and standard deviations from the survey data. This phase of our data analysis focused on the amount and type of overall nutrition education across the curriculum. The portions of the survey related to obesity teaching were not analyzed and are not reported in this publication.

3. Results

We received responses from 26 of the 30 targeted US colleges of osteopathic medicine and campuses (87% response rate). Respondents from 2 (8%) of the schools indicated that they did not require any nutrition education during the 2012/2013 school year. However, elective nutrition education was offered at both of these institutions. Overall, osteopathic colleges required 17.0 hours (standard deviation 12.5 hours) of required nutrition instruction. Almost all of the required nutrition instruction (15.7 ± 10.8 hours) occurred during years one and two. Only 7 of the 26 responding schools required nutrition instruction during years three and four, comprising 4.1 ± 2.9 hours of the curriculum at those institutions.

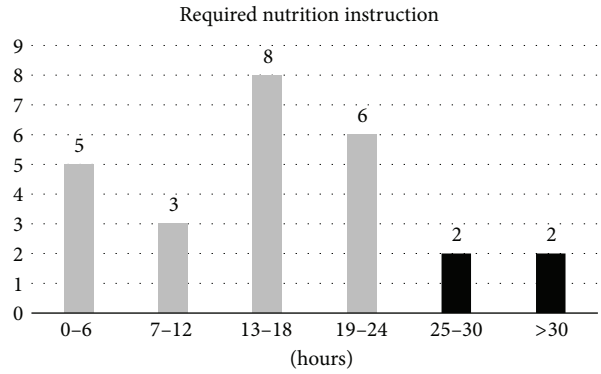

Figure 1: Distribution of nutrition instruction hours provided at US colleges of osteopathic medicine. 26 US colleges of osteopathic medicine responded to a survey about nutrition education during the 2012/13 academic year. This figure shows the number of schools meeting the recommended minimum requirement of 25 hours of nutrition education as indicated by the black bars compared with those providing less than the minimum as indicated by the grey bars. The number of schools falling into each category of required nutrition instruction is indicated above each bar.

Considering the context of nutrition instruction (e.g., dedicated nutrition instruction, biochemistry, physiology, integrated courses, or clinical nutrition practice), the greatest amount (16.3 ± 12.3 hours) was taught together with other topics as part of integrated courses (Table 1). The four schools that reported that they required a designated nutrition course provided 14.0 ± 8.8 hours in that course alone, which provided 79% of their total nutrition teaching. More than half of responding colleges taught at least some nutrition in an integrated format (16/26, 62%). Nutrition topics were also presented in the context of biochemistry (6.9 ± 5.6 hours) and physiology (3.3 ± 1.8 hours) courses. Seven curricula taught clinical nutrition practice with an average number of 4.1 hours (standard deviation 2.9 hours).

Most of the responding schools (22/26, 85%) did not meet the benchmark of at least 25 hours of required nutrition education across the 4-year curriculum (Figure 1). Nearly a third of them required less than half of that number of hours.

4. Discussion

In light of the ongoing obesity and diabetes epidemics and morbidity and mortality related to these conditions, ensuring that physicians are ready to address the nutritional aspects of patient care seems essential. With osteopathy providing a focus on primary care and preventive medicine, it was surprising to find that most osteopathic medical schools are providing inadequate hours of nutrition instruction. The survey data show that only small percentage of responding DO schools are requiring the minimum recommended amount of nutrition education hours during their four-year curricula. All medical schools, in particular osteopathic schools, should be offering a solid training program in something as fundamental to health maintenance and disease prevention as nutrition [6]. For medical school graduates to be competent in a field, they need to be adequately trained in terms of both hours of content delivery and practical real-world experiences. These findings that only 4 of the 26 responding osteopathic medical schools met the minimum recommended 25 hours of required nutrition education show that most of these DO students are not receiving the training they need to effectively treat their patients in maintaining health and preventing the most commonly encountered problems in the American health care system today such as obesity, diabetes, and cardiovascular disease. While we realize that this benchmark of 25 hours was a recommendation made several decades ago [27], before many medical schools moved to a more integrated or problem-based curriculum, it still can be used as a gauge for whether all students at a school are receiving the knowledge and practice skills that they need. For future DOs to be fully prepared to address the nutritional health of their patients, they need to be taught specific skills and mentored in clinical nutrition interactions. These survey results show that the amount of nutrition covered in the clinical years is very sparse and unlikely to instill the confidence and knowledge base physicians need to be skillful at effectively educating patients on nutrition issues. This is also supported in medical resident literature, where a survey found that the vast majority (86%) of residents felt inadequately prepared to provide nutritional guidance to their patients [28], highlighting the fact that something needs to change at the medical-school level so that physicians feel more prepared to provide competent nutrition care.

4.1. What Would It Take to Increase the Number of Nutrition Instruction Hours? For many medical schools, the increasing content needed to fulfill basic requirements has created a very crowded curriculum [29], making for difficult decisions by curriculum administrators regarding what and how much instruction is necessary. State medical licensing exams (COMLEX for DOs and USMLE for MDs) do not put much emphasis on nutrition; therefore, some argue that until licensing exams change, curricula will not substantially change [30–32].

There are multiple curricular approaches that can be used within medical schools to increase both the quality and quantity of nutrition education during the undergraduate medical education years. The Nutrition in Medicine modules offer a convenient, economical, and unique opportunity for medical schools to increase nutrition content in their curricula. The modules are well received by students and offer medical schools both flexibility and affordability. Retaining nutrition content experts on the faculty, especially ones with real-world patient and clinical experience, and having them oversee all aspects related to nutrition and lifestyle within the curriculum to ensure all relevant topics are being addressed adequately can be very beneficial in improving the quality and quantity of nutrition education. Working with clinical faculty to include nutrition and exercise patient history-taking skills and teaching students how to assess key indicators of disease risk such as waist circumference are also valuable. Additionally, an institution's standardized patient program should include assessing and counseling overweight and obese patients for more clinically oriented experiences. For those schools using a systems-based curriculum, nutrition-related topics such as eating disorders should include a nutrition content expert as part of the behavioral medicine course. For lifestyle nutrition such as those covering issues related to pregnancy and lactation, a reproductive system course director should be sure to include pertinent nutrition topics. Collaborating with course directors for the cardiovascular and endocrine [33] systems will facilitate how and when lifestyle-related obesity, hypertension, and diabetes topics can be covered. The renal system should include information on renal diets and how these significantly impact outcomes in chronic kidney disease [33]. The musculoskeletal system can include instructional discussions on sports nutrition and physical activity needs for health maintenance and weight loss. For schools following a traditional first-year basic sciences curriculum, course directors in biochemistry and physiology should ensure adequate (but not excessive overlap) coverage is given to topics such as digestion, macro- and micronutrients, and metabolism. And finally, clinical practice sites during years three and four offer an important avenue to helping ensure medical students receive patient training in nutrition topics; however, this is often a big challenge because most osteopathic training sites are at smaller clinics, which are rightly concerned about time management and costs.

Regardless of what type of curriculum or teaching methods are in use, understanding where topics such as counseling techniques (e.g., motivational interviewing) are being taught and when students have the opportunity to practice these skills is invaluable. Surveying the curriculum to find when and where students learn about nutrition and obesity and how to talk to an obese patient to facilitate lasting behavior change is both patient-centric and practical. Teaching students to look beyond the BMI into related variables like waist circumference and family/social habits related to eating and exercise can help physicians solve problems with patients to find solutions that are more likely to work [34]. Helping today's physicians to understand health and wellness emphasizing prevention should be the goal. Adopting nutrition-related graduation competencies would be another approach to raising the likelihood of increased nutrition education during medical school. Lastly, taking advantage of organizations that are key stake-holders in

nutrition education, such as the American Society for Nutrition (ASN), the Academy of Nutrition and Dietetics (AND), or the Association of Biochemistry Course Directors (ABCD), is important because these groups have many members who have been in the past or are currently involved with teaching nutrition or overseeing its delivery in a medical school setting.

Osteopathic schools, like their allopathic peer institutions focusing on training physicians for rural and underserved areas, often have a strong community service expectation for their student body [35]. In some cases, these are required components in the curriculum, whereas in other cases they are simply strongly encouraged and supported by administration. Exposing medical students to the reality of the social-health issues related to nutrition, such as childhood obesity and diabetes or hunger in their community, is highly valued by many osteopathic medical schools and their students, and anecdotal reports support their effectiveness in increasing awareness. Students who are involved in community wellness events report making the connection between what they learn in the classroom setting and what they see and do at such events. Getting a school's student body involved in community issues that have a strong focus on nutrition, obesity, and wellness is an important approach used in many osteopathic schools to increase community service and enrich the relationship between the community and the school. Some osteopathic medical schools turn to their local K-12 school system, partnering to provide nutrition education to youth while providing teaching opportunities to their student doctors. Others partner with charity or community groups (e.g., free clinics targeted at the homeless population, YMCA, local food banks, etc.) within the communities their school serves. Some schools create completely novel programs and work with the student government associations to ensure the event/program continues into the future after the students have moved on in their education. Whatever the venue, providing medical students a chance to teach what they have learned about nutrition is an effective way to enhance their learning experience and benefit the community at large.

4.2. Strengths. A great strength of our survey is its 87% response rate. Another strength is the established survey methodology, as this study builds on already-existing data which have been published previously but only included analysis of allopathic medical schools. We asked respondents to indicate the number of required nutrition hours in two different ways, allowing us to seek clarification if the numbers do not match up.

4.3. Limitations. Any survey that allows for descriptive responses requires a great effort on behalf of respondents, and researchers need to clarify and quantify the data whenever respondents do not provide ordinal numbers as part of the response. There were a few duplicate responses from some schools whereby different people submitted surveys with conflicting numbers, requiring additional one-on-one follow-up to get a determination of the actual hours offered.

5. Conclusions

These data highlight deficits in nutrition education at colleges of osteopathic medicine that have huge public health ramifications, especially in light of the fact that 60% of DOs practice in primary care [36]. Most schools do not dedicate enough time to prepare DOs for the daily patient encounters that require in-depth nutrition knowledge and specific practice skills. The findings reinforce the understanding that nutrition is not as well-represented in colleges of osteopathic medicine as their philosophy of holistic medicine demands. To the best of our knowledge, this is the first report of its kind looking specifically at nutrition education in osteopathic medical schools. Future studies should seek to understand the connection between undergraduate and residency-level nutrition education and knowledge, skills (proficiency), and self-confidence in nutrition counseling and related practice behaviors of osteopathic physicians.

Ethical Approval

The institutional review board of the University of North Carolina at Chapel Hill made the determination that this project has exempt status.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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References

[1] Centers for Disease Control, *Leading Causes of Death*, CDC, 2014, http://www.cdc.gov/nchs/fastats/leading-causes-of-death.htm.

[2] R. F. Kushner, L. van Horn, C. L. Rock et al., "Nutrition education in medical school: a time of opportunity," *The American Journal of Clinical Nutrition*, vol. 99, no. 5, supplement, pp. 1167S–1173S, 2014.

[3] B. Wansink, "Position of the American Dietetic Association: food and nutrition misinformation," *Journal of the American Dietetic Association*, vol. 106, no. 4, pp. 601–607, 2006.

[4] K. M. Kolasa and K. Rickett, "Barriers to providing nutrition counseling cited by physicians: a survey of primary care practitioners," *Nutrition in Clinical Practice*, vol. 25, no. 5, pp. 502–509, 2010.

[5] B. S. Rosen, P. J. Maddox, and N. Ray, "A position paper on how cost and quality reforms are changing healthcare in America:

focus on nutrition," *Journal of Parenteral and Enteral Nutrition*, vol. 37, no. 6, pp. 796–801, 2013.

[6] P. M. Kris-Etherton, S. R. Akabas, C. W. Bales et al., "The need to advance nutrition education in the training of health care professionals and recommended research to evaluate implementation and effectiveness," *The American Journal of Clinical Nutrition*, vol. 99, supplement 5, pp. 1153S–1166S, 2014.

[7] J. E. Harris, V. Hamaday, and E. Mochan, "Osteopathic family physicians' attitudes, knowledge, and self-reported practices regarding obesity," *The Journal of the American Osteopathic Association*, vol. 99, no. 7, pp. 358–365, 1999.

[8] R. A. Dimaria-Ghalili, M. Edwards, G. Friedman et al., "Capacity building in nutrition science: revisiting the curricula for medical professionals," *Annals of the New York Academy of Sciences*, vol. 1306, no. 1, pp. 21–40, 2013.

[9] C. M. Lenders, D. D. Deen, B. Bistrian et al., "Residency and specialties training in nutrition: a call for action," *The American Journal of Clinical Nutrition*, vol. 99, no. 5, supplement, pp. 1174S–1183S, 2014.

[10] K. M. Adams, M. Kohlmeier, and S. H. Zeisel, "Nutrition education in U.S. medical schools: latest update of a national survey," *Academic Medicine*, vol. 85, no. 9, pp. 1537–1542, 2010.

[11] D. S. McLaren, "Nutrition in medical schools: a case of mistaken identity," *American Journal of Clinical Nutrition*, vol. 59, no. 5, pp. 960–963, 1994.

[12] M. Chung, V. J. van Buul, E. Wilms, N. Nellessen, and F. J. P. H. Brouns, "Nutrition education in European medical schools: results of an international survey," *European Journal of Clinical Nutrition*, vol. 68, no. 7, pp. 844–846, 2014.

[13] American Association of Colleges of Osteopathic Medicine (AACOM), "Osteopathic Medical Profession Report. 2012," http://www.osteopathic.org/inside-aoa/about/aoa-annual-statistics/Documents/2012-OMP-report.pdf.

[14] American Osteopathic Association (AOA), *DOs Around the World*, 2015, http://www.osteopathic.org/osteopathic-health/about-dos/dos-around-the-world/Pages/default.aspx.

[15] D. J. Colegrove and B. E. Whitacre, "Interest in rural medicine among osteopathic residents and medical students," *Rural and Remote Health*, vol. 9, no. 3, p. 1192, 2009.

[16] M. Cummings and K. J. Dobbs, "The irony of osteopathic medicine and primary care," *Academic Medicine*, vol. 80, no. 7, pp. 702–705, 2005.

[17] A. S. Peters, N. Clark-Chiarelli, and S. D. Block, "Comparison of osteopathic and allopathic medical schools' support for primary care," *Journal of General Internal Medicine*, vol. 14, no. 12, pp. 730–739, 1999.

[18] American Association of Colleges of Osteopathic Medicine (AACOM), "Overview of osteopathic medical education/accreditation/the four-year curriculum," in *Osteopathic Medicine Information Book*, American Association of Colleges of Osteopathic Medicine, 2015, https://www.aacom.org/docs/default-source/cib/2015cib_p10-11.pdf?sfvrsn=2.

[19] American Osteopathic Association, *Tenets of Osteopathic Medicine*, 2014, http://www.osteopathic.org/inside-aoa/about/leadership/Pages/tenets-of-osteopathic-medicine.aspx.

[20] R. Hopkins, D. Pratt, J. L. Bowen, and G. Regehr, "Integrating basic science without integrating basic scientists: reconsidering the place of individual teachers in curriculum reform," *Academic Medicine*, vol. 90, no. 2, pp. 149–153, 2015.

[21] B. Ross-Lee, D. L. Wood, D. D. Mann, R. P. Portanova, L. E. Kiss, and M. A. Weiser, "An osteopathic prescription for medical education reform. Part 1. Curriculum and infrastructure," *The Journal of the American Osteopathic Association*, vol. 97, no. 7, pp. 403–408, 1997.

[22] S. C. Shannon, "Reevaluating osteopathic medical education for the 21st century and beyond," *Journal of the American Osteopathic Association*, vol. 114, no. 4, pp. 228–230, 2014.

[23] S. C. Shannon and H. S. Teitelbaum, "The status and future of osteopathic medical education in the United States," *Academic Medicine*, vol. 84, no. 6, pp. 707–711, 2009.

[24] K. M. Adams, W. S. Butsch, and M. Kohlmeier, "The state of nutrition education at US medical schools," *Journal of Biomedical Education*. In press.

[25] K. M. Adams, M. Kohlmeier, M. Powell, and S. H. Zeisel, "Nutrition in medicine: nutrition education for medical students and residents," *Nutrition in Clinical Practice*, vol. 25, no. 5, pp. 471–480, 2010.

[26] K. C. Lindell, K. M. Adams, M. Kohlmeier, and S. H. Zeisel, "The evolution of nutrition in medicine, a computer-assisted nutrition curriculum," *The American Journal of Clinical Nutrition*, vol. 83, no. 4, pp. 956S–962S, 2006.

[27] Committee on Nutrition in Medical Education Food and Nutrition Board, Commission on Life Sciences, and National Research Council, *Nutrition Education in U.S. Medical Schools*, The National Academies Press, Washington, DC, USA, 1985.

[28] M. L. Vetter, S. J. Herring, M. Sood, N. R. Shah, and A. L. Kalet, "What do resident physicians know about nutrition? An evaluation of attitudes, self-perceived proficiency and knowledge," *Journal of the American College of Nutrition*, vol. 27, no. 2, pp. 287–298, 2008.

[29] P. Gallagher, N. Wilson, and R. Jaine, "The efficient use of movies in a crowded curriculum," *Clinical Teacher*, vol. 11, no. 2, pp. 88–93, 2014.

[30] C. Lo, "Integrating nutrition as a theme throughout the medical school curriculum," *The American Journal of Clinical Nutrition*, vol. 72, no. 3, supplement, pp. 882S–889S, 2000.

[31] J. Haddad, "Nutrition needs to be taught in medical school," KevinMD.com Blog, 2011, http://www.kevinmd.com/blog/2011/12/nutrition-taught-medical-school.html.

[32] N. P. Morris, "The neglect of nutrition in medical education: a firsthand look," *JAMA Internal Medicine*, vol. 174, no. 6, pp. 841–842, 2014.

[33] M. M. Estrella, B. G. Jaar, K. L. Cavanaugh et al., "Perceptions and use of the national kidney foundation KDOQI guidelines: a survey of U.S. renal healthcare providers," *BMC Nephrology*, vol. 14, no. 1, article 230, 2013.

[34] J. Stubbs, S. Whybrow, P. Teixeira et al., "Problems in identifying predictors and correlates of weight loss and maintenance: implications for weight control therapies based on behaviour change," *Obesity Reviews*, vol. 12, no. 9, pp. 688–708, 2011.

[35] A. Vohra and Z. Meyler, "The Disaster Reserve Partner Group at NYCOM," *Journal of the American Osteopathic Association*, vol. 103, no. 11, pp. 505–506, 2003.

[36] American Osteopathic Association, *What is a DO?*, 2014, http://www.osteopathic.org/osteopathic-health/about-dos/what-is-a-do/Pages/default.aspx.