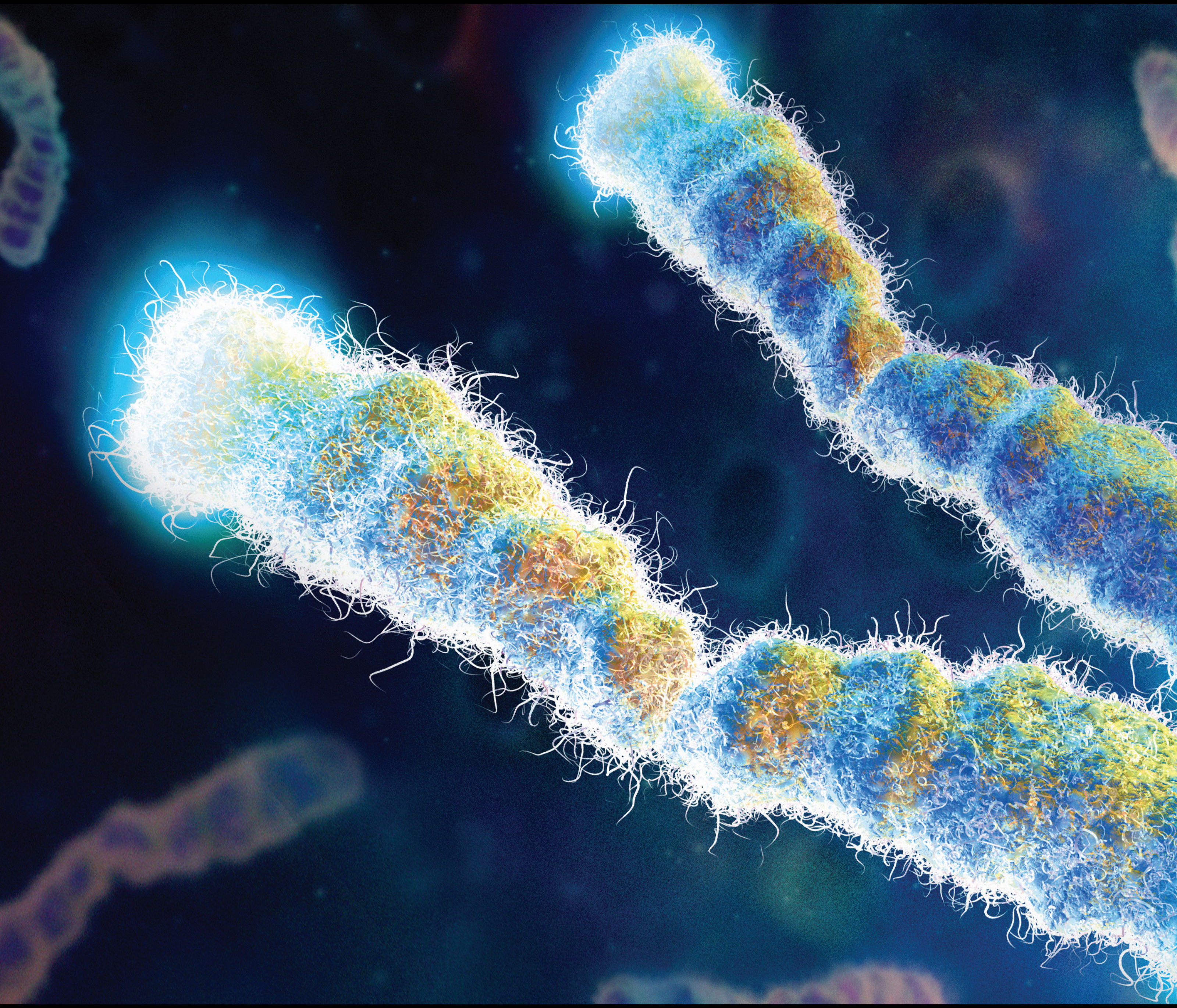
Journal of Aging Research

Active and Healthy Ageing and Independent Living 2016

Guest Editors: Maddalena Illario, Miriam M. R. Vollenbroek-Hutten, D. William Molloy, Enrica Menditto, Guido Iaccarino, and Patrik Eklund



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Editorial Board

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Editorial

Active and Healthy Ageing and Independent Living 2016

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Population ageing is a global trend linked to the progressive improvement of living conditions and to the progress of the medical fields [1]. Sustainability issues related to the provision of social and health services are emerging in developed countries [2] that are implementing a number of strategies to ensure good quality of life for all ages and older adults, focusing on maintaining independence and ensuring an active life as people age in their own environment [3, 4]. Several dimensions have traditionally been linked to the management of health in older adults that were mostly related to physical functionality. Currently, an emerging role is being identified for additional factors that overcome the boundaries of health but nonetheless influence health outcomes, such as lifestyles, built environment, and social inclusion [5, 6]. This special issue provides examples of innovative, cross-sectorial strategies that contribute directly or indirectly to improving the quality of life for older adults and their closer ones, making our health and social care systems more efficient and sustainable.

The need to provide tailored models to be implemented on a large scale is addressed by Md. N. Haque, whose study is aimed at providing evidences for prioritizing the policy agenda in Thailand. The author provides an overview of active ageing level and its discrepancy in different regions (Bangkok, Central, North, Northeast, and South) of Thailand has been examined for prioritizing policy agenda to be implemented. In his paper, Haque makes an attempt to test preliminary active ageing models for Thai older persons by evaluating the active ageing index (AAI ranges from 0 to 1) and using nationally representative data and confirmatory factor analysis approach. The study results show that active ageing level of Thai older persons is not high (mean AAI for female and male older persons are 0.64 and 0.61, respectively, and those are significantly different ($p < 0.001$)). Mean AAI in Central region is lower than those in North, Northeast, and South regions but there is no significant difference in the latter three regions of Thailand. The author urges a special emphasis to the Central region and to the need for a central policy aimed at increasing active ageing level. The study suggests that the implementation of an Integrated Active Ageing Package (IAAP), containing policies for older persons to improve their health and economic security, to promote participation in social groups and longer working lives, and to arrange learning programs, would be helpful for increasing older persons' active ageing level in Thailand.

The link between social inclusion and health is addressed by C. McKibbin et al. and by A. Rapacciuolo et al. in two different locoregional contexts: rural communities and metropolitan areas.

C. McKibbin et al. investigate how health status and social networks are associated with resilience among older adults and contribute to their ability to remain in rural and remote communities as they age. The authors examined the association of health status and social networks with resilience among older adults dwelling in a rural and remote county in the Western United States. A random sample of 198 registered voters aged 65 years or older from a frontier Wyoming county was selected for the study. Hierarchical linear regression was used to examine the association of health status and social networks with resilience. Health status was also examined as a moderator of the relationship between social networks and resilience. The results show that family networks ($p = 0.024$) and mental health status ($p < 0.001$) significantly predict resilience. Mental health status moderated the relationship of family ($p = 0.004$) and friend ($p = 0.021$) networks with resilience. Smaller family and friend networks were associated with greater resilience when mental health status was low but not high. The authors conclude that efforts to increase mental health status may improve resilience among older adults in rural environments, particularly for those with smaller family and friends networks.

Complementary to the previous study, A. Rapacciuolo et al. describe the impact of social and cultural engagement and dieting on well-being and resilience in a group of residents in the metropolitan area. They highlight that a number of related isolation factors, inadequate transportation system and restrictions in individuals' life-space, have been associated with malnutrition in older adults. Since eating is a social event, isolation can have a negative effect on nutrition. Cultural involvement and participation in interactive activities are essential tools to fight social isolation and they can counteract the detrimental effects of social isolation on health. They developed an ad hoc questionnaire to investigate the relationship between cultural participation and well-being and resilience in a sample of residents in the metropolitan area of Naples. The questionnaire includes a question on adherence to diet or to a special nutritional regimen; in addition, it is required to refer to height and weight. We investigated the relationship between BMI, adherence to diet, and perceived well-being (PWB) and resilience in a sample of 571 subjects over 60 years of age. In the paper, the authors present evidence that engagement into social and cultural activities is associated with higher well-being and resilience, in particular in females over 60 years of age.

Physical activity is a key component of healthy lifestyles: M. J. Turner et al., C. A. Parker and R. Ellis, and R. C. Mason et al. describe different experiences to approach this issue in older adults.

M. J. Turner et al. assess the influence of participating in regularly scheduled activity on weekly physical activity levels in an independent-living older adult population and investigate lifetime exercise history and sex differences, in an effort to understand how they relate to current weekly step activity. Total weekly step counts, measured with a pedometer, were assessed in two older adult groups: the first consisted of members of a local senior center who regularly used the fitness facility (74.5 ± 6.0 yrs; mean ± SD), while the second group consisted of members who did not use the fitness facility (74.8 ± 6.0 yrs). Participants also completed the Lifetime Physical Activity Questionnaire (LPAQ). The LPAQ suggested a significant decline in activity with ageing ($p = 0.01$) but no difference between groups ($p = 0.54$) or sexes ($p = 0.80$). A relationship was observed between current step activity and MET expenditure over the past year ($p = 0.008$, $r^2 = 0.153$) and from ages of 35–50 years ($p = 0.037$, $r^2 = 0.097$). The lack of difference in weekly physical activity level between our groups suggests that independent older adults will seek out and perform their desired activity, either in a scheduled exercise program or through other leisure-time activities. Also, the best predictor of current physical activity level in independent-living older adults was the activity performed over the past year.

C. A. Parker and R. Ellis investigated whether electronic messaging would increase aerobic physical activity (PA) among older adults. Participants were active older adults ($n = 28$; M age = 60 years, SD = 5.99, and range = 51–74 years). Using an incomplete within-subjects crossover design, participants were randomly assigned to begin the 4-week study receiving the treatment condition (a morning and an evening text message) or the control condition (an evening text message). Participants self-reported min of completed aerobic PA by cell phone text. The 1-way within-subjects ANOVA showed significant group differences ($p < 0.05$). Specifically, when participants were in the treatment condition, they reported significantly greater average weekly min of aerobic PA (M = 96.88 min; SD = 62.9) compared to when they completed the control condition (M = 71.68 min; SD = 40.98). They conclude that electronic messaging delivered via cell phones was effective at increasing min of aerobic PA among older adults.

R. C. Mason et al. investigated the effects of exercise on the physical fitness of high and moderate-low functioning older adult women. The primary purpose of their study was to observe the exercise habits of older adults with different levels of physical function to determine any differential effects of exercise on their physical fitness and functional ability. The effects of 10 weeks of community-based exercise on the cardiovascular endurance, muscular strength, flexibility, and balance fitness components of older adult women with high and moderate-low levels of physical function were evaluated. This study provides several noteworthy findings. Firstly, it shows that community-based exercise programs offering a variety of exercise types to people with varying levels of functional ability can be useful in maintaining or improving fitness and independence. Secondly, it suggests that such programs may also be capable of improving the self-efficacy of lower functioning older adults toward performing daily tasks. Additionally, self-report instruments such as activity logs may be useful to track and gain an understanding of the exercise habits of older adults.

Research has demonstrated that active and healthy ageing can be enhanced by enabling societal infrastructure, urban planning, architecture of healthcare facilities, and personal accommodations throughout the life span. Yet, there is a paucity of research on how to bring together the various disciplines involved in a multidomain synergistic collaboration to create new living environments for ageing throughout the life span. E. Chrysikou et al.'s study aims to explore the key domains of skills and knowledge to consider in order to generate a conceptual prototype where healthcare professionals, architects, planners, and entrepreneurs may establish shared theoretical and experiential knowledge base, vocabulary, and implementation strategies, to create age-friendly living communities, that are fit also for persons with disabilities and chronic disease. The study focuses on the domains of knowledge that need to be included in establishing a learning model that focuses on the impact of the benefits toward active and healthy ageing, where architects, urban planners, clinicians, and healthcare facility managers are educated toward a synergistic approach at the operational level. A number of studies support the concept that health and well-being in later life are heavily influenced by behavioural factors and social conditions [7–9], and interventions targeting multiple behavioural and social factors are showing their effectiveness in promoting health and well-being during ageing [10–13]. Many governments are introducing policies to support effective lifestyle interventions to enhance active and healthy ageing and reduce the burden of age-related disease [14, 15]. To this purpose, using a one-size-fits-all approach demonstrated limited long-term effectiveness and posed the risk of generating on the contrary health inequalities. Integrating the design of the different interventions with subsets of indicators that are specific to the different settings (locoregional, rural, metropolitan, etc.) and with novel ICT tools will contribute to convenience, facilitate scalability, and allow personalisation to stratified target populations [16, 17].

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References

[1] WHO, *World Report on Ageing and Health*, WHO, Geneva, Switzerland, 2015.

[2] European Commission, *The 2015 Ageing Report: Economic and Budgetary Projections for the 28 EU Member States (2013–2060)*, European Economy Series, Economic and Financial Affairs, Brussels, Belgium, 2015.

[3] European Innovation Partnership on Active and Healthy Ageing, *European Strategy in Active & Healthy Ageing*, European Commission, 2015.

[4] European Innovation Partnership on Active and Healthy Ageing, *Building European Commitment to Prevent and Tackle Frailty: A Decalogue on Frailty Prevention*, 2015.

[5] G. Liotta, R. O'Caoimh, F. Gilardi et al., "Assessment of frailty in community-dwelling older adults residents in the Lazio region (Italy): a model to plan regional community-based services," *Archives of Gerontology and Geriatrics*, vol. 68, pp. 1–7, 2017.

[6] A. Steptoe, A. Shankar, P. Demakakos, and J. Wardle, "Social isolation, loneliness, and all-cause mortality in older men and women," *Proceedings of the National Academy of Sciences of the United States of America*, vol. 110, no. 15, pp. 5797–5801, 2013.

[7] R. O'Caoimh, Y. Gao, A. Svendrovski et al., "Screening for markers of frailty and perceived risk of adverse outcomes using the Risk Instrument for Screening in the Community (RISC)," *BMC Geriatrics*, vol. 14, article 104, 2014.

[8] R. J. Gobbens, K. G. Luijkx, M. T. Wijnen-Sponselee, and J. M. Schols, "Frail elderly. Identification of a population at risk," *Tijdschrift voor Gerontologie en Geriatrie*, vol. 38, no. 2, pp. 65–76, 2007.

[9] L. P. Fried, L. Ferrucci, J. Darer, J. D. Williamson, and G. Anderson, "Untangling the concepts of disability, frailty, and comorbidity: implications for improved targeting and care," *The Journals of Gerontology, Series A: Biological Sciences and Medical Sciences*, vol. 59, no. 3, pp. 255–263, 2004.

[10] J. R. Beard and D. E. Bloom, "Towards a comprehensive public health response to population ageing," *The Lancet*, vol. 385, no. 9968, pp. 658–661, 2015.

[11] M. C. Marazzi, M. C. Inzerilli, O. Madaro et al., "Impact of the community-based active monitoring program on the long term care services use and in-patient admissions of the over-74 population," *Advances in Aging Research*, vol. 4, pp. 187–194, 2015.

[12] L. van Velsen, M. Illario, S. Jansen-Kosterink et al., "A community-based, technology-supported health service for detecting and preventing frailty among older adults: a participatory design development process," *Journal of Aging Research*, vol. 2015, Article ID 216084, 9 pages, 2015.

[13] F. Orfila, L. Romera, J. M. Segura, A. Ramırez, S. Fabregat, and M. Moller, "Effectiveness of a multifactorial intervention to modify frailty parameters in the elderly. European General Practice Research Network (EGPRN)," *European Journal of General Practice*, In press.

[14] European Innovation Partnership on Active and Healthy Ageing, http://ec.europa.eu/research/innovation-union/pdf/active-healthy-ageing/leaflet.pdf#view=fit&pagemode=noneAction plan A3.

[15] European Innovation Partnership on Active and Healthy Ageing, Action Group A3, Renovated Action Plan 2016–2018, https://ec.europa.eu/eip/ageing/library/action-plan-2016-2018-a3_en.

[16] C. Boehler, F. Abadie, M. Lluch, and R. Sabes-Figuera, "Monitoring and Assessment Framework for the European Innovation Partnership on Active and Healthy Ageing (MAFEIP)—first report on outcome indicators," JRC Science and Policy Report, 2013.

[17] C. Boehler, F. Abadie, and R. Sabes-Figuera, "Monitoring and Assessment Framework for the European Innovation Partnership on Active and Healthy Ageing (MAFEIP)—second report on outcome indicators," JRC Science and Policy Report, 2014.

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Review Article

Perspectives on the Role and Synergies of Architecture and Social and Built Environment in Enabling Active Healthy Aging

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Research has demonstrated that enabling societal and physical infrastructure and personal accommodations enhance healthy and active aging throughout the lifespan. Yet, there is a paucity of research on how to bring together the various disciplines involved in a multidomain synergistic collaboration to create new living environments for aging. This paper aims to explore the key domains of skills and knowledge that need to be considered for a conceptual prototype of an enabling educational process and environments where healthcare professionals, architects, planners, and entrepreneurs may establish a shared theoretical and experiential knowledge base, vocabulary, and implementation strategies, for the creation of the next generation of living communities of active healthy adults, for persons with disabilities and chronic disease conditions. We focus on synergistic, paradigmatic, simple, and practical issues that can be easily upscaled through market mechanisms. This practical and physically concrete approach may also become linked with more elaborate neuroscientific and technologically sophisticated interventions. We examine the domains of knowledge to be included in establishing a learning model that focuses on the still-understudied impact of the benefits toward active and healthy aging, where architects, urban planners, clinicians, and healthcare facility managers are educated toward a synergistic approach at the operational level.

1. Introduction

According to the World Health Organization (WHO), physical and social environments are key determinants in maintaining an autonomous, meaningful life along the aging process [1]. Research from epidemiological studies and social sciences has provided sufficient evidence that maintaining health, independency, and autonomy would imbue longevity with wellbeing, a more meaningful life span, and lower healthcare costs. Urban planning, architecture of healthcare facilities that promote healing, and domestic buildings supporting autonomy are important elements in enabling a more active and healthy aging process throughout the life span. Yet, in practice, the fields of traditional healthcare and architecture or urban planning seldom cross paths in either the academic curricula, the research arena, or the actual execution of theory and evidence-based research and planning of these physical spaces within which individuals and societies age [2]. This paper aims to outline the domains of a new model of multidisciplinary learning which takes place in face-to-face interactions with all the interested parties: architects, healthcare providers and managers, and planners. Aging is not a disease, but rather a normal and valued part of the life course, as defined by the WHO [1, p. 103]. In this paper, we briefly present the theoretical complexity and the multidisciplinary nature involved in the planning of the healthcare facilities and domestic living spaces. The three elements comprising this planning: the healthcare framework, the social context and the physical milieu, and their interrelationships. We then present the argument that by examining how to intergrade these three elements in a potentially synergistic enabling educational process would lead the participants to ponder on the integration of these elements in real market scenarios. Our approach is informed by the synergies groups generated by the EIP AHA [3] and planned activities of our commitment to A2 group of the EIP AHA [4].

2. Theoretical Framework

2.1. Health and Society and Space: An Integrated Perspective. Epidemiological studies have identified a strong link between health status and societal domains [5]. The healthcare system and its practitioners are aiming to use this evidence-based knowledge in supporting and advocating policy at the local level for improvement of the social determinants of health including the built environment [6]. Hillier and Hanson's [7] work has contributed significantly to the interconnection and synergies of the built environment, society, and space, arguing that there is a social logic of space and that the linkage is cross-cultural and not age specific [8]. Thus, the link between health and society has been established through public health, and the link between society and space has been established through space syntax [9]. The theory of salutogenesis [10] joints all three domains bridging health and physical space. Salutogenesis, derived from medical sociology, was conceived by Antonovsky [11] who looked at the relationship between stress and wellbeing, through the "Sense of Coherence." Antonovsky's salutogenesis theory focuses on the factors and mechanisms that promote health, not on illness [12]. The multidisciplinary and the intercultural application of the "Sense of Coherence," an essential element of the salutogenic theory [13], has influenced a growing body of research based design framework of the built environment, creating a platform for a creative dialogue between healthcare and architecture [14–16]. Although Antonovsky did not aim directly at the spatial elements, which are considered part of the physical pillar [17] that lead to increase somebody's "Sense of Coherence" [18], his theories has prompted the generation of a variety of fields, including practitioners of medical architecture, salutogenic design or design and health field [19–21], and Healing Gardens [22].

The work of Zeisel on Alzheimer's [23] is a paradigmatic example of the three pillars of Salutogenesis connecting health, space, and society and stresses the benefits deriving from their synergy, as depicted in Figure 1.

Zeisel advocates that although there are three key elements in the treatment and care of people with Alzheimer's, that is, the medication, the human interaction, and the physical environment, funding and research concentrate on the first, reducing considerably the resources allocated to the other two. This disproportionate allocation of resources happens despite the fact that space and human care may have significant, sustained, and immediate impact on health status of dementia person, when compared to pharmaceuticals where progress still needs to be made [23].

In this paper, we aim to highlight the need for synergy between healthcare systems, the built environment, as well as their social context including public and private domains and urban setting as well as the smallest scale of domestic objects and artefacts that can enhance life during the life span.

Despite the evidence suggesting that space is a key component of any healthcare plan, the design of individual dwellings for encouraging active and healthy aging is a truly

Figure 1: Visual interpretation of Zeisel's three key elements in the treatment and care of people with dementia—the medication, the human interaction, and the physical environment.

underdeveloped area of research, compared, for example, to assistive technologies. Yet, the living space and its impact on quality of life are indeed a very ancient concept [24]. The literature regarding active and healthy aging has in general concluded that healthy life styles through the life span contribute to better quality of life including physical, mental, and cognitive capacity. In general, building and urban design lag behind knowledge from relevant fields such as neuroscience, mental health, rehabilitation, and active healthy aging research. Our aim is to help bridge this gap by creating a learning platform for the relevant disciplines that is experiential and theory driven, while at the same time targeted to generating marketable solutions of the built environment. One area where this leaning platform may be considered of urgent importance is the emerging field of adoption of healthier life style patterns and the need for environmental factors to support these changes.

2.2. Life Style Patterns and Environmental Factors to Support Active Healthy Aging (AHA). "More of the Same Is Not Enough" [25] reviews the most recent research efforts to increase physical activity and thus decrease sedentary life styles, especially among older adults, thus contributing to the top ten chronic diseases worldwide [26]. Understanding how to do more to change this "pandemic" pair of sedentary lifestyles and chronic diseases burden requires new approaches to our theoretical understandings of the causes, as well as the design of innovative interventions to change them at the individual level, since the "one-model-fits-all" approach does not take into account the ecological perspective at the root of the problem. The ecological model for changing toward healthier life styles take into account multiple predisposing factors and barriers such as intrapersonal variables (e.g., personality, health beliefs, knowledge, attitudes, and skills), interpersonal processes, and their likely interactions with genetics as well as community and macro/public policy levels factors [27]. Furthermore, research has shown that interventions for change are likely to take place, not in the conventional healthcare system, but rather in what sociologists have labelled "enabling spaces." Virtual or physical enabling spaces provide the opportunity for peer learning and teaching that could be actualized within a community. Copresence and observation could provide the mechanism that would generate this learning [28, 29].

The diversity of noncommunicable chronic diseases (NCDs), which hamper healthy and active aging, also shares key modifiable life style factors: sedentary lifestyles with lack of physical activity, poor nutritional habits, high stress levels, and lack of social connectivity [30]. Each one of these modifiable lifestyle factors can be improved with appropriate attention to how neighborhoods/workspaces are designed, how architectural design enhances the creation of enabling spaces for mingling and connecting physically, and how green spaces and walkable communities create more active aging environments. The regional authorities, planning agencies, and healthcare systems working in synergies may be able to create an ecosystem that supports active and healthy lifestyles throughout the life span. This includes industries of food production and distribution as well as boutique culinary facilities catering to aging populations and their physical needs.

A crucial component of this ecosystem is the enabling of movement. This is primarily viewed through the concept of universal design. It is the main concept that has provided solutions for the mobility of the general population, yet so far it presents limitations when neurological or mental disorders are concerned [31]. User involvement from the planning stage of these facilities was one of the key elements of fit for purpose. Similarly, when designing for extra care homes accessibility, user involvement at the planning and remodelling stages was a crucial element of success as it was the involvement of all professionals involved including architects and builders that were aware of universal design and assistive technologies [32]. The next domain that our theoretical model for a multidisciplinary teaching program focuses on is the role of what is now a serious priority for the EIP AHA and WHO and generally falls under the title of age-friendly environment [33, 34].

3. Age-Friendly Liveable Environment

3.1. Living Styles Supported by Built Environment. The built environment is commonly used in connection with technology supported aging [35]. However, here we would suggest that the WHO definition of environments is more useful in considering healthy and active aging. This definition is broad: "*all the factors in the extrinsic world that form the context of an individual's life; these include home, communities and the broader society; within these environments are a range of factors, including the built environment, people and their relationships, attitudes and values, health and social policies, systems and services*" [1, p. 240]. As it is important for older people to stay at their homes as long as possible [36] some home adaptations might prolong aging in place, the preferred alternative by persons and also a more cost-effective way from a societal perspective [37]. Yet, even if for supported accommodation, research involves physical environment as a determinant of active aging [38] and links QoL with homelike design traits [39, 40] and the fine balance between requirements for safety and homelike environments [41].

In addition to the homelike age-friendly environment, there is an emerging literature of the important connection to nature and its restorative and therapeutic value, along with space for physical and recreative activities in mental health and healthy aging. We discuss these topics next.

3.2. Mental Wellbeing and Nature. Research has long established the beneficial elements of nature to mental and physical wellbeing [42, 43], and there is a strong link between perceived sense of health and availability of green areas especially for the elderly and even more so for those living in urban environments [44]. Its integration in the architectural environment of home can have multiple benefits for the resident, from a window view, to the beneficial feel of a breeze and sunshine, which can be appreciated even by patients with Alzheimer's disease [23], to mild form of exercise or gardening, especially if combined with raised accessible flower beds. Yet, gardening does not cover all potential benefits of incorporating nature into design. For instance, in more complex healthcare environments, views to gardens can act as orientation elements [14].

3.3. Physical Activity Space. As far as physical activity space is concerned, ergonomic design of healthcare facilities, mainly concentrating on nurses' movement, ignored the complications of confined space for patients without access to the outdoors. Single-loaded corridors for instance could increase the opportunity for walks indoors as well as allow better orientation [21]. At a residential environment, however, there could be other solutions for physical exercise that could be creatively codesigned with appropriately trained architect and the input of the carer and the resident.

3.4. Creativity and Social Interaction Spaces. In healthcare environments creativity could be enhanced through a variety of spaces designed for different uses, such as dancing or exercise and space for horticulture, to give to examples out of the numerous possibilities, rather than the one-type-of-common-room-fits-all approach. Research on long-term care connected architecture and the implementation of therapeutic regime through the availability/lack of such areas [45].

3.5. Adjusting an Older Residential Care Facility to Contemporary Dementia Care Visions. In residential settings suitable comfortable sitting, presenting a variety of types in accordance with individual preferences and functional elements such as task lighting, worktops, and variety of storage could provide opportunity that a variation of the "student bedsit" that is often applied in care environments, that is, one desk, one bed with a side table, and a wardrobe, or hopefully if it is like a 4- or a 5-star hotel room an additional armchair and a coffee table, could not possibly cover.

3.6. Visiospatial Orientation. External views, art, and positive or negative distraction methods [23], such as concealing the external door or using clearly visible clues and colour for bathroom doors, might prove invaluable tools for the orientation and the cognitive function of older people and especially those suffering from dementia.

Figure 2: Day Centre for children and adolescents with autism in Paleo Faliro, Greece. Designed by SynThesis Architects.

Figure 3: Maggie's West London, located at Charing Cross Hospital. Designed by Rogers Stirk Harbour + Partners.

3.7. Autonomy and Independence. Control is a factor that tends to appear lower in the pyramid of needs, when compared to more basic needs of sustaining life. However, it is linked with improved health [6], mental healthcare [21], and noninstitutional design frameworks that cater for heterogeneity [40, 46]. At a strategic level, control might be expressed through user involvement and through accessibility means that might enter the core of day-to-day life, such as the case of accessible kitchens or fixtures and fittings at a suitable height. In general, the healthcare environments granted significant control to healthcare professionals as opposed to patients [22]. Yet, lately through increasing patient involvement in the design process we have seen projects that grant significant spatial control to the patients (Figure 2). A very interesting example from the area of cancer care provision is the Maggie's Centre initiative (Figure 3), an innovative, holistic type of facility for cancer patients that has been developed from Maggie Jenks, an architect, when she had been diagnosed with terminal cancer [47].

3.8. Fall Prevention Architectural Elements. Lighting, carefully designed circulation spaces, especially in turning points, comfortable and strong grab-rails, preferably cleverly integrated in the decoration rather than the sad and possibly dangerous accessibility devices, opportunities for mind and body exercise for the brain through salutogenic design, and solid and strong furniture at an adequate height for people lifting themselves comfortably are only some of the possibilities that architects can consider as their tools in their aim to design an environment that allows older people to use their body in a safer manner. Yet, the lack of research and the lack of a communication channel between the disciplines have not provided the data that would allow these solutions to be approached systematically and eventually enter the design guidelines documentation allowing their broader implementation.

4. Results and Discussion

Based on the theoretical models and research utilizing these models as cited above, we suggest that the creation of an experiential curriculum for all relevant players in designing and building facilities to meet the needs of an aging society is a goal we should be aspiring to. The planning of this type of curriculum should involve all sectors of the economy, that is, governmental, private, and the third sector, as well as cross-industry from the very beginning. This would utilize the experience of the stakeholders, from policy to user level, and enable the burning issues that are well known to those that deal with the subject on an everyday basis to be addressed in a more systematic way. We are aware, for example, of participatory design initiatives such as the Collectively Commissioned Housing in Casteren, Netherlands, where the architects worked mainly as facilitators and residents were the main decision-makers, which proved a cost-effective solution [48]. Such an approach is important for highlighting the importance of the involvement of the users and the financial gains of similar approaches. Yet for more elaborate dwellings, such as residences for vulnerable populations, this crucial amount of user involvement should be complemented by substantial know-how from the architects on special design aspects and implications. For instance, an excellent case of a synergy between informed architectural intervention and the active involvement of users and carers at all levels of decision-making has been the Foyer Élan Retrouvé in Paris, an accommodation facility for the social reintegration of adult mentally ill patients that generated innovation and at the same time presented high user satisfaction results [21, 49]. Similarly, the close collaboration between staff working on a day centre for children with developmental disabilities and a team including a medical architect and a neuroscientist in Faliro, Athens, presented significant reduction of the autistic behaviour of the children during the time they used the facility. In that case, staff would enable a design that was fully compatible with the care regime and the experts introduced to the design elements such as the evidence-based use of positive and negative distraction through colours, shapes, and patterns [50, 51]. Central to these initiatives has been the task to work on an interdisciplinary language and understanding in order to deliver a more evidence based, inclusive practice.

Medical sciences have a clear knowledge that the perception and the physiology of an older frail person differs from a normative one. Yet, that message has not entered the conscious design process of the built environment professionals, as the perception and visual distraction in architectural literature [52] concentrates on architectural-focused instead of person-focused aims, unrelated to the distortions of perception due to ill health. Moreover, research suggests that architects might have a combination of lack of knowledge and misconceptions on the actual needs and preferences of the elderly and research by design projects, such as the example of a Dementia ward at Flanders [45, 53]. This gap of architectural knowledge and education on the perception and users' needs should make us reflect on the way architectural education is delivered as well as potential for further research.

It would be important, among others, for practitioners, designers, and stakeholders, to understand to what extent the built environment is adequate for its residents. It would be important, for instance, to research the safety of universal design features in an older person's bathroom and ways for improvement. Through learning we could encourage designers to broaden their perspective of what constitutes innovative architecture, in a way more human-focused than the glass and steel iconic landmarks. It would be important to help them understand user needs across the lifespan when designing public outdoor areas. That would be the way to create a series of public space improvements that might encourage people to be confident enough and go out of their home in a not so cold day and engage in social activities. A module should provide students the know-how of facility planning in order to create facilities that could act as a magnet for older and frail people and how these could be intergraded in the urban grid. Through case study learning and fieldtrips they could familiarise themselves with existing examples of good practice that need to be explored and lessons to be learned. They should be able to understand the limitations of the existing definition of accessibility in covering the needs of the largest ever generation approaching old age. It would be also important for all stakeholders to build the skills to comprehend the value of more elaborate and neuroscientific and technologically sophisticated interventions that could generate significant health benefits with relatively low costs. The list is indicative and the authors could by no means cover the whole spectrum of research possibilities and the learning potential in a single paragraph.

4.1. Conclusions. Part of the gap between human science and architecture relates to the educational process of architects, the lack of evidence-based guidelines or best practices that architects could refer to, and the lack of translational research across fields. The article presented a theoretical framework for incorporating into architecture the vision of design for active and healthy living; features medical research suggest would add value toward active and healthy aging.

The challenges aging presents to individuals and society as a whole are complex and multilevel. For example, aging person functionality is impacted by not only one's intrinsic personality but also by ecopsychosocial elements. These multilevel and complex societal domains can be modified through the creation of multidisciplinary knowledge and educational opportunities along with design for wellbeing research to explore the benefits of interlinking space, architecture of living environments, and their impact on physical and cognitive functionality. It is important for medical practitioners to be aware of the developments and opportunities in the built environment and vice versa and at the same time to see the social impact and the extent in terms of social scale of the problem. Creating a multidisciplinary program for the various professionals (architects, doctors, and planners) and aging persons can be accomplished through blended learning curriculum (see, e.g., http://www.eitdigital.eu/eit-digital-academy/master-school/). The EIP AHA through its synergies initiative can play an important leadership role for securing funding to initiate such blended learning environments throughout the EU.

Competing Interests

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

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References

[1] WHO, *World Report on Ageing and Health*, World Health Organization, Luxembourg, Luxembourg, 2015.

[2] R. S. Ulrich, L. L. Berry, X. Quan, and J. T. Parish, "A conceptual framework for the domain of evidence-based design," *HERD: Health Environments Research & Design Journal*, vol. 4, no. 1, pp. 95–114, 2010.

[3] European Innovation Partnership on Active and Healthy Ageing, A2 and A3, https://ec.europa.eu/eip/ageing/commitments-tracker/a2/a2-and-a3_en.

[4] European Innovation Partnership on Active and Healthy Ageing, Inclusive Urban and Rural Communities (Commitment), https://ec.europa.eu/eip/ageing/commitments-tracker/d4/inclusive-urban-and-rural-communities_en.

[5] G. P. Westert, F. G. Schellevis, D. H. De Bakker, P. P. Groenewegen, J. M. Bensing, and J. Van Der Zee, "Monitoring health inequalities through general practice: the Second Dutch National Survey of General Practice," *European Journal of Public Health*, vol. 15, no. 1, pp. 59–65, 2005.

[6] M. Marmot, *The Health Gap: The Challenge of an Unequal World*, Bloomsbury Publishing, London, UK, 2015.

[7] B. Hillier and J. Hanson, *Social Logic of Space*, Cambridge University Press, New York, NY, USA, 1988.

[8] C. Alexander, *The Nature of Order, Book Three, Part Two Chapter 3*, Centre for Environmental Structure, Berkeley, Calif, USA, 2003.

[9] A. Penn, "Space syntax and spatial cognition: or why the axial line?" *Environment and Behavior*, vol. 35, no. 1, pp. 30–65, 2003.

[10] A. Antonovsky, "The salutogenic model as a theory to guide health promotion," *Health Promotion International*, vol. 11, no. 1, pp. 11–18, 1996.

[11] A. Antonovsky, *Health, Stress and Coping*, Jossey-Bass, San Francisco, Calif, USA, 1979.

[12] A. Antonovsky, *Unraveling the Mystery of Health: How People Manage Stress and Stay Well*, Jossey Bass Social and Behavioral Science Series, Jossey Bass, San Francisco, Calif, USA, 1987.

[13] M. Eriksson and B. Lindström, "Validity of Antonovsky's sense of coherence scale: a systematic review," *Journal of Epidemiology & Community Health*, vol. 59, no. 6, pp. 460–466, 2005.

[14] I. M. Assali, "Enhance indoor environment in buildings and its effect on improving occupant's health," *International Journal of Civil, Environmental, Structural, Construction and Architectural Engineering*, vol. 10, no. 2, pp. 90–96, 2016.

[15] A. A. Behbehani, *Design for Wellbeing: Investigating the Relationship Between Built Environments and Art Therapy Experiences*, Florida State University, Tallahassee, Fla, USA, 2013.

[16] A. Dilani, "Psychosocially supportive design: a salutogenic approach to the design of the physical environment," *Design and Health Scientific Review*, vol. 1, no. 2, pp. 47–55, 2008.

[17] K. Hudson, "Salutogenesis: the origin of health," *Nursing Management*, vol. 44, no. 11, pp. 12–13, 2013.

[18] European Communities, "Salutogenesis and the promotion of positive mental health in older people," in *Proceedings of the EU Thematic Conference "Mental Health and Well-Being in Older People—Making It Happen"*, Madrid, Spain, April 2010.

[19] A. Dilani, *Healthcare Building as Supportive Environments*, KTH, Landstinget Härnösand, Sweden, 1998.

[20] J. A. Golembiewski, "Start making sense: applying a salutogenic model to architectural design for psychiatric care," *Facilities*, vol. 28, no. 3-4, pp. 100–117, 2010.

[21] E. Chrysikou, *Architecture for Psychiatric Environments: Environments and Therapeutic Spaces*, IOS Press, Amsterdam, Netherlands, 2014.

[22] C. Marcus and M. Barnes, "Introduction: historical and cultural perspective on healing gardens," in *Healing Gardens: Therapeutic Benefits and Design Recommendations*, pp. 1–26, John Wiley & Sons, New York, NY, USA, 1999.

[23] J. Zeisel, *I'm Still Here-A Breakthrough Approach to Understanding Someone Living with Alzheimer's*, Piatkus, London, UK, 2010.

[24] E. M. Sternberg, *Healing Space: The Science of Place and Well-Being*, Harvard University Press, Cambridge, Mass, USA, 2009.

[25] P. C. Hallal, A. E. Bauman, G. W. Heath, H. Kohl III, I. Min Lee, and M. Pratt, *Physical Activity: More of the Same Is Not Enough*, Federal University of Pelotas, Pelotas, Brazil, 2012.

[26] University of Turku, http://www.utu.fi/fi/Sivut/home.aspx.

[27] N. Fitzgerald and K. Spaccarotella, "Barriers to a healthy lifestyle: from individuals to public policy—an ecological perspective," *Journal of Extension*, vol. 47, no. 1, pp. 1–8, 2009.

[28] C. Duff, "Networks, resources and agencies: on the character and production of enabling places," *Health & Place*, vol. 17, no. 1, pp. 149–156, 2011.

[29] A. M. McMurray, "The enabling community for child and family health," *Contemporary Nurse*, vol. 40, no. 1, pp. 2–4, 2011.

[30] S. Ballesteros, E. Kraft, S. Santana, and C. Tziraki, "Maintaining older brain functionality: a targeted review," *Neuroscience & Biobehavioral Reviews*, vol. 55, pp. 453–477, 2015.

[31] E. Chrysikou, "Accessibility for mental healthcare," *Facilities*, vol. 31, no. 9-10, pp. 418–426, 2013.

[32] R. Mayagoitia, E. Van Boxstael, H. Wojgani, F. Wright, J. Hanson, and A. Tinker, "Is extra care housing in England care-neutral?" *Journal of Assistive Technologies*, vol. 9, no. 1, pp. 3–20, 2015.

[33] World Health Organisation, 2016, http://www.who.int/ageing/age-friendly-world/en/.

[34] L. Plouffe and A. Kalache, "Towards global age-friendly cities: determining urban features that promote active aging," *Journal of Urban Health*, vol. 87, no. 5, pp. 733–739, 2010.

[35] Centres for Disease Control and Prevention, *Healthy Aging & The Built Environment*, Centres for Disease Control and Prevention, 2015, http://www.cdc.gov/healthyplaces/healthtopics/healthyaging.htm.

[36] K. Croucher, *Housing Choices and Aspirations of Older People. Research from the New Horizons Programme*, Communities and Local Government, London, UK, 2008.

[37] J. L. Wiles, A. Leibing, N. Guberman, J. Reeve, and R. E. S. Allen, "The meaning of 'aging in place' to older people," *The Gerontologist*, vol. 52, no. 3, pp. 357–366, 2012.

[38] L. Van Malderen, T. Mets, P. De Vriendt, and E. Gorus, "The Active Ageing-concept translated to the residential long-term care," *Quality of Life Research*, vol. 22, no. 5, pp. 929–937, 2013.

[39] S. A. Bradshaw, E. D. Playford, and A. Riazi, "Living well in care homes: a systematic review of qualitative studies," *Age and Ageing*, vol. 41, no. 4, pp. 429–440, 2012.

[40] L. Van Malderen, P. De Vriendt, T. Mets, and E. Gorus, "Active ageing within the nursing home: a study in Flanders, Belgium," *European Journal of Ageing*, vol. 13, no. 3, pp. 219–230, 2016.

[41] I. Van Steenwinkel, S. Baumers, and A. Heylighen, "Home in later life: a framework for the architecture of home environments," *Home Cultures*, vol. 9, no. 2, pp. 195–217, 2012.

[42] C. Maller, M. Townsend, A. Pryor, P. Brown, and L. St Leger, "Healthy nature healthy people: 'contact with nature' as an upstream health promotion intervention for populations," *Health Promotion International*, vol. 21, no. 1, pp. 45–54, 2006.

[43] R. Ulrich, "View through a window may influence recovery from surgery," *Science*, vol. 224, no. 4647, pp. 420–421, 1984.

[44] J. Maas, R. A. Verheij, P. P. Groenewegen, S. de Vries, and P. Spreeuwenberg, "Green space, urbanity, and health: how strong is the relation?" *Journal of Epidemiology and Community Health*, vol. 60, no. 7, pp. 587–592, 2006.

[45] I. Van Steenwinkel, E. Verstraeten, and A. Heylighen, "Adjusting an older residential care facility to contemporary dementia care visions," in *Designing Around People*, P. Langdon, J. Lazar, A. Heylighen, and H. Dong, Eds., Springer, Berlin, Germany, 2016.

[46] T. Marcus, *Buildings and Power: Freedom and Control in the Origin of Modern Building Types*, Routledge, London, UK, 1993.

[47] Maggie's, 2016, https://www.maggiescentres.org.

[48] T. T. Veeger and S. J. E. Maussen, *Dutch Experiment in Co-Creation in a Collectively Commissioned Housing Project*, Architectural Research Addressing Societal Challenges, Taylor & Francis, New York, NY, USA, 2016.

[49] E. Diebolt, *De la Quarantaine au Quarantaine: Histoire dy Foyer de Postcure Psychiatrique de l'Elan*, L' lan Retrouve, Paris, France, 1997.

[50] C. Lustig, K. Giannakopoylou, and E. Chrysikou, "Quality architecture as a means of reducing the functional expenses in health facilities: cooperation of architect, physician and neurologist at a project in Faliro," in *Proceedings of the 4th Panhellenic Congress on Management, Economics and Health Policy*, Athens, Greece, December 2008.

[51] E. Chrysikou and C. Lustig, "Accessibility for fully mobile patients: the case of children with intellectual disabilities and autism spectrum disorder," in *Proceedings of the 7th Cambridge Workshop on Universal Access and Assistive Technology*, P. Langdon, J. Lazar, A. Heylighen, and H. Dong, Eds., chapter 5, pp. 33–38, University of Cambridge, Cambridge, UK, 2014.

[52] A. P. Bader, “A model for everyday experience of the built environment: the embodied perception of architecture,” *The Journal of Architecture*, vol. 20, no. 2, pp. 244–267, 2015.

[53] K. Coomans, P.-W. Vermeersch, and A. Heylighen, “How do older residents experience a recently built innovative housing and care facility?” in *Designing Around People*, P. Langdon, J. Lazar, A. Heylighen, and H. Dong, Eds., pp. 209–218, Springer, London, UK, 2016.

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Research Article

The Effects of Exercise on the Physical Fitness of High and Moderate-Low Functioning Older Adult Women

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Introduction. Understanding how exercise affects individuals with varying levels of functional ability will provide further insight into the role of exercise during the aging process. It will also aid in the development of exercise programs that are appropriate for a wider spectrum of older adults. Specifically it was the primary aim of this study to determine and compare the effects of 10 weeks of community-based exercise on the cardiovascular endurance, muscular strength, flexibility, and balance fitness components of older adult women with high and moderate-low levels of physical function. *Methods*. Participants were placed in either the high functioning ($n = 13$) or moderate/low functioning ($n = 17$) groups based on their level of physical functioning. Fitness components were measured by the Senior Fitness Test and physical function was determined by the Composite Physical Function scale. *Results*. The results of the 3×2 mixed ANOVA statistical analysis showed no significant interaction effect for time $*$ group for any of the six subtests (chair stand, arm curls, 2-minute step, chair sit-and-reach, back scratch, and 6-foot up-and-go) of the SFT. However, the main effect of time was significant for all fitness components and the main effect of group was significant for all fitness components except lower extremity flexibility. *Discussion*. Community-based exercise programs offering a variety of exercise types to people with varying levels of functional ability can be useful in maintaining or improving fitness and independence. These programs may also be capable of improving the self-efficacy of lower functioning older adults toward performing daily tasks.

1. Introduction

Participation in exercise and regular physical activity can provide numerous physiological, cognitive, and psychological health benefits in the aging population [1]. Impairments in fitness components such as muscle strength and balance influence the development of disability. In addition to muscle strength and balance, aerobic endurance, agility, mobility, and flexibility have also been shown to be significant determinants of physical independence [2]. This is consistent with the notion that physical fitness factors greatly on the ability to successfully perform routine daily tasks. This includes functional tasks such as simple housework, lifting and carrying objects, negotiating steps, and walking far enough to shop and complete errands [3, 4]. Defined as the capacity of an individual to carry out the physical activities of daily living, physical function is an independent predictor of functional independence, disability, morbidity, and mortality [5]. Aging is often associated with declines in physical function affecting vital processes that are critical to independence, social engagement, and quality of life [6]. Older adults transitioning toward disability may no longer be able to appropriately utilize and execute movement patterns associated with activities of daily living (ADL) as a result of declining physical fitness. Programs of regular exercise that include cardiorespiratory, resistance, flexibility, and neuromotor exercise beyond activities of daily living to improve and maintain physical fitness and health are then essential for most adults [5]. Although mature nervous system function and motor skills are achieved in the earlier stages of life, changes in movement patterns also occur during adulthood and the latter stages of the lifespan [7]. Older adults need to practice, learn new, and relearn known motor skills as part of task training, recreational pursuits, or rehabilitation [8]. Therefore, opportunities for exercise that foster fitness, efficient functional movement skills, and self-efficacy toward performing daily tasks are needed to impede the progression of the disablement process among older adults. As such, community-based modes of exercise aimed to equip older adults with neuromotor (balance, coordination, and agility), physical (aerobic endurance, muscle strength, and flexibility), and functional components of fitness necessary for daily life should be explored and developed [6].

As the population of older adults is continuing to increase and become more diverse, it will be important to recognize individual differences in level of functioning [9]. While aging is an inevitable process, it is an individual experience that has considerable variability. Older adults of the same chronological age may differ in physiological age and function due to differences in genetic makeup, lifestyle choices, cognitive ability, and several other variables. Exercise programs such as the one in this study should be designed to accommodate the variable capabilities and functional levels of older adult women. Additionally, they must be motivating enough to ensure active participation at an enjoyable level and increase the frequency of physical activity in a social, interactive setting. While this is true it is often the case that opportunities for exercise in community-based settings are not accommodating to individuals of all levels of functioning. Instruction of proper movement technique and motivational factors that promote adherence are often lacking. Exercise classes at community centers and facilities for adults will most likely contain individuals with varied levels of disability, as this is the nature of the older adult population. For example, a step aerobics class at the local senior center may have a participant who is highly functional and does not suffer from any level of disability exercising next to someone who is of the same age but has low cardiovascular endurance and poor balance. The effect and benefit of exercise on both types of individuals in this kind of environment are largely unknown. Therefore, the primary purpose of this study was to observe the exercise habits of older adult women with varying levels of physical function to determine any differential effects of exercise on their physical fitness.

2. Methods

2.1. Participants. A convenience sample of 30 women ($n = 30$, $m_{age} = 69$ years) recruited from the YWCO in Athens, Georgia, completed participation in this study. Participant demographics can be found in Table 1. Initially 37 women agreed to participate. However, seven participants were forced to withdraw for various reasons including hospitalization due to sickness, moving away, and summer travel. Participants were recruited in person while they attended exercise classes at the YWCO and also by posting flyers and sign-up sheets at the facility. All potential participants completed a medical history questionnaire to screen for conditions that may have inhibited safe exercise participation. Exclusion criteria included history of stroke, heart attack, osteoarthritis, neurological disease, mental illness, and fracture or joint replacement within the last six months. Individuals reporting one or more of such conditions were excluded from participation in this study. Additionally, the participant medical history form provided demographic information related to age, sex, height, weight, marital status, employment status, and dwelling status. Participants were also asked to report an average amount of time per week they routinely spent involved in planned exercise.

Table 1: Demographics and clinical features of participants by group.

	High function	Moderate/low function
Number of women	$n = 13$	$n = 17$
	Mean (SD)	Mean (SD)
Age (years)	67.2 (5.7)	70.2 (5.1)
CPF score	24	20.4 (3.7)
Exercise (min/week)	803 (715)	526 (377)

Two groups of participants were formed according to their physical ability to live independently as determined by the Composite Physical Function (CPF) scale. The CPF is a self-report 12-item scale capable of assessing physical function across a wide range of activities from basic ADLs such as bathing and dressing to instrumental ADLs including gardening and shopping [3, 4]. Each item can be scored from "0" to "2" (0 = cannot do; 1 = can do with help; 2 = can do without help) based on the participants perceived ability to perform the task in question. The CPF scale can be used to categorize individuals as "high functioning," "moderate functioning," or "low functioning" and at risk for loss of independence. High functioning individuals are those who indicate that they can perform all 12 items on their own without assistance, thus receiving a perfect score of 24. Both the definition of moderate functioning and its interpretation are adjusted for age. It is important that younger age groups have more stringent criteria than older age groups for being assessed as moderate functioning as age-related declines in physical capacity after the age of 60 are commonly reported to decline at least 10%–15% per decade [10]. Whereas a score of 14 (ability to perform a minimum of seven CPF activities without assistance) is required for a rating of moderate of those aged 90 years and older, higher scores of 20, 18, and 16, respectively, are needed in order for those in their 60s, 70s, and 80s to be rated as moderate functioning [3, 4]. Using this age-adjusted scoring the participants were placed in either the high functioning ($n = 13$) or moderate/low functioning ($n = 17$) groups.

2.2. Procedure. All participants were required to read and sign the University of Georgia Institutional Review Board consent form prior to commencing any screening, testing, or exercising. As part of a Senior Fitness Initiative, each participant from both groups was encouraged to continue their normal routine of attending group exercise classes at the YWCO and also to exercise on their own at home for a 10-week period. Weekly exercise logs were used throughout the study as a method of self-reporting to record and compare the exercise habits of participants from each group with varying levels of functional independence. The participants were instructed to use the weekly exercise log to record each bout of planned exercise in which they participated during the 10-week study. The Senior Fitness Test (SFT) [3, 4] was used to assess the overall fitness of both groups of participants at baseline, after five weeks, and again after 10 weeks of exercising. The SFT is commonly used to assess physical fitness in older adults, as it represents an easy-to-use field test battery that allows for the assessment of physical fitness components vital to maintaining independent functioning [11].

2.3. Exercise and Fitness Assessments

2.3.1. Weekly Exercise Log. A weekly exercise log was given to each participant of them to record the type and duration of each bout of exercise. Participants only received credit for planned exercise and not for other forms of physical activity such as housework, grocery shopping, or doing laundry. The weekly exercise logs were used as a method of self-reporting to record and compare the exercise habits of participants from each group with varying levels of functional independence. Participants received reminders to continue tracking their exercise in-person and by email on a weekly basis. Weekly exercise logs were submitted for review at the midpoint and at the end of the 10-week exercise period. The number of weekly minutes of exercise performed by the high functioning and moderate/low functioning groups was then tallied and recorded at these time points. The average number of minutes exercised was then calculated for each group after five weeks and 10 weeks of exercise.

2.3.2. Senior Fitness Test. The Senior Fitness Test consists of seven items, including one alternate test for measuring aerobic endurance. The SFT items are as follows: (1) 30-second chair stand; (2) arm curl; (3) chair sit-and-reach; (4) back scratch; (5) 6-minute walk; (6) 2-minute step; and (7) 8-foot up-and-go. The purpose of the 30-second chair stand is to measure lower extremity strength, which is necessary for tasks such as transferring from a chair, walking, and climbing stairs. The total number of complete stands able to be completed in 30 seconds was recorded. The arm curl component of the SFT measures upper extremity strength, which is needed to perform household activities such as lifting and carrying groceries, suitcases, or grandchildren. The total number of bicep curls completed with correct form with the dominant arm while holding a five-pound weight in 30 seconds was recorded. The chair sit-and-reach test will be administered to assess lower body flexibility, which is important for good posture and normal gait patterns. Lower body flexibility also contributes to performing mobility tasks such as getting in and out of a car or bed. From a sitting position at the end of a chair, with one leg extended and hands reaching toward toes, the number of inches (+ or −) between extended fingers and tip of toe was measured during the chair sit-and-reach test. Upper body flexibility was measured by the back scratch test. Shoulder flexibility is vital for tasks such as combing one's hair, putting on a coat, and reaching for a seat belt. During this test, the number of inches between middle fingers (+ and −) was measured while reaching over the shoulder with arm and up the middle of the back with the other arm. The 2-minute step test was chosen for the assessment of aerobic endurance because space and time limited the use of the 6-minute walk. Aerobic endurance is important for walking distances, climbing stairs, and other activities such as shopping or sightseeing. As such, cardiovascular fitness was measured with the 2-minute step test which entails recording the number of full steps completed in two minutes while raising each knee to a point midway between the patella and iliac crest. The recorded score was equal to the number of times the right knee reaches the required height. The final component of the SFT is the 8-foot up-and-go test and is intended to assess agility and dynamic balance. This fitness component is essential for quick maneuvering which is required for activities such as rushing to answer a telephone or to use the restroom. The 8-foot up-and-go test requires an individual to rise from a chair, walk forward 8 feet, change direction, and return to their seated position in the chair. The fastest time from two trials was recorded to the nearest hundredth of a second. Each test item of the SFT has accompanying performance standards for men and women ages 60 to 94-plus based on a national study of more than 7,000 Americans [3, 4]. Additionally, the SFT provides threshold values on each test item that help to identify if an older adult is at risk for mobility loss.

2.3.3. Exercise Protocol. For a 10-week period participants were monitored while performing their normal exercise routines within the Athens, GA, community. The majority of this exercise took place at the Athens YWCO with the remaining exercise taking place at home or in other settings. While at the YWCO, participants attended a variety of exercise classes designed for older adults. The classes were either 30 or 60 minutes in duration and collectively emphasized all components of physical fitness. There was no limit placed on the participants in terms of type or amount of classes they were allowed to attend in each week. It was common for the women in both groups to exercise together in the same classes and attend different classes on an individual basis. The exercise classes offered at the YWCO during the time of the study focused on functional movements and included Group Strength Training, Pilates, Silver Sneakers, and Step and Sculpt. After baseline testing the participants were educated on how to execute proper posture during exercise and while performing daily activities. The researchers collaborated with the YWCO instructors to ensure that proper execution of functional movements was emphasized during class time. Instructors were also asked to associate the movements being taught to activities of daily living. For example, when performing arm strengthening exercises instructors were asked to relate these movements to functional tasks such as lifting and carrying items similar to laundry baskets, grocery bags, or grandchildren. The type and duration of class participation and other exercise activities were recorded on the weekly exercise log.

2.4. Statistical Analysis

2.4.1. Senior Fitness Test. The Senior Fitness Test was given to each group before, at midpoint, and following 10 weeks of community-based exercise. The Senior Fitness Test (SFT) measures the components of fitness with a chair stand test, arm curl test, 2-minute step test, chair sit-and-reach test, back scratch test, and 8-foot up-and-go test. Each test is scored separately as there is no composite score for the SFT. As such, a separate mixed 3 (time) × 2 (group) ANOVA, with time as the within-subjects factor and group based on level of physical function as the between-subjects factor, was run for each subtest of the SFT. Analyses were conducted using SPSS 22 software (SPSS IBM, New York, USA). The $p = 0.05$ rejection level was used in all analyses.

2.4.2. Weekly Self-Reported Exercise. The number of weekly minutes of exercise performed by the high functioning and moderate/low functioning groups was tallied and recorded at the midpoint and after 10 weeks of exercise. The estimation of time spent exercising reported on the health and medical history questionnaire before the study was used as the preexercise value for self-report exercise.

3. Results

3.1. Senior Fitness Test. The results of the 3 × 2 mixed ANOVA statistical analysis showed no significant interaction effect for time ∗ group for any of the six subtests (chair stand, arm curls, 2-minute step, chair sit-and-reach, back scratch, and 6-foot up-and-go) of the SFT. However, the main effect of time was significant for all fitness components and the main effect of group was significant for all fitness components with the exception of lower extremity flexibility (chair sit-and-reach test). Means and standard deviation for each of the six subtests scores for both groups are presented in Figures 1–6. The results for each SFT subtest are reported below.

3.2. Chair Stand Test. Statistical analysis showed no significant interaction effect for time ∗ group: $F(2, 52) = 0.089$, $p = 0.915$, and $n^2 = 0.003$ for number of chair stands at any of the three time points. The main effect of time showed a statistically significant difference in chair stands at the 3 time points: $F(2, 52) = 26.983$, $p < 0.0005$, and partial $n^2 = 0.509$. The main effect of group showed a statistically significant difference in chair stands between physical function groups: $F(1, 26) = 7.387$, $p = 0.012$, and partial $n^2 = 0.221$. The mean scores for the high function group for pre-, mid-, and posttests were 17.5, 20.8, and 22.9, respectively. Percent change from baseline to midpoint was 18.8%. The high function group mean score for chair stands also increased from midpoint to posttest with a percent change of 10.1%. The moderate/low function group showed larger percent changes between time points. Mean scores for the moderate/low function group increased from 12.5 to 15.3 yielding a percent change of 22.4%. Percent change between midpoint and posttest was 14.4% with mean scores increasing from 15.3 to 17.5.

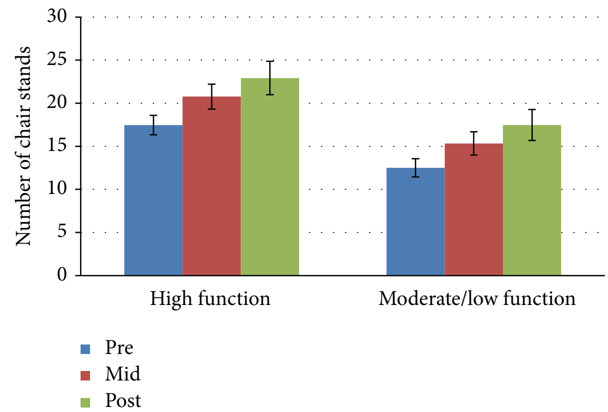

Figure 1: Chair Stand Test mean scores by group and time.

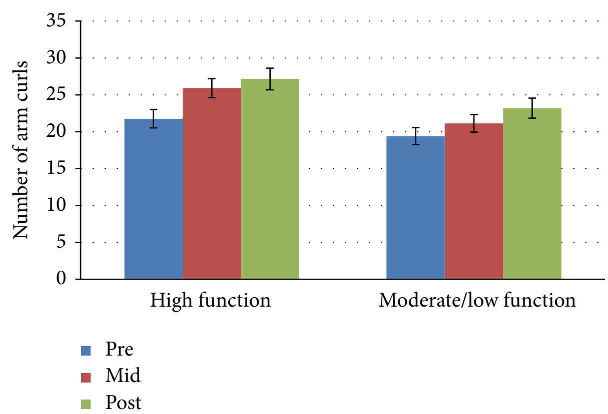

Figure 2: Arm curl test mean scores by group and time.

3.3. Arm Curls Test. Mean scores for the high function group increased over time and were 21.8, 25.9, and 27.15 for pre-, mid-, and posttests, respectively. Percent change between baseline and midpoint was 18.8% and was 4.8% between midpoint and posttest. The moderate/low function group mean scores at pre-, mid-, and posttests were 19.4, 21.3, and 23.2. Baseline to midpoint percent change was calculated to be 9.8% and midpoint to posttest percent change was 8.9%. Statistical analysis showed no significant interaction effect for time ∗ group: $F(2, 52) = 0.743$, $p = 0.481$, and partial $n^2 = 0.028$ at any of the data collection time points. The main effect of time showed a statistically significant difference in arm curls at the three time points: $F(2, 52) = 10.636$, $p < 0.0005$, and partial $n^2 = 0.290$. The main effect of group showed a statistically significant difference in arm curls between physical function groups: $F(1, 26) = 6.969$, $p = 0.014$, and partial $n^2 = 0.211$.

3.4. Two-Minute Step Test. The high function group averaged 113, 131.9, and 142.54 steps at the three data collection time points. The percent change between baseline and midpoint was 16.7% and was calculated to be 8.1% between midpoint and posttest. The moderate/low function group mean scores increased by 18.5% between baseline and midpoint and also

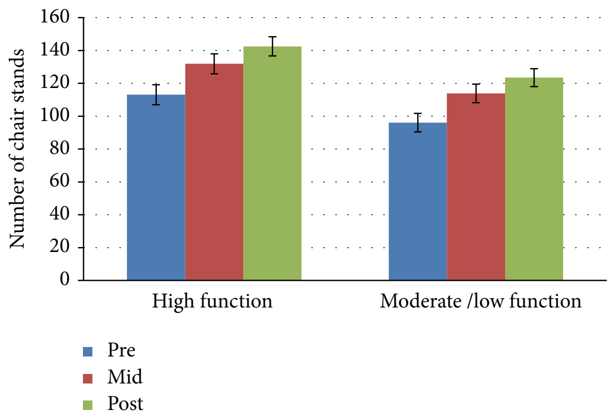

FIGURE 3: Two-minute step test mean scores by group and time.

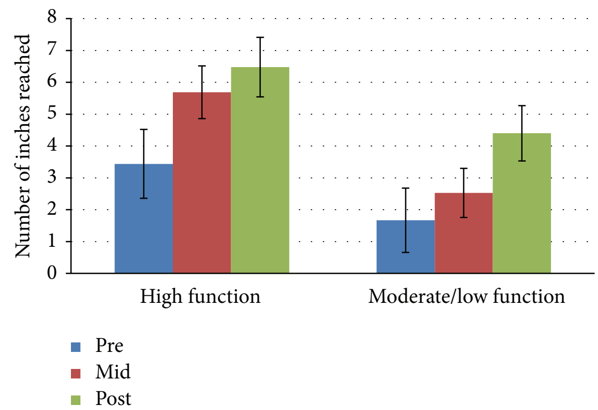

FIGURE 4: Chair sit-and-reach test mean scores by group and time.

increased between midpoint and posttest with a percent change of 8.4%. There was no significant interaction effect for time ∗ group for the 2-minute step test: $F(2, 50) = 0.032$, $p = 0.853$, and partial $n^2 = 0.001$ at any of the three data collection time points. The main effect of time showed a significant difference in steps at the 3 time points: $F(2, 50) = 14.08$, $p < 0.0005$, and partial $n^2 = 0.360$. The main effect of group showed a significant difference in steps between physical function groups: $F(1, 26) = 10.71$, $p = 0.003$, and partial $n^2 = 0.292$.

3.5. Chair Sit-and-Reach Test. There was no significant interaction effect for time ∗ group for the chair sit-and-reach test: $F(2, 52) = 0.967$, $p = 0.387$, and partial $n^2 = 0.036$. The main effect of time showed a significant difference in inches reached at the 3 time points: $F(2, 52) = 15.235$, $p < 0.0005$, and partial $n^2 = 0.369$. However, the main effect of group did not show a significant difference in inches reached between physical function groups: $F(1, 25) = 4.09$, $p = 0.054$, and partial $n^2 = 0.136$. The high function group increased their mean scores by 67.6% and 14% between baseline and midpoint and between midpoint and posttest, respectively. The moderate/low function group increased their mean scores by 47% between baseline and midpoint and also increased mean scores by 76% between midpoint and posttest.

3.6. Back Scratch Test. There was no significant interaction effect for time ∗ group for inches reached on the back scratch test: $F(2, 52) = 1.1$, $p = 0.341$, and partial $n^2 = 0.115$ at any of the three data collection time points. The main effect of time showed a significant difference in inches reached at the 3 time points: $F(2, 50) = 3.321$, $p = 0.044$, and partial $n^2 = 0.117$. The main effect of group showed a significant difference in inches reached during the back scratch test between physical function groups: $F(1, 26) = 24.374$, $p < 0.0005$, and partial $n^2 = 0.484$. The high function group increased their mean scores by 45.7% and 25% between baseline and midpoint and between midpoint and posttest, respectively. The moderate/low function group increased mean scores by

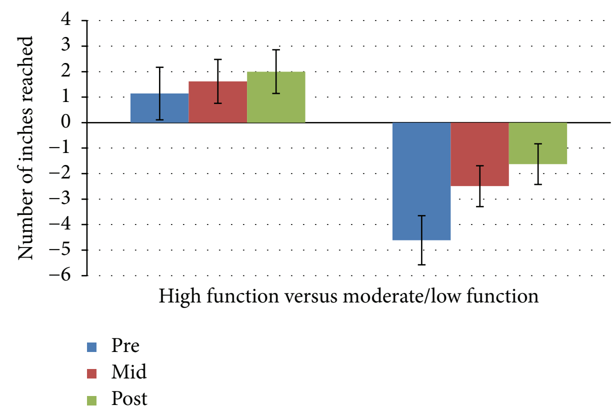

FIGURE 5: Back scratch test mean scores by group and time.

47.8% between baseline and midpoint and also increased mean scores by 36% between midpoint and posttest.

3.7. Eight-Foot Up-and-Go Test. There was a 12.6% percent change for the high function group between pre- and posttest. The percent change for the same group between midpoint and posttest was 7.6%. The moderate to low function group improved by 13.7% and 6.3%, respectively, during the two periods between data collection time points. There was no significant interaction effect between time ∗ group for the 8-foot up-and-go test: $F(2, 52) = 0.06$, $p = 0.942$, and partial $n^2 = 0.002$. The main effect of time showed a significant difference between midpoint and postexercise tests: $F(2, 52) = 4.099$, $p = 0.022$, and partial $n^2 = 0.136$. The main effect of group showed a significant difference in up-and-go scores between physical function groups: $F(1, 26) = 13.071$, $p = 0.001$, and partial $n^2 = 0.335$.

4. Discussion

The benefits of exercise for older adults have been established in the research literature and are well known. There is evidence that habitual exercise can minimize the physiological effects of an otherwise sedentary lifestyle and prolong active

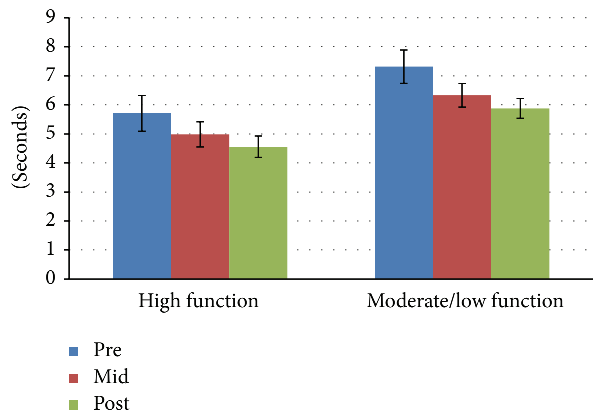

Figure 6: Eight-foot up-and-go test mean scores by group and time.

life expectancy [12]. The heterogeneity observed among older adults and their level of physical function has important implications for research and clinical practice. This notion supports the concept that tailoring exercise programs and interventions to specific deficits and the current state of physical functioning is an important consideration. Research has left little doubt that exercise interventions for older adults need to consider the individual functional needs of participants. As such, the success of aerobic and resistance training for obese men and women [13], balance training for individuals at risk for falls, and water exercise for those with osteoarthritis [14] have all been shown to be effective for older adults with these specific physical function deficits. Despite the plethora of data showing an overall benefit of exercise training for improving, or maintaining functional ability in older adults, there is likely to be large individual variability in functional responses to exercise. Attention to individual differences and identification of factors that influence efficacy of exercise as a therapy for aging-related loss of physical function have important clinical significance. Moreover, the specific amount of exercise necessary to elicit maximal improvements in physical outcomes may differ between types of individuals. Exercise training studies that show efficacy for improving functional ability often report main effects or mean group differences without expressing the extent of variability for these tasks. Therefore, it was the primary purpose of this study to observe the exercise habits of older adult women with different levels of physical function abilities, to determine any differential effects of exercise on their physical fitness.

The specific aim of the study was to determine and compare the effects of 10 weeks of community-based exercise on the cardiovascular endurance, muscular strength, flexibility, and balance fitness components of older adult women with high and moderate-low levels of physical function. The results of the statistical analysis indicate that the impact of time (10 weeks of exercise) on the fitness-related outcome measures did not differ based on level of physical function at any time during the study. In other words, older adult women from this sample were able to improve fitness over time regardless of their initial level of physical function as indicated by their initial score on the Composite Physical Function scale and group assignment. Over the course of 10 weeks the women from both groups improved their SFT scores related to leg strength, arm strength, cardiovascular endurance, leg flexibility, arm flexibility, and mobility and dynamic balance. This finding is consistent with the hypothesis that all participants would increase their scores on all SFT subtests over time. The exercise classes offered at the YWCO provided the participants with a variety of options in terms of which fitness components to train. Many of the exercise classes such as Pilates and Silver Sneakers emphasized multiple fitness components making them highly beneficial to the overall fitness of the participants. By offering programs of regular exercise that include cardiorespiratory, resistance, flexibility, and neuromotor exercise beyond activities of daily living, the Athens YWCO is equipped to improve and maintain the fitness and health of its members [5]. Additionally, the implementation of the Senior Fitness Initiative at the YWCO greatly influenced the participants in terms of their morale and enthusiasm toward exercise. They were highly engaged and eager to learn more about their individual level of fitness.

While the high functioning group consistently had significantly better SFT scores as compared to their counterparts, they did not improve at a greater rate or more significantly over time as compared to the moderate/low functioning group. However, it should be noted that the percent change during the second half of the study between midpoint and posttests was higher for the moderate/low functioning group for all six subtests of the Senior Fitness Test. This implies that the group with lower amounts of functional ability continued to improve and were more resistant to the plateau effect shown by the high function group. The lower functioning individuals seemed to be inspired by their gains and were highly motivated to keep pace with the other women in the study. This finding suggests that there may be some benefit to integrating community-based exercise classes with people of various functional skill sets when resources or logistics are not conducive to separating them. This should only be done with qualified instructors who are able to offer modifiable exercise opportunities to the variable older adult population.

As it was also an aim of this study to compare the exercise habits of older adult women functioning at different levels of independence, self-report weekly exercise logs were used to track the time spent exercising of each participant. Prior to the 10-week exercise period, both groups were asked to estimate the amount of time they spent engaged in exercise on a weekly basis. An interesting finding was that the actual number of recorded minutes during the study (at midpoint and after study) was lower than the estimated averages reported by both groups prior to commencing the 10-week exercise period. Perhaps this can be explained by social desirability, which can lead to overreporting of physical activity [15]. This common limitation of self-report instruments appears to have held true for the weekly exercise logs and this sample of older adult women. Despite this limitation, there were some benefits of utilizing the weekly exercise logs to self-report exercise activity. The participants often reported the feeling of being held accountable for their exercise activity because they were forced to write it down and track it over 10 weeks. The weekly exercise logs seemed to produce a sense of pride among the participants and may have motivated them to be more physically active. Initiating exercise programs and adhering to them is often problematic for older adults [16]. Using weekly exercise logs may help to alleviate this problem among older adults. Also, all participants consistently reported performing exercise activity at home and in other settings outside of the YWCO. This indicates that Senior Fitness Initiatives such as the one implemented during this study may be helpful in improving the overall exercise habits of older adults. These findings suggest that, although sometimes limited in effectiveness, self-report instruments to track the exercise habits of older adults in a community-based setting may be useful when more scientific and reliable options are not available. It is possible that these instruments may have cognitive and physical benefits for older adults. Their use requires the highly complex task of recall and may motivate individuals to be more active by holding them accountable for the amount of time they choose to be engaged in exercise. Additionally, study findings suggest that participation in fitness and exercise initiatives in a community-based setting can improve the perceived ability of older adults to function independently.

In conclusion, this study provides a few noteworthy findings. First, community-based exercise programs offering a variety of exercise types to people with varying levels of functional ability have both physical and psychosocial benefits. These programs can be useful in maintaining and improving fitness and independence. Second, these programs may also be capable of improving the self-efficacy of lower functioning older adults toward performing daily tasks. Finally, self-report instruments such as activity logs may be useful to track and gain an understanding of the exercise habits of older adults. This study was limited due to the nature of the community from which the participants were recruited. The YWCO members were highly educated and most already had an established history of physical activity and exercise. Additionally they were extremely competitive and eager to improve. Future research should build upon using multi-modal exercise regimes focusing on proper format, periodic assessment and feedback, and encouragement of home-based activities. More importantly exercise programs should teach older adults to move correctly while generalizing movements to activities commonly encountered by the population.

Competing Interests

The authors declare that they have no competing interests. As such, the professional judgement of the validity of this research was not influenced by any secondary interests.

References

[1] K. L. Smith, K. Carr, A. Wiseman, K. Calhoun, N. H. McNevin, and P. L. Weir, "Barriers are not the limiting factor to participation in physical activity in canadian seniors," *Journal of Aging Research*, vol. 2012, Article ID 890679, 8 pages, 2012.

[2] W.-N. Wennie Huang, S. Perera, J. Vanswearingen, and S. Studenski, "Performance measures predict onset of activity of daily living difficulty in community-dwelling older adults," *Journal of the American Geriatrics Society*, vol. 58, no. 5, pp. 844–852, 2010.

[3] R. E. Rikli and C. J. Jones, "Development and validation of criterion-referenced clinically relevant fitness standards for maintaining physical independence in later years," *The Gerontologist*, vol. 53, no. 2, pp. 255–267, 2013.

[4] R. Rikli and C. Jones, *Senior Fitness Test Manual*, Human Kinetics, Champaign, Ill, USA, 2nd edition, 2013.

[5] C. E. Garber, B. Blissmer, M. R. Deschenes et al., "Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: Guidance for prescribing exercise," *Medicine and Science in Sports and Exercise*, vol. 43, no. 7, pp. 1334–1359, 2011.

[6] S. Vaughan, N. Morris, D. Shum, S. O'Dwyer, and D. Polit, "Study protocol: a randomised controlled trial of the effects of a multi-modal exercise program on cognition and physical functioning in older women," *BMC Geriatrics*, vol. 12, article 60, pp. 1–11, 2012.

[7] D. Cech and S. Martin, *Functional Movement Development Across the Lifespan*, Elsevier, Linn, Mo, USA, 3rd edition, 2012.

[8] C. Voelcker-Rehage, "Motor-skill learning in older adults—a review of studies on age-related differences," *European Review of Aging and Physical Activity*, vol. 5, no. 1, pp. 5–16, 2008.

[9] F. D. Lees, P. G. Clark, C. R. Nigg, and P. Newman, "Barriers to exercise behavior among older adults: A Focus-Group Study," *Journal of Aging and Physical Activity*, vol. 13, no. 1, pp. 23–33, 2005.

[10] D. H. Paterson, G. R. Jones, and C. L. Rice, "Ageing and physical activity: evidence to develop exercise recommendations for older adults," *Applied Physiology, Nutrition and Metabolism*, vol. 32, pp. S69–S108, 2007.

[11] L. B. Sardinha, D. A. Santos, A. M. Silva, F. Baptista, and N. Owen, "Breaking-up sedentary time is associated with physical function in older adults," *Journals of Gerontology*, vol. 70, no. 1, pp. 119–124, 2015.

[12] W. J. Chodzko-Zajko, D. N. Proctor, M. A. Fiatarone Singh et al., "Exercise and physical activity for older adults," *Medicine & Science in Sports and Exercise*, vol. 41, no. 7, pp. 1510–1530, 2009.

[13] E. A. Chmelo, C. I. Crotts, J. C. Newman et al., "Heterogeneity of physical function responses to exercise training in older adults," *Journal of the American Geriatrics Society*, vol. 63, no. 3, pp. 462–469, 2015.

[14] K. S. Roaldsen, A. Halvarsson, T. Sahlström, and A. Ståhle, "Task-specific balance training improves self-assessed function in community-dwelling older adults with balance deficits and fear of falling: a randomized controlled trial," *Clinical Rehabilitation*, vol. 28, no. 12, pp. 1189–1197, 2014.

[15] J. F. Sallis and B. E. Saelens, "Assessment of physical activity by self-report: status, limitations, and future directions," *Research Quarterly for Exercise and Sport*, vol. 71, supplement 2, pp. 1–14, 2000.

[16] E. C. Tak, J. G. van Uffelen, M. J. Paw, W. Van Mechelen, and M. Hopman-Rock, "Adherence to exercise programs and determinants of maintenance in older adults with mild cognitive impairment," *Journal of Aging and Physical Activity*, vol. 20, no. 1, pp. 32–46, 2012.

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Research Article

Health Status and Social Networks as Predictors of Resilience in Older Adults Residing in Rural and Remote Environments

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Purpose. Health status and social networks are associated with resilience among older adults. Each of these factors may be important to the ability of adults to remain in rural and remote communities as they age. We examined the association of health status and social networks and resilience among older adults dwelling in a rural and remote county in the Western United States. *Methods*. We selected a random sample of 198 registered voters aged 65 years or older from a frontier Wyoming county. Hierarchical linear regression was used to examine the association of health status as well as social networks and resilience. We also examined health status as a moderator of the relationship between social networks and resilience. *Results*. Family networks ($p = 0.024$) and mental health status ($p < 0.001$) significantly predicted resilience. Mental health status moderated the relationship of family ($p = 0.004$) and friend ($p = 0.021$) networks with resilience. Smaller family and friend networks were associated with greater resilience when mental health status was low, but not when it was high. *Conclusion*. Efforts to increase mental health status may improve resilience among older adults in rural environments, particularly for those with smaller family and friends networks.

1. Introduction

Older rural adults comprise a large and increasing percentage of the population in the United States. As of 2014, more than 16% of the population aged 65 years and older were categorized as living in rural settings by the US Census Bureau [1]. The proportion of older adults in rural areas has grown rapidly due in part to aging in place, retirement transitions, and outmigration of younger families [2]. Frontier areas are the most remote and sparsely populated areas among these rural settings. While it is well known that most older adults would prefer to age in their homes and communities [3], older residents in the most remote areas may be far from healthcare and social services, social venues, and other necessities to promote engagement and independent living. Additionally, transportation is frequently lacking and traveling to larger towns and cities where necessities including healthcare are located can be difficult [4].

Shifting demographic trends in rural and remote communities will bring societal changes and challenges. Primary among them will be identifying effective resources to foster health, wellbeing, and independence of older people as they face many of the stressors that often accompany aging in rural environments. For example, with increasing age, risk escalates for adverse outcomes associated with physical and mental health [5], disability [6], declining social network size [7], and economic security [8]. These stressors may be compounded by living in low-density population regions and can impact the quality of life of older adults, especially when the resources they may have available to help them adapt to change may be suboptimal.

The concept of resilience has gained traction as a means to explain how some individuals are able to bounce back from adverse events and stressors and adapt to their changing life circumstances, while others continue to struggle or decline in the face of similar events. On an individual level, resilience is thought to be a personality attribute that helps to neutralize negative effects of high stress [9]. According to Wagnild [10] resilience comprises dimensions of equanimity, a sense of purpose, perseverance, and acceptance of one's life, and a belief in one's self and capabilities. As a general resource possessed by many older adults, resilience can serve to buffer the negative impacts of stress, promote adaptation to late life changes, and contribute to maintenance of independent functioning and wellbeing [11].

As a research construct, resilience has received increasing attention in recent years. For instance, resilience has been examined in relation to specific age-related stressors, including pain [12, 13], mental health outcomes [14], aging with HIV/AIDS [15], bereavement following loss of a spouse [16], and having low income [10]. These studies suggest that resilience may play an important role in promoting healthy response to age-related change.

Much of the previous research on resilience has focused on urban and suburban samples [17] and few studies have examined resilience of community-dwelling older adults in rural and remote settings. One exception is research by Wells [18], which examined resilience levels of older adults residing in rural New York as well as predictors of resilience levels. Wells found that resilience levels were high in participants of this study. Importantly, resilience was not associated with sociodemographic factors and was only weakly associated with social networks. Significant relationships were also reported between physical and mental health status and resilience. While this was one of the first studies examining resilience among rural adults, the study was conducted in one rural community in New York. It is not clear to what degree these results will generalize to other rural communities or to older adults living in not only rural but also remote areas. Moreover, several studies show relationships between social networks and health among older adults [19–21]. Additionally, the work of Li and Zhang showed that relationships between social networks and health among older adults may be bidirectional such that those who have poorer health rely on more restricted social networks [20]. To date, few studies have been conducted to examine whether health status may moderate the relationship between social networks and other constructs like resilience among older adults, especially those residing in rural or remote areas.

The purpose of this study was to extend this small but important body of research. As part of this study, we examined the relationships between resilience and both social networks and health status, in a sample of older adults living in a rural environment. This study differs from the previous work, in that we sampled a population that is relatively more remote than the sample analyzed by Wells [18, 22] and substantially more remote than many other areas in the United States. The Western US state of Wyoming is unique with regard to its topography and the distribution of its population. Cities and towns are widely dispersed across the state's 97,093 square miles and long distances between points of interest are common. Additionally, the population of the state is very small relative to other states. According to estimates produced by data from the American Community Survey (ACS), there were just fewer than 600,000 Wyoming residents in 2014, equating to only about 5.8 persons per square mile (compared to 87.4 persons per square mile, nationally) [1]. Thus, many older Wyoming residents live in an expansive frontier environment that creates unique challenges for them with respect to accessing resources and necessities. Additionally, residents in general may live long distances away from their families, friends, and neighbors, potentially reducing the support and resources available when stressors such as acute and chronic illnesses arise. Given these circumstances, it is reasonable to expect that health outcomes and individual characteristics such as resilience may differ in this type of environment, even compared to other areas that are also categorized as rural. We expected that, like the work of Wells [18], social networks and health status would predict resilience. To build upon existing research, we examined moderation effects of physical and mental health status on the relationship of social networks and resilience in rural, community-dwelling older adults. We hypothesized that both physical and mental health status would moderate the relationship between social networks and resilience.

2. Methods

2.1. Study Sample. The University of Wyoming's Institutional Review Board approved all study methods. We used random sampling methods to obtain a sample of older adults residing in a frontier Wyoming county. First, we used the United States Department of Agriculture (USDA) Economic Research Service's 2013 Rural-Urban Continuum Codes [23] to determine the rurality of all counties in the state. This scale ranges from 0 to 9, with nine being the most rural based on the degree of urbanization and proximity to metro areas. We chose Fremont County, which scores a 7 on the scale, as the basis for our sample (compared to a rating of 6 for the county analyzed in the study by Wells [18]). Fremont County is relatively more rural than the rest of Wyoming, with only 4.4 persons per square mile. A prospective pool of study participants over the age of 65 residing in Fremont County ($N = 3{,}368$) was identified using the 2009 voting registration electoral roll. From this population, a sample of 600 individuals (18%) was randomly selected to receive a mailed survey packet.

Mailings included four components: (1) a cover letter that described the project, (2) a consent form that explained the recipient's rights as a research participant, (3) a raffle entry slip that gave participants an opportunity to win a $50 gift card as incentive to participate, and (4) the survey instrument (described below). Postcards reminding prospective participations of our request were mailed two weeks after the initial mailing. Of the 600 packets that were sent, 80 (13%) were returned as undeliverable. Of the 520 successfully delivered surveys, 225 were returned with useable data, resulting in a return rate of about 43%. A total of 27 incomplete surveys with only partial demographic data completed were removed prior to analysis, yielding a sample of 198 respondents.

2.2. Measures. The survey comprised questionnaires assessing the following four components: (1) sociodemographics, (2) degree of resilience, (3) self-reported physical and mental health status, and (4) size and quality of social networks.

2.2.1. Sociodemographic Questionnaire. The sociodemographic questionnaire included items that assessed the age, gender, race/ethnicity, educational attainment, marital status, and employment status of participants.

2.2.2. Connor-Davidson Resilience Scale. We measured each participant's degree of resilience using the Connor-Davidson Resilience Scale (CD-RISC; [24]). The CD-RISC is a 25-item questionnaire that asks participants to rate their level of agreement over the last month with statements such as "*I am able to adapt when changes occur*" and "*I tend to bounce back after illness, injury, or other hardships*." Each statement was rated on a 0 (not true at all) to 5 (*true nearly all the time*) scale. Item responses were summed to generate a total score, with higher scores indicating greater resilience. The CD-RISC has demonstrated convergent validity and good internal reliability ($\alpha = 0.89$) in previous work [24] as well as in the current study ($\alpha = 0.92$).

2.2.3. Short-Form Revised Health Survey. We assessed the physical and mental health status of participants using all twelve items of the Short-Form revised Health Survey (SF-12v2). Items in this instrument ask participants to rate their general health and to describe how physical and mental health issues limit or interfere with their daily activities and social activities. Weighted-items scores were used to calculate a Physical Component Summary score and a Mental Component Summary score. The SF-12v2 provides norms-based scores for the Physical Component Summary and the Mental Component Summary scores that are standardized (population mean = 50; standard deviation = 10) with higher scores reflecting greater functioning in each domain [25].

2.2.4. Lubben Social Network Scale-6. We used the abbreviated Lubben Social Network Scale-6 to assess the social networks and supports of participants [26]. The Lubben Social Network Scale-6 is comprised of two 3-item subscales, which assess the size and quality of family and friend social networks. Several items are designed to assess the number of regular social contacts. For example, respondents are asked, "*How many relatives do you see or hear from at least once a month?*" Responses to these items are made on a five-point scale ranging from 0 (*none*) to 5 (*nine or more*). Other items ask about frequency of contact with family and friends (e.g., *"How often do you hear from the relative with whom you have the most contact?"*). Responses to these items range from 0 (*less than monthly*) to 5 (*daily*). Finally, the quality and availability of social relationships are addressed using items such as "*How often is one of your relatives available for you to talk to when you have an important decision to make?*" Responses to these items range from 0 (*never*) to 5 (*always*). Higher scores on the Lubben Social Network Scale reflect more substantial social networks. Subscale scores less than or equal to 6 are suggestive of marginal family and friendship ties, and total scores less than or equal to 12 are indicative of social isolation. Both subscales have demonstrated convergent validity with measures of emotional support and social engagement [26]. The family and friend subscales have demonstrated good internal reliability in previous work (i.e., $\alpha = 0.89$ and 0.82, resp.) [26] as well as in the current study ($\alpha = 0.80$ and 0.81, resp.).

2.3. Statistical Analysis. All analyses were conducted using Statistical Package for the Social Sciences (SPSS) Version 22.0 [27]. Descriptive statistics (i.e., percentages, means, and standard deviations) were calculated to characterize the sample. Bivariate analyses were used to assess the zero-order correlations among SF-12vs component scores (i.e., Physical Component Summary and Mental Component Summary score), Lubben Social Network Scale subscale scores (family and friends), and resilience scores. A two-step hierarchical linear regression was used to simultaneously examine Physical Component Summary scores, Mental Component Summary scores, family network scores, and friend network scores as predictors of resilience while controlling for relevant sociodemographic variables. We entered age, gender, educational attainment (i.e., ≤ high school = 0; > high school = 1), marital status (i.e., single, divorced, or widowed = 0; married or long-term relationship = 1), and employment status (i.e., not employed = 0; employed = 1) in the first step of the model. In the second step of the model, we entered SF-12v2 Physical Component Summary and Mental Component Summary scores, as well as the family network and friend network scores. Tolerances were assessed for possible multicollinearity.

We used the PROCESS macro for SPSS to examine whether SF-12v2 Physical Component Summary scores and Mental Component Summary scores moderated the relationships between the social network subscales and resilience scores [28]. All predictors and covariates were mean centered. Heteroskedasticity consistent standard error estimators were used to guard against violations of homogeneity of variance [29]. Simple slopes were evaluated at one standard deviation above and below the mean of the moderator variable. The Johnson-Neyman approach was used to determine the boundary value of the moderator above and below which simple slopes were significantly different from zero [28, 30].

Bias-corrected and accelerated bootstrapping with 5,000 replications was used to estimate 95% confidence intervals ($CI_{95\%}$) for all correlation and unstandardized regression coefficients. Alpha was set to $p < 0.05$, and all tests were two-tailed.

3. Results

Table 1 depicts the result of descriptive analyses. The majority of survey respondents were female, non-Hispanic White, married, and retired. Age of participants ranged from 64 to 95 years and the average age was about 74 years. The mean resilience score was near 80 and comparable to the average resilience (i.e., CD-RISC) scores for the US general population (M = 80.4) [24]. Average social network scores for family and friends were each over 8 and greater than the suggested cut-point of 6 used for identifying marginal family and friendship networks among older adults [26]. Using a cut-score of 6 or lower, approximately 17% of the sample had marginal family networks and 24% of the sample had marginal friend networks. Physical Component Summary scores and Mental Component Summary scores of study participants were each slightly higher on average than the established population means for adults aged 65 years and

Table 1: Descriptive statistics for covariates, independent variables, and dependent variable (N = 198).

	M (SD)	n (%)
Sociodemographic		
Age	73.68 (6.90)	
Gender (female)		104 (52.5)
Race (white)		186 (93.9)
Non-Hispanic		198 (100)
Education (> high school)		149 (75.3)
Not employed		151 (76.3)
Married or having a long-term relationship		121 (61.1)
SF-12 health status		
MCS	53.49 (7.56)	
PCS	46.36 (10.50)	
Lubben Social Network Scale-6		
Friends	8.93 (2.85)	
Family	8.30 (3.18)	
CD-RISC	81.56 (12.23)	

Note. MCS: Mental Component Summary score; PCS: Physical Component Summary score; family: family network size; friend: friend network size; CD-RISC: resilience.

Table 2: Correlations among all independent variables and dependent variable (N = 198).

	PCS	Family	Friend	CD-RISC
MCS	0.11	$0.21^{\dagger}$	$0.22^{\dagger}$	$0.48^{\ddagger}$
PCS		0.08	0.14	0.16^{*}
Family			$0.56^{\ddagger}$	$0.33^{\ddagger}$
Friend				$0.28^{\ddagger}$

$^{*}p < 0.05$; $^{\dagger}p < 0.01$; $^{\ddagger}p < 0.001$.
Note. MCS: Mental Component Summary score; PCS: Physical Component Summary score; family: family network size; friend: friend network size; CD-RISC: resilience.

Table 3: Regression results of resilience status on covariates and independent variables (N = 198).

	B	SE	ΔR^2	p
Step1			<0.01	0.994
Age	−0.01	0.15		0.974
Gender	0.51	1.81		0.786
Relationship status	0.67	1.95		0.726
Employed	−0.31	2.00		0.876
Education	0.77	2.15		0.715
Step2			0.29	<0.001
SF-12 MCS	0.67	0.11		<0.001
SF-12 PCS	0.10	0.08		0.165
LSNS-6 friend	0.23	0.29		0.424
LSNS-6 family	0.88	0.39		0.024
Full-model			0.30	<0.001

Note. MCS: Mental Component Summary score; PCS: Physical Component Summary score; LSNS-6 friend: friend network size; LSNS-6 family: family network size; CD-RISC: resilience.

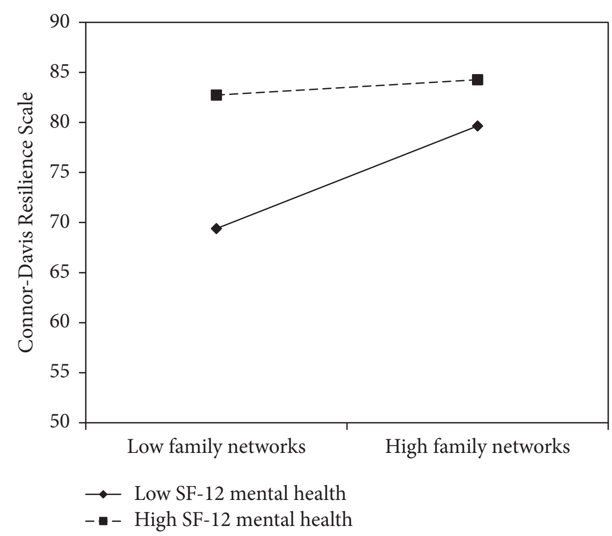

Figure 1: The simple slopes of Lubben Social Network Scale-6 family networks on Connor-Davis Resilience Scale scores at high and low levels of SF-12 Mental Health Component Summary scores.

older (Physical Component Summary score, M = 43.73, and Mental Component Summary score, M = 53.15) [25]. Table 2 shows correlations among all key predictor and outcome variables. Notably, significant positive correlations were found between resilience and Physical Component Summary scores (p = 0.025), Mental Component Summary scores ($p < 0.001$), family networks ($p < 0.001$), and friend networks ($p < 0.001$).

Table 3 shows unstandardized regression coefficients, standard errors, and ΔR^2 values for the two-step hierarchical linear regression analysis. In step one of the analysis, the covariates (i.e., age, gender, educational attainment, marital status, and employment status) did not explain a significant amount of variance in resilience scores, and none of the variables independently predicted resilience scores. In the second step, the Physical Component Summary score, Mental Component Summary score, family network, and friend network scores accounted for a significant increase in explained variance in resilience scores. Whereas, the Physical Component Summary scores and friend networks were not significant predictors of resilience, both the Mental Component Summary score and family network scores significantly predicted resilience scores while controlling for sociodemographic variables.

As shown in Figure 1, the bootstrapped test of moderation yielded a significant interaction of family network by Mental Component Summary scores on resilience scores (B = −0.10, SE = 0.03, $\mathrm{CI}_{95\%}$ [−0.17, −0.03], and p = 0.004), when controlling for age, gender, educational attainment, marital status, and employment status. Specifically, family network scores significantly predicted resilience scores at low (i.e., −1 SD) values of Mental Component Summary

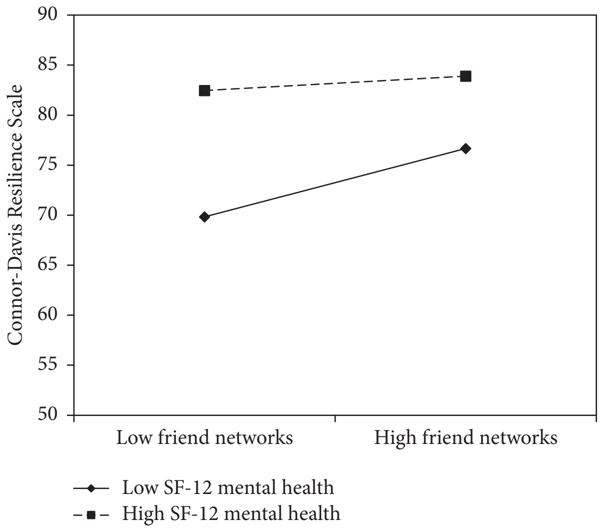

FIGURE 2: The simple slopes of Lubben Social Network Scale-6 friend networks on Connor-Davis Resilience Scale scores at high and low levels of SF-12 Mental Health Component Summary scores.

scores (B = 1.80, SE = 0.39, $CI_{95\%}$ [1.03, 2.57], and p < 0.001). However, no significant relationship between family networks and resilience was observed at high (i.e., +1 SD) values of Mental Component Summary scores (B = 0.27, SE = 0.42, $CI_{95\%}$ [−0.56, 1.10], and p = 0.529). Family networks significantly predicted resilience below, but not above, the Mental Component Summary score of 56.98. The majority of the sample (n = 117, 59.1%) scored below this boundary value.

Figure 2 shows the significant interaction of friend networks by Mental Component Summary scores on resilience scores (B = −0.06, SE = 0.02, $CI_{95\%}$ [−0.10, −0.01], and p = 0.021), when controlling for sociodemographic covariates. Analysis of simple slopes showed a significant positive association between friend networks and resilience at low (−1 SD) levels of Mental Component Summary scores (B = 1.07, SE = 0.32, $CI_{95\%}$ [0.45, 1.71], and p = 0.001). There was no significant association between friend networks and resilience at high (+1 SD) levels of Mental Component Summary scores (B = 0.23, SE = 0.28, $CI_{95\%}$ [−0.33, 0.78], and p = 0.425). Friend networks were significantly associated with resilience below, but not above, the Mental Component Summary score of 49.45, below which most participants scored (n = 115, 58.1%).

Contrary to our expectations, moderation analyses did not show any additional significant interactions between the Physical Component Summary scores and family (B = −0.02, SE = 0.04, $CI_{95\%}$ [−0.09, 0.05], and p = 0.619) or friend (B = −0.05, SE = 0.04, $CI_{95\%}$ [−0.13, 0.02], and p = 0.163) networks when controlling for age, gender, educational attainment, marital status, and employment status.

4. Discussion

Developing a better understanding of resilience in rural older adults and its interrelationships with social networks and health status can help determine who may struggle to adapt successfully to stressful age-related changes and, ultimately, who will experience poorer outcomes. Literature shows that older adults living in rural and remote areas possess varying degrees of resilience, as do individuals living in urban and suburban areas [20]. For some older adults, a rural environment with strong social networks can provide valuable caring environments for people as they age. For others, rural environments may be isolating.

Results of our study showed that resilience levels of older adults living in a rural and remote county in Wyoming are generally high. Our results also suggest that both family social networks and mental health status are important predictors of resilience among these individuals. According to Fiori et al. [31], many types of social networks may contribute to relationship satisfaction in older adults and ultimately to better or worse health outcomes. For example, unmarried older adults often report lower physical and psychological wellbeing than married couples, and widowed women with friend-focused social networks report higher wellbeing than unmarried individuals. Older adults vary in the types and quantities of support needed from their social networks at different times. Utilizing networks in ways that serve the specific needs of older individuals is a likely contributor to the goal of successful aging via physical and psychological benefits, which also have potential to foster resilience [31]. With respect to social networks, results from this study suggest that family members are particularly important social resources that are associated with resilience among rural and remote older residents. In regions of the country where populations are widely dispersed, formal support resources are less likely to be directly on hand to provide assistance when it is needed. Thus, compared to more densely populated areas, family members of older adults living in remote areas may be required to step in more frequently when crises occur. It is possible that resilience can be fostered among residents in rural and remote communities by policies and programs that provide support for family members who may provide care for older residents.

Our results suggest that rural and remote, older persons with better functioning in the mental health domain also have higher degrees of resilience. This finding corresponds with the research of Fiori et al. [31], who reported similar outcomes. There are a few possible explanations for the association. First, resilience itself functions as an adaptive resource for coping with stressful situations. It may be that flexibility and adaptability serve as a buffer to stressors. Because our data were gathered at a single point in time, it did not take into account the order in which mental health-related issues arose relative to resilience status. Therefore, it is possible that our results reflect mental wellness that resulted from having high resilience, rather than the other way around. Second, older adults whose perceived mental health scores reflect higher levels of functioning may have traits that are more likely to promote and support the development of resilience. For example, older individuals who are able to maintain a positive outlook in the face of aging-related stressors can direct more of their cognitive resources toward productive problem-solving strategies and fewer resources toward monitoring and maintaining their mental health. Regardless of the explanation, our results suggest that encouraging mental health services and supporting access to them by older people in rural and remote areas can have a positive impact on resilience status and coping mechanisms.

Results of this study also expand the previous work of Wells [18] by suggesting that family social network may be an important moderator of the relationship between mental health functioning and resilience. A moderating relationship is one in which a variable—in this case family social networks—increases or decreases the magnitude of the relationship between two different variables [32]. Our findings suggest that strong family social networks can buffer the impact of poor mental health functioning with respect to its influence on resilience. In other words, when older rural and remote individuals experience mental health problems, strong family networks and the support they provide can help to make up the difference and restore resilience to levels near to those without mental health issues.

Dumitrache and colleagues [33] suggested that types of stressors and cultural contexts could impact the effects of social support in promoting resilience. Among older adults, factors associated with rural or remote living might strengthen, modify, or diminish relationships between social support, physical health status, and resilience. For example, Moore and colleagues [34] examined the interrelationships of perceived stress, social support, and self-reported successful aging and found that the influence of perceived stress on the relationship between physical functioning and self-reported successful aging was stronger among those with high levels of social support. Among rural and remote older adults in our study, physical health status did not predict resilience as it did in the study by Wells [18] and, thus, did not moderate the relationship between social support and resilience. It could be that the influence of the rural, Western context of participants in this study had a different influence compared to the rural Eastern context in which Wells' participants were recruited. One variable that may differ between the two samples is perceived stress. While neither this study nor the study by Wells [18] included a measure of perceived stress, this construct may have influenced relationships among the variables in both studies. Additional work that incorporates other potentially influential variables such as perceived stress and coping strategies might lead to greater understanding of the relationships between these variables.

This study is important to consider within the context of several limitations. First, like Wells [18, 22], we used mailed surveys to collect our data. Employing self-reported responses acquired through a mailed survey may not have captured the actual average level of resilience in rural and remote community-dwelling older adults. Selection bias may have limited participation by individuals with lower levels of resilience. The response rate in this study was 43%. While this rate was good, those with better health status, social networks, or resilience may have been more likely to respond. Additionally, although surveys were printed in 14-point font, participants with low visual acuity, chronic conditions, or low literacy may have been less able and less likely to respond to the survey. If this were the case, then our results might not generalize to those populations. This study did not gather information on all nonresponders. Therefore, it is not possible to discern how health status, social networks, or resilience may have differed among responding and nonresponding groups. Third, while this study addressed size and quality of social networks, other related constructs such as social connectedness, isolation, and loneliness were not measured. Other social network-related constructs should be addressed in future research. Fourth, as noted above, our study design was cross-sectional and, therefore, it is not possible to know with certainty the order of effects that we reported (i.e., whether mental health status precedes resilience, or the other way around). Future research that utilizes longitudinal data to assess how associations between social networks, health dimensions, and resilience levels covary over time would improve understanding of causal associations between these constructs. Lastly, our study only included older adults residing in rural and remote areas. Therefore, comparison of resilience and relationships of social networks and health status to resilience between rural and urban samples was not possible. Work by Wells [22] showed that resilience levels of older adults did not statistically differ depending on whether participants lived in rural, urban, or suburban areas. Thus, it is possible that there are no differences among older adults in these settings and that these results could generalize to older adults regardless of the size of their communities. However, it is also possible that older adults in rural versus urban settings utilize healthcare and mental health resources differently and/or that family and friend networks play unique roles in the lives of rural older adults compared to their more urban counterparts. Therefore, future work should include samples of rural, urban, and suburban residents to understand better the interplay of these constructs in each subgroup.

In addition to its statistical contribution, this study has clinical implications that are worthy of mention. The Institute of Medicine Report "Retooling for an Aging America: Building a Better Workforce" [35] echoes the recognized need for a workforce that is trained to meet the growing healthcare demands of an aging population. This report calls for an expansion of the roles of many members of the healthcare workforce including informal caregivers and direct care workers to improve care access [35]. While much attention has been given to mental health screening in primary care, other members of the workforce should also be prepared to identify mental health symptoms common among older adults. Moreover, all members of the healthcare workforce should have access to tools to assess social isolation among older adults and refer those individuals who are isolated or at risk for social isolation to community resources in order to prevent isolation or increasing isolation.

The inclusion of social supports in mental health interventions may also serve in mental health access and improve outcomes among older individuals facing mental health challenges. While collaborative care models have shown success for improving mental health outcomes, modifications of these models to include peer specialists to assist with transportation and delivery of basic interventions have shown success in improving access to care within small practices, such as those found in rural areas [36]. The delivery of socialization interventions by way of telehealth is another strategy to improve access to mental health services as well as health outcomes. For example, recent work by Choi and colleagues showed that tele-problem-solving therapy delivered through a Skype video call was an efficacious treatment for low-income homebound older adults [37]. Similarly, Jimison and colleagues [38] designed an intervention to increase social contact time of older adults in the home by enrolling them and a remote family member in a Skype-based health-coaching project. This program included weekly activities to meet target socialization goals as part of an individualized plan. Whereas positive impacts of telehealth interventions implemented to increase contact with social networks are feasible, additional challenges persist, such as lack of adequate technological infrastructure in rural areas to support cutting edge advancements that older adults in more urban regions may take for granted. Thus additional studies are needed to examine the specific needs and resources of older rural residents and their communities and the efficacy of technology for building strong social networks and improving mental health and resilience outcomes among rural and remote older adults.

Competing Interests

The authors declare that they have no competing interests.

References

[1] US Census Bureau, *State & County QuickFacts*, United States Census Bureau, Suitland, Md, USA, 2014.

[2] N. Glasgow, "Rural/urban patterns of aging and caregiving in the United States," *Journal of Family Issues*, vol. 21, no. 5, pp. 611–631, 2000.

[3] A. Kochera, A. Straight, and T. Guterbock, *A Report to the Nation on Livable Communities: Creating Environments for Successful Aging*, AARP, Washington, DC, USA, 2005.

[4] S. T. Syed, B. S. Gerber, and L. K. Sharp, "Traveling towards disease: transportation barriers to health care access," *Journal of Community Health*, vol. 38, no. 5, pp. 976–993, 2013.

[5] P. de Souto Barreto, "Participation bias in postal surveys among older adults: the role played by self-reported health, physical functional decline and frailty," *Archives of Gerontology and Geriatrics*, vol. 55, no. 3, pp. 592–598, 2012.

[6] M. E. Miller, W. J. Rejeski, B. A. Reboussin, T. R. Ten Have, and W. H. Ettinger, "Physical activity, functional limitations, and disability in older adults," *Journal of the American Geriatrics Society*, vol. 48, no. 10, pp. 1264–1272, 2000.

[7] C. Wrzus, M. Hänel, J. Wagner, and F. J. Neyer, "Social network changes and life events across the life span: a meta-analysis," *Psychological Bulletin*, vol. 139, no. 1, pp. 53–80, 2013.

[8] J. M. Poterba, "Retirement security in an aging population," *The American Economic Review*, vol. 104, no. 5, pp. 1–30, 2014.

[9] Q. Q. Tiet, D. Huizinga, and H. F. Byrnes, "Predictors of resilience among inner-city youths," *Journal of Child and Family Studies*, vol. 19, no. 3, pp. 360–378, 2010.

[10] G. Wagnild, "Resilience and successful aging: comparison among low and high income older adults," *Journal of Gerontological Nursing*, vol. 29, no. 12, pp. 42–49, 2003.

[11] J. W. Rowe and R. L. Kahn, "Successful aging and disease prevention," *Advances in Renal Replacement Therapy*, vol. 7, no. 1, pp. 70–77, 2000.

[12] O. Friborg, O. Hjemdal, J. H. Rosenvinge, M. Martinussen, P. M. Aslaksen, and M. A. Flaten, "Resilience as a moderator of pain and stress," *Journal of Psychosomatic Research*, vol. 61, no. 2, pp. 213–219, 2006.

[13] P. Karoly and L. S. Ruehlman, "Psychological 'resilience' and its correlates in chronic pain: findings from a national community sample," *Pain*, vol. 123, no. 1-2, pp. 90–97, 2006.

[14] G. Netuveli, R. D. Wiggins, S. M. Montgomery, Z. Hildon, and D. Blane, "Mental health and resilience at older ages: bouncing back after adversity in the British Household Panel Survey," *Journal of Epidemiology and Community Health*, vol. 62, no. 11, pp. 987–991, 2008.

[15] C. A. Emlet, S. Tozay, and V. H. Raveis, "'I'm not going to die from the AIDS': resilience in aging with HIV disease," *The Gerontologist*, vol. 51, no. 1, pp. 101–111, 2011.

[16] K. M. Bennett, "How to achieve resilience as an older widower: turning points or gradual change?" *Ageing and Society*, vol. 30, no. 3, pp. 369–382, 2010.

[17] S. E. Hardy, J. Concato, and T. M. Gill, "Resilience of community-dwelling older persons," *Journal of the American Geriatrics Society*, vol. 52, no. 2, pp. 257–262, 2004.

[18] M. Wells, "Resilience in rural community-dwelling older adults," *Journal of Rural Health*, vol. 25, no. 4, pp. 415–419, 2009.

[19] T. D. Windsor, P. Rioseco, K. L. Fiori, R. G. Curtis, and H. Booth, "Structural and functional social network attributes moderate the association of self-rated health with mental health in midlife and older adults," *International Psychogeriatrics*, vol. 28, no. 1, pp. 49–61, 2016.

[20] T. Li and Y. Zhang, "Social network types and the health of older adults: exploring reciprocal associations," *Social Science & Medicine*, vol. 130, pp. 59–68, 2015.

[21] S. B. Rafnsson, A. Shankar, and A. Steptoe, "Longitudinal influences of social network characteristics on subjective well-being of older adults: findings from the ELSA study," *Journal of Aging and Health*, vol. 27, no. 5, pp. 919–934, 2015.

[22] M. Wells, "Resilience in older adults living in rural, suburban, and urban areas," *Journal of Rural Nursing & Health Care*, vol. 10, no. 2, pp. 45–54, 2010.

[23] Economic Research Service USDA: Rural-Urban Continuum Codes, 2013.

[24] K. M. Connor and J. R. T. Davidson, "Development of a new resilience scale: the Connor-Davidson resilience scale (CD-RISC)," *Depression and Anxiety*, vol. 18, no. 2, pp. 76–82, 2003.

[25] J. Ware, M. Kosinski, D. M. Turner-Bowker, and B. Gandek, *User's Manual for the SF-12v2 Health Survey*, Quality Metric Incoroporated, Lincoln, RI, USA, 2007.

[26] J. Lubben, E. Blozik, G. Gillmann et al., "Performance of an abbreviated version of the Lubben Social Network Scale among three European community-dwelling older adult populations," *The Gerontologist*, vol. 46, no. 4, pp. 503–513, 2006.

[27] IBM Corp, *IBM SPSS Statistics for Windows*, Version 22.0., IBM Corp, Armonk, NY, USA, 2013.

[28] A. F. Hayes, *PROCESS: A Versatile Computational Tool for Observed Variable Mediation, Moderation, and Conditional Process Modeling*, 2012.

[29] A. F. Hayes and L. Cai, "Using heteroskedasticity-consistent standard error estimators in OLS regression: an introduction and software implementation," *Behavior Research Methods*, vol. 39, no. 4, pp. 709–722, 2007.

[30] S. A. Spiller, G. J. Fitzsimons, J. G. Lynch Jr., and G. H. McClelland, "Spotlights, floodlights,andthe magic number zero: simple effects tests in moderated regression," *Journal of Marketing Research*, vol. 50, no. 2, pp. 277–288, 2013.

[31] K. L. Fiori, J. Smith, and T. C. Antonucci, "Social network types among older adults: a multidimensional approach," *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, vol. 62, no. 6, pp. P322–P330, 2007.

[32] R. M. Baron and D. A. Kenny, "The moderator-mediator variable distinction in social psychological research. Conceptual, strategic, and statistical considerations," *Journal of Personality and Social Psychology*, vol. 51, no. 6, pp. 1173–1182, 1986.

[33] C. G. Dumitrache, L. Rubio, and R. Rubio-Herrera, "Perceived health status and life satisfaction in old age, and the moderating role of social support," *Aging & Mental Health*, 2016.

[34] R. C. Moore, L. T. Eyler, B. T. Mausbach et al., "Complex interplay between health and successful aging: role of perceived stress, resilience, and social support," *The American Journal of Geriatric Psychiatry*, vol. 23, no. 6, pp. 622–632, 2015.

[35] Institute of Medicine, *Retooling for an Aging America: Building the healthcare Workforce*, Institute of Medicine, Washington, DC, USA, 2008.

[36] A. L. Rollins and D. Frantz, "Peer specialists in collaborative care for older adults with depression," *Psychiatric Services*, vol. 66, no. 9, pp. 1000–1001, 2015.

[37] N. G. Choi, M. T. Hegel, C. N. Marti, M. L. Marinucci, L. Sirrianni, and M. L. Bruce, "Telehealth problem-solving therapy for depressed low-income homebound older adults," *The American Journal of Geriatric Psychiatry*, vol. 22, no. 3, pp. 263–271, 2014.

[38] H. B. Jimison, K. A. Klein, and J. L. Marcoe, "A socialization intervention in remote health coaching for older adults in the home," in *Proceedings of the 35th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC '13)*, pp. 7025–7028, Osaka, Japan, July 2013.

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Research Article

Active Ageing Level of Older Persons: Regional Comparison in Thailand

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Active ageing level and its discrepancy in different regions (Bangkok, Central, North, Northeast, and South) of Thailand have been examined for prioritizing the policy agenda to be implemented. Attempt has been made to test preliminary active ageing models for Thai older persons and hence active ageing index (AAI, ranges from 0 to 1) has been estimated. Using nationally representative data and confirmatory factor analysis approach, this study justified active ageing models for female and male older persons in Thailand. Results revealed that active ageing level of Thai older persons is not high (mean AAIs for female and male older persons are 0.64 and 0.61, resp., and those are significantly different ($p < 0.001$)). Mean AAI in Central region is lower than North, Northeast, and South regions but there is no significant difference in the latter three regions of Thailand. Special emphasis should be given to Central region and policy should be undertaken for increasing active ageing level. Implementation of an Integrated Active Ageing Package (IAAP), containing policies for older persons to improve their health and economic security, to promote participation in social groups and longer working lives, and to arrange learning programs, would be helpful for increasing older persons' active ageing level in Thailand.

1. Introduction

Active ageing (AA) is the global goal of present ageing world for meeting the challenges of older persons and for improving their quality of life. Active ageing can be explained as a concept [1] and Walker (2002) has defined AA as profound strategy to maximize participation and wellbeing as people grow older [1]. World Health Organization (WHO) defined AA as the way of thinking and working on "the process of optimizing opportunities for health, participation and security in order to enhance quality of life as people age" [2]. The concept of AA can be encapsulated as "engaged in life" and it has been recognized as a latent construct which has no specific clear dependent variable to measure it and it may be determined by various latent (unobserved) factors. The AA construct is influenced by several groups of determinants or determinant factors including the cross-cutting determinants (gender and culture) [2]. These determinant factors are unobserved or latent and each of them can be presented by some indicators [2, 3].

The growth of population ageing in Thailand is faster compared to other Asian countries [4]. The pace of recent population ageing in Thailand is faster than other Asian countries and even far more faster than developed countries in the West [4, 5], and proportion of elderly (aged 60 and over) is projected to reach more than 30% within the next three decades in Thailand [6]. Thailand has become an ageing society and is going to increase its older population. A rapid proceeding pace of population ageing, along with demographic changes in Thailand, is posing critical challenges for Thai government to maintain economic growth, social stability, and living standard of people in the nation.

All determinant factors of AA with their indicators (hence active ageing level, AAL) need to be better understood for developing policies and programs focused on active ageing in an ageing society. Moreover, comparison of AAL regarding cross-cutting determinants of AA, gender and culture, should be unveiled for better policy implications for the older persons and for the nation as a whole. Using exploratory factor analysis, one study by Haque et al. found

Table 1: Selected indicator variables for validating active ageing determinant factors model in Thailand.

Variables	Coding
Age	1: 60–69 years; 2: 70–79 years; 3: 80+ years
Happiness level[a]	1: 1–6; 2: 7-8; 3: 9; 4: 10
Psychological distress status	1: very high; 2: high; 3: moderate; 4: poor or nearly never
Smoking	0: yes; 1: no
Drinking alcohol	0: yes; 1: no
Basic ADL (activities of daily living) index	0: severe; 1: moderately severe; 2: moderate; 3: independent
Subjective health	0: poor; 1: moderate; 2: good
Illness	0: two and/more chronic illnesses; 1: one chronic illness; 2: none
Visibility	0: no or not clear; 1: clear
Hearing	0: no or not clear; 1: clear
Education	0: no or less than primary; 1: primary; 2: secondary and/or higher
Community participation	0: no; 1: yes
Participation in elderly group	0: no; 1: yes
Work	0: no; 1: yes
Income[a]	1: no or <20000 Baht; 2: 20000–40000 Baht; 3: 40000–60000 Baht; 4: 60000+ Baht
Sufficiency of income	0: not sufficient; 1: sufficient
Savings	0: no; 1: yes

[a]Quartiles.

active ageing determinant factors models with six determinant factors for female and male older persons in Thailand [3]. But the study did not validate the models (i.e., how does the model fit with the sample data?). Along with the lack of model validation, the study by Haque et al. (or any other study so far in knowledge) did not compare AAL for culture of different regions in Thailand. Culture, defined as people's behavior, attitude, or way of life, varies depending on region of residence (e.g., urban or rural, different region of a country) of individuals. Therefore, people's behavior, attitude, or way of life depends on the place or region of society where the society is situated. Though Thailand is perceived as Southeast Asia's most ethnically homogeneous nation state and strong unity of Thai culture, Thailand government's use of regional terms (Central, North, Northeast, and South) indicates some regional cultural diversity in Thailand [7]. Despite the important strength and unity of Thai culture, each region in Thailand has its own unique cultural features [8]. So, doing research or formulating policies on active ageing in Thailand, the variations of active ageing depending on region of residence (Central, North, Northeast, and South) should be considered or should be borne in mind. Hence active ageing level should be compared in different regions of Thailand.

The objective of this study was to gain empirical knowledge on active ageing determinant factors model for Thai older persons including their active ageing level. The main specific objectives of this study are (i) to test the validity of active ageing determinant factors model for Thai older persons and (ii) to test the similarity of active ageing level for various regions (Bangkok, Central (excluding Bangkok), North, Northeast, and South) in Thailand.

2. Materials and Methods

2.1. Data. The data for this study come from a nationally representative sample from the 2011 Survey of Older Persons in Thailand (SOPT). The SOPT was conducted by Thailand's National Statistical Office (NSO). The sample of SOPT consists of 62,840 persons aged 50 years and over, 54% of whom were 60 years and older. The data have been collected in SOPT by using stratified two-stage sampling method. The primary sampling units were villages for nonmunicipal areas and blocks for municipal areas. The secondary sampling units were private dwellings selected by random sampling from the list of all enumerated households in each village or block of the first sampling units. The 2011 SOPT is a nationally representative survey which covers data for population subgroups or geographic subareas (e.g., regions and urban-rural areas). Further details of the methodology, including sampling strategy, for SOPT are available at NSO's "report on the 2011 Survey of Older Persons in Thailand" [9]. This study included individuals (same as in Haque et al. study [3]) aged 60 years and over (n = 23,801; female = 14,369 and male = 9,432).

2.2. Variables. For validating the active ageing determinant factors structure in Thailand (suggested by Haque et al.) [3], the variables used for this study in confirmatory factor analysis (CFA) are provided in Table 1.

2.3. Hypothesized Active Ageing Determinant Factors Model. The study by Haque et al., a pioneer study for finding a model for active ageing determinants, suggested two separate determinant factor structures for each gender [3]. Using the

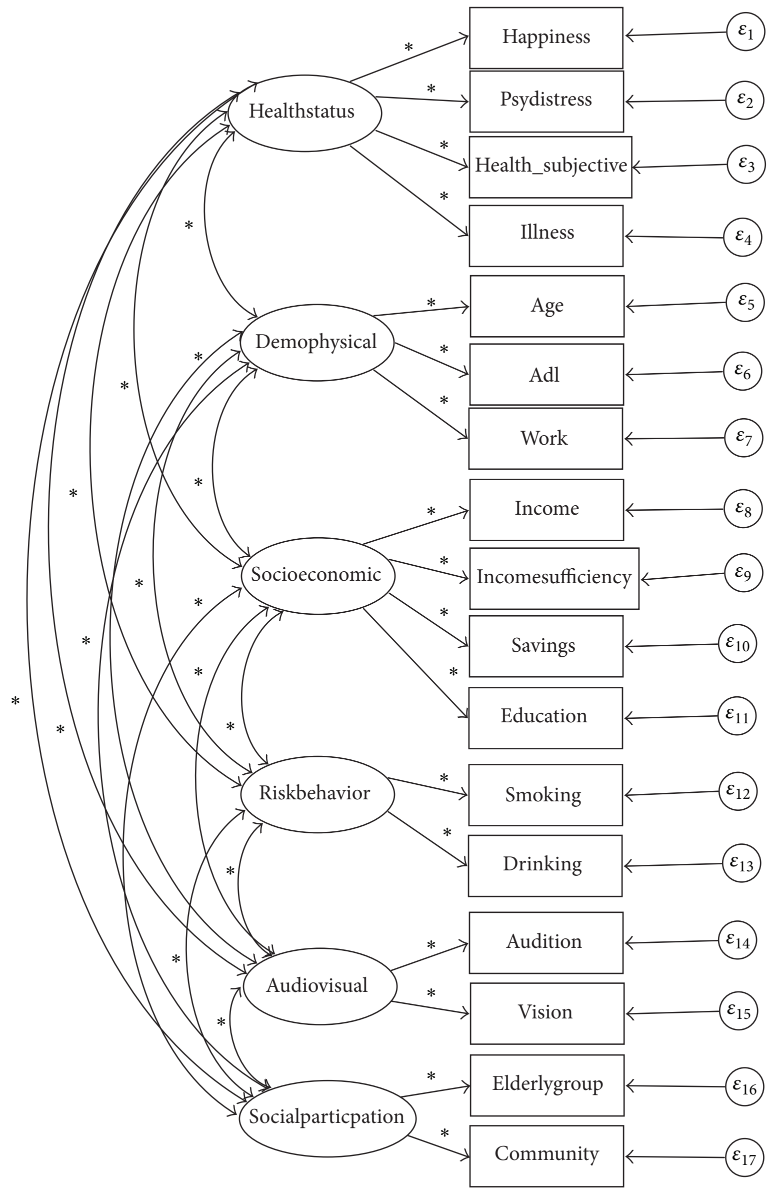

Figure 1: Hypothesized active ageing determinant factors model for female older persons in Thailand. Source: figure is constructed from Haque et al.'s study [3].

indicator variables, listed in Table 1, the suggested active ageing determinant factors models of female and male older persons [3] are provided in Figures 1 and 2, respectively.

2.4. Description of Hypothesized Models Presented in Diagrams. In the hypothesized models in Figures 1 and 2, the factors are represented in ovals and indicator variables are represented in rectangles. The error terms of indicator variables are indicated by ε. The asterisks indicate parameters (regression coefficient (standardized), covariances of independent variables in the model) to be estimated. Meanwhile, error terms in CFA are considered as independent variables and their variances should be estimated [10]. Unidirectional arrows in the hypothesized models indicate directional linear influences (i.e., linear effect of one variable on another), and both-way directional arrows indicate correlation between connected variables but no directional influence of one on others is hypothesized.

2.5. Model Evaluation. Parameters of each of the hypothesized models can be estimated in CFA framework which was done using STATA 12 (model fit statistics, in CFA, are available after estimation of parameters). Maximum likelihood (ML) estimation method is currently one of the most used methods for parameter estimation [10]. Details of parameter estimation procedure in CFA are available elsewhere [10–12]. As this paper has no aim to estimate the parameters of those models (but has aim to evaluate those models), the parameter estimation results are not shown. Any estimated model should be tested for how well the model fits

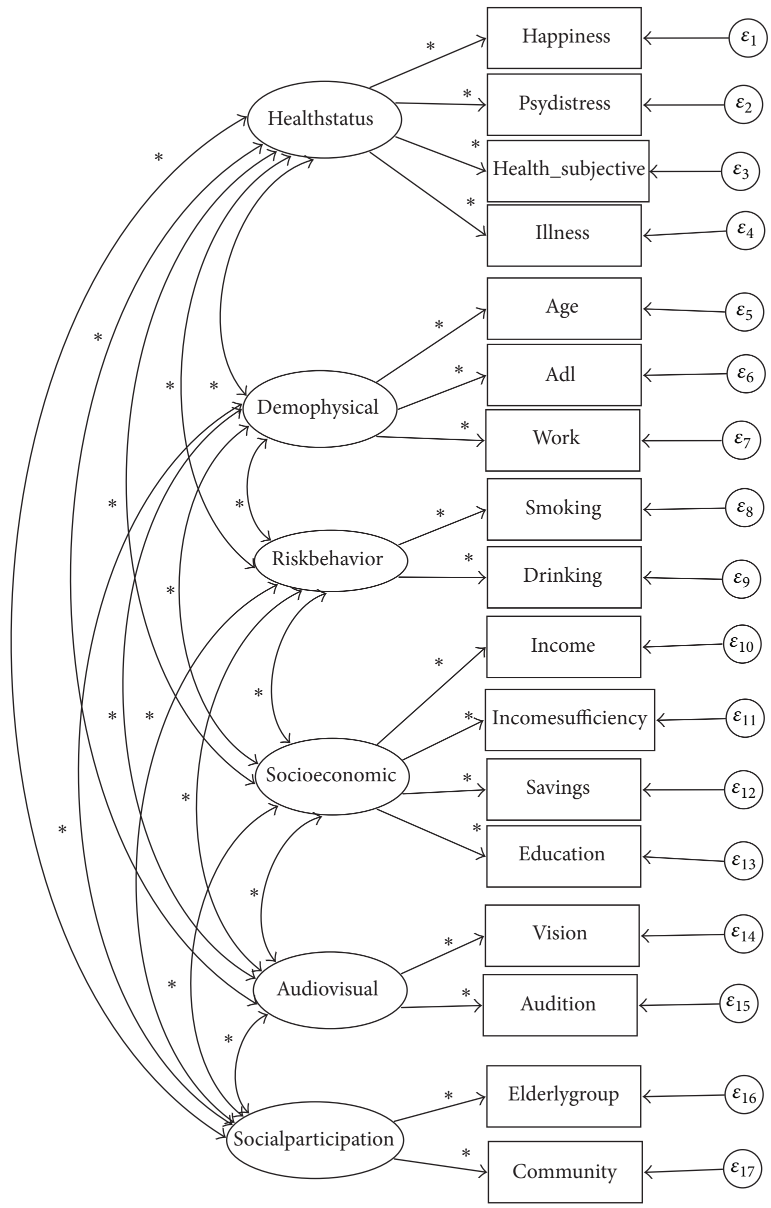

Figure 2: Hypothesized active ageing determinant factors model for male older persons in Thailand. Source: figure is constructed from Haque et al.'s study [3].

to the sample data. There are many fit indices for evaluating models in CFA framework. This study used Chi-square (χ^2), Root Mean Squared Error of Approximation (RMSEA), Comparative Fit Index (CFI), and Standardized Root Mean Squared Residual (SRMR). The χ^2 is a traditional measure of overall model fit (it assesses the magnitude of differences between sample and estimated covariance matrices) [13]. That is, the null hypothesis for model evaluation is as H_0: there is no difference between sample covariance and estimated covariance; that is, the model fits well to the data. The threshold values of the above fit statistics are provided in Table 2.

2.6. Estimation of Active Ageing Level. Active ageing level can be exhibited by computing the active ageing index (AAI) of older persons [3]. The AAI ranges from 0 to 1 and a higher value of AAI indicates higher active ageing level. The study by Haque et al. (2016) has suggested that AAI should be calculated separately for female and male older persons in Thailand. Using nationally representative sample and exploratory factor analysis (EFA), Haque et al. calculated the AA level for female and male older persons in Thailand [3]. The weakness of results from a model constructed from EFA is that there is no scope to test the model fit. Haque and colleagues study used only EFA and the model (from which AAI has been obtained) was not validated. For overcoming the weakness in EFA, this study used confirmatory factor analysis (CFA). The CFA framework facilitates testing how well the model fits to the sample data. The study by Haque and his colleagues used EFA in Thai national data for establishing

Table 2: Some selected model fit indices and their cut-off points (limits).

Fit index	Acceptable threshold levels
Chi-square (χ^2) (df, p value)	Low χ^2 relative to degrees of freedom (df) with an insignificant p value ($p > 0.05$)
Root Mean Squared Error of Approximation (RMSEA)	Values less than 0.07
Comparative Fit Index (CFI)	Closer to 1 is better but ≥ 0.90 indicates good fit
Standardized Root Mean Squared Residual (SRMR)	<0.05

Source: [14].

the preliminary active ageing model of older persons and the study has identified six determinant factors for each gender [3]. Using the same factors (with their corresponding indicator variables) as in Haque et al.'s study, this study runs the model in CFA framework (in STATA 12) which provides the predicted factor scores of each factor. From the predicted factor score, the factor index for each factor has been estimated using the following formula:

Index of F_i:

$$f_i = \frac{[\text{Score of } F_i - \min(\text{Score of } F_i)]}{[\max(\text{Score of } F_i) - \min(\text{Score of } F_i)]}, \quad (1)$$

where F_i is the ith factor.

Score of F_i for every individual has been produced during CFA running in STATA. The theoretical maximum value of any factor index is 1. Then an AAI was calculated by using factor specific indices. Calculation of the AAI, from CFA, used the following formula:

$$\text{AAI} = \frac{\sum_{i=1}^{n=6} f_i}{6}, \quad (2)$$

where f_i is the index of factor i ($n = 6$, because there were 6 factors).

It should be noted here that the AAI has been calculated for every individual. Then an overall average AAI has been calculated using all values of AAI for all individuals. For simplicity, the AAI is a composite index which combines a number of factor indices.

2.7. Active Ageing Level Comparison Depending on Region of Residence. Because of social change over time and of cultural diversities in different places, possible changes may occur in individual AAL over time, as has occurred in other aspects of individual or population in Thailand; for example, between 1994 and 2007 Thailand experienced rapid social changes (population ageing, socioeconomic development, health policies, etc.) and these changes affect health across groups (rural-urban) and overall [15]. As has been stated in Introduction, there exists cultural variability in Thailand depending on region of residence (Bangkok, Central, North, Northeast, and South). It also may be hypothesized that under the circumstances of cultural diversities in different cultural settings, there would be variability of AA level in various cultural contexts, that is, in various regions within a country.

AA level quartiles would be the one method of comparing changes in the AAL at a community over time or for comparing it in different places or for groups. AA level quartiles can be calculated by ranking individuals from lowest AAI to the highest value and then dividing list into four groups or quartiles. Each quartile for individuals, in whole Thailand, for instance, contains 25% of individuals (along with specific mean level of AAI). Then we may compare those distributions of quartiles (percentage distribution) for individuals overall (national) with different places (e.g., Bangkok, Central, North, Northeast, and South). This quartile method of comparison will provide only the overview of difference(s) but is unable to test the significance of the differences. Similarity with significance of AA levels in different regions could be tested by using one-way analysis of variance (ANOVA). One-way ANOVA is appropriate for one categorical variable with k levels (e.g., region of residence with 5 levels in this study) or k groups and there should be a population of interest for which there is a quantitative variable for each of the k levels of the categorical variable (e.g., AAI in this study). The AAIs for each group have mean parameters (population means) that we may label as μ_1 through μ_k. The number of individuals (older persons) in group i $(1 \leq i \leq k)$ is defined as n_i and $n = \sum_{i=1}^{k} n_i$ is the total sample size. The null hypothesis to be tested in one-way ANOVA states that all the population means are equal; that is, H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5$ (for 5 regions of this study). The ANOVA technique can identify significant differences (if there were any) but is unable to specify where the significant differences exist. So, post hoc comparisons using a built-in test in STATA (e.g., Bonferroni test) were conducted.

3. Results and Discussion

3.1. Results

3.1.1. Model Fit Statistics. It has been stated, in Materials and Methods, that the model fit statistics can be obtained after the model estimation in CFA. The hypothesized models have been run in CFA in STATA 12 and the obtained model fit indices are summarized in Table 3.

The Chi-square (χ^2) statistics for two models are very high and indicated that none of the models fits well to the sample data. But the χ^2 statistic is very sensitive to sample size; usually for large sample (which is the case for two models) it shows significant result which rejects the null hypothesis (H_0: there is no difference between sample covariance and estimated covariance; i.e., the model fits well to the data). For correcting the sensitivity of χ^2 statistic to large sample (i.e., tendency to reject the null hypothesis), there are other test statistics which are most widely used (e.g., Root Mean Squared Error of Approximation (RMSEA),

Table 3: Goodness of model fit indices for confirmatory factor analysis for models of active ageing for older persons in Thailand.

Fit index	Female	Male
Chi-square (χ^2) (df, p value)	3548.33 (104, 0.00)	3131.96 (104, 0.00)
Root Mean Squared Error of Approximation (RMSEA)	0.048	0.056
Comparative Fit Index (CFI)	0.867	0.839
Standardized Root Mean Squared Residual (SRMR)	0.035	0.043

Table 4: Mean level of active ageing of older persons in Thailand.

	Mean of AAI	
	Female	Male
Lowest group	0.49	0.46
Medium lowest	0.61	0.58
Medium highest	0.69	0.66
Highest group	0.77	0.74
Overall mean AAI	0.64	0.61

$t = 21.554$, $p < 0.001$.

Comparative Fit Index (CFI), and Standardized Root Mean Squared Residual (SRMR)). However, comparing the estimated RMSEA, CFI, and SRMR fit indices presented in Table 3 with the threshold values of those indices presented in Table 2 suggests that both the estimated models seemed to fit well to the data. That is, active ageing determinant factors model for each gender can be adequately described by those six respective (to each model) correlated factors.

3.1.2. Active Ageing Level for Female and Male Older Persons. As, in the Haque et al. study, relationships of indicator variables with determinant factors of active ageing (factor structure of active ageing, i.e., the active ageing determinant factors model) are different for female and male older persons [3], separate active ageing index has been estimated for female and male older persons. The calculated mean AAIs for female and male older persons are 0.64 and 0.61, respectively. Comparing these mean AAIs with UNDP's Human Development Index (HDI), female and male older persons in Thailand had moderate level mean AAI [16].

Female and male older persons have been divided into four groups according to their mean AAI (i.e., they are divided according to quartiles of mean AAI); mean AAI for each group has been presented in Table 4.

An independent-samples t-test was run to determine if there were differences in mean AAI of female and male older persons. This study found that active ageing level of female is bit higher than active ageing level of male older persons. The calculated statistic, $t(23799) = 21.554$ with $p < 0.001$, indicates a statistical significant difference of two populations' mean level of active ageing (may reject the null hypothesis that there is no difference between the mean of AAI of female and male older population). It implies that mean active ageing levels of female older population and male older population, in Thailand, are significantly different.

3.1.3. Active Ageing Level Comparison Depending on Region of Residence. The calculated average active ageing levels of female and male older persons for every five regions (Bangkok, Central, North, Northeast, and South) have been portrayed in Figure 3. Region-wise mean active ageing level of older persons represented in Figure 3 shows the glimpse of situation only. But distribution of older persons according to AAI quartiles and region of residence enables showing the apparent disparities of AAL in different regions. Distribution of older persons according to AAI quartiles and region of residence is provided in Tables 5 and 7.

The results in Table 5 exhibited that highest proportion of female older persons in Bangkok was the lowest group of mean AAI whereas in North and Northeast region highest proportion was in medium highest group of mean AAI. The highest percentage of female older persons in South region was in highest group of mean AAI. Female older persons from the North and Northeast region had equal mean AAI and higher mean AAI than other regions. Comparing with UNDP's HDI, overall mean AAIs of female elderly in all five regions were in moderate level [16].

A one-way ANOVA between female elderly persons was conducted to compare the mean AAI for regions (Bangkok, Central, North, Northeast, and South). There was a significant difference of mean AAI at the $p < 0.001$ level for the five regions [$F(4, 14364) = 56.79$; $p = 0.00$]. The results of ANOVA found significant differences but could not specify where the significant differences exist. So, post hoc comparisons using Bonferroni test were conducted and the results are presented in Table 6.

Post hoc comparisons by Bonferroni test indicated that the mean AAI of female older persons is significantly lower in Bangkok than all other regions. Mean AAI of female older persons is significantly higher in Central region than Bangkok but the first two regions are lower than the other three regions (North, Northeast, and South). There is no significant difference in female elderly's mean AAI in North, Northeast, and South of Thailand.

The results in Table 7 revealed that highest proportion of male older persons in Bangkok and in Central region were in the lowest group of mean AAI whereas in North region highest proportion were in medium highest group of mean AAI. The highest percentage of male older persons in Northeast and in South region was in highest group of mean AAI. Overall, it can be mentioned from the sample results that male older persons from Northeast and South region had equal mean AAI and higher mean AAI than that of other regions. Comparing with UNDP's HDI, overall mean AAI male older persons in all five regions were in moderate level [16].

A one-way ANOVA between male elderly persons was conducted to compare the mean AAI for regions (Bangkok,

TABLE 5: Distribution of female older persons according to quartiles of mean active ageing level and region.

Region	Bangkok	Central*	North	Northeast	South	Total
Total cases	*652*	*4,706*	*3,560*	*3,496*	*1,955*	*14,369*
Lowest group	43.56	28.58	21.15	19.94	26.29	25.00
Medium lowest	30.98	25.18	24.02	25.69	23.12	25.00
Medium highest	09.05	22.16	29.80	28.86	21.48	25.00
Highest group	16.41	24.08	25.03	25.51	29.10	25.00
Overall mean AAI	0.59	0.63	0.65	0.65	0.64	0.64

*Excluding Bangkok, F-statistic = 56.59, $p < 0.001$.

TABLE 6: Comparison of mean AAI of female older persons by region (Bonferroni test).

Row mean-col. mean	Bangkok	Central	North	Northeast
Central	0.04 (0.00)			
North	0.06 (0.00)	0.02 (0.00)		
Northeast	0.06 (0.00)	0.02 (0.00)	0.00 (1.00)	
South	0.05 (0.00)	0.01 (0.001)	−0.01 (0.291)	−0.01 (0.044)

Note. Numbers within bracket indicate the level of significance (the test is considered significant at <0.01).

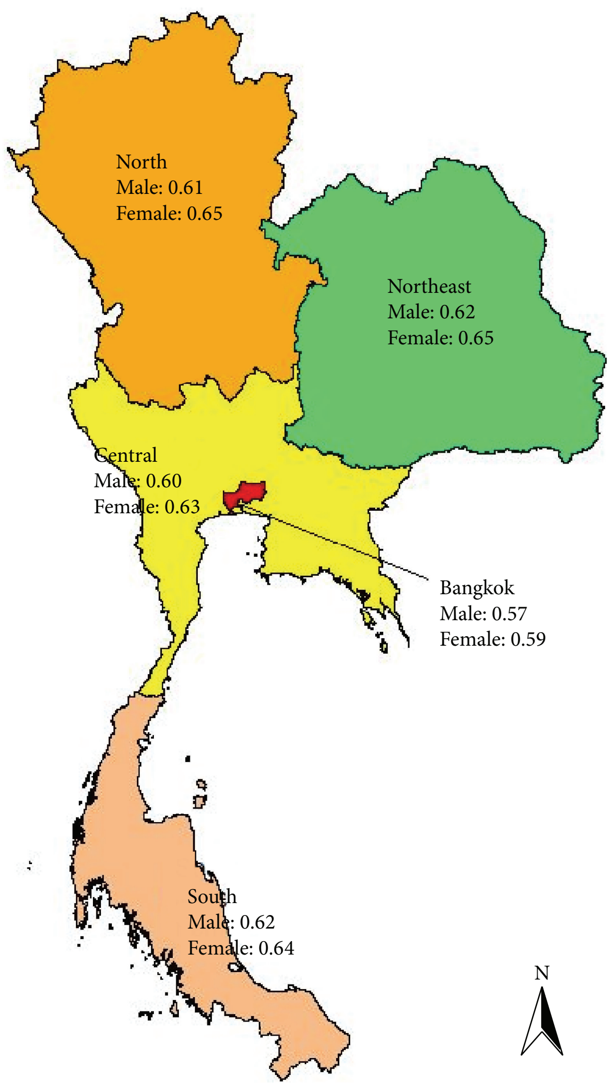

FIGURE 3: Map of Thailand with region-wise mean active ageing index value of female and male older persons.

Table 7: Distribution of male older persons according to quartiles of mean active ageing level and region.

Region	Bangkok	Central*	North	Northeast	South	Total
Total cases	*394*	*2,914*	*2,558*	*2,206*	*1,360*	*9,432*
Lowest group	40.10	29.72	22.91	19.63	23.16	25.00
Medium lowest	29.95	24.09	23.18	28.42	23.38	25.00
Medium highest	14.21	22.82	29.52	25.43	23.60	25.00
Highest group	15.74	23.37	24.39	26.52	29.85	25.00
Overall AAI	0.57	0.60	0.61	0.62	0.62	0.61

Note. F-statistic = 28.58; $p < 0.001$; *excluding Bangkok.

Table 8: Comparison of mean AAI of male elderly by region (Bonferroni).

Row mean-col. mean	Bangkok	Central	North	Northeast
Central	0.03 (0.00)			
North	0.04 (0.00)	0.01 (0.00)		
Northeast	0.05 (0.00)	0.02 (0.00)	0.01 (1.00)	
South	0.05 (0.00)	0.02 (0.00)	0.01 (1.00)	0.00 (1.00)

Note. Numbers within bracket indicate the level of significance (the test is considered significant at <0.01).

Central, North, Northeast, and South). There was a significant difference of mean AAI at the $p < 0.001$ level for the five regions [$F(4, 9427) = 28.58$; $p = 0.00$]. The results of ANOVA found significant differences but could not specify where the significant differences exist. So, post hoc comparisons using Bonferroni test were conducted and the results are presented in Table 8.

Post hoc comparisons by Bonferroni test indicated that the mean AAI of male older persons is significantly lower in Bangkok than all other regions. Mean AAI of male older persons is significantly higher in Central region than Bangkok but the first two regions (Bangkok and Central) are lower than the other three regions (North, Northeast, and South). Male older persons' mean AAI is significantly similar in North, Northeast, and South region.

3.2. Discussion. As it has been stated and also proved that active ageing determinant factors model varies for female and male older persons, their active ageing level also varies; for instance, results revealed that the overall mean AAI for female and male older persons was revealed as 0.64 and 0.61, respectively. These estimates proved the hypothesis regarding the one cross-cutting determinant, gender, (i.e., active ageing determinant factors model and active ageing level vary depending on gender in Thailand) as true. The numerical values of AAI for both female and male older persons must aim for further improvement. Because active ageing index shows that even top performing female older persons still fall short by almost 36% to the highest desired status possible (i.e., the goalpost of AAI is equal to 1).

If we look at region-wise active ageing level, then it is evident that active ageing level of older persons in Central region is comparatively lower than other regions. Results for comparing active ageing level in different regions revealed that there were disparities in mean AAI for female older population. Female older persons from Bangkok region had the lowest level of mean AAI among the five regions. Even though mean AAI of female older persons in the three regions (North, Northeast, and South) seemed significantly the same, female older persons in Central region had significantly lower mean AAI than the North, Northeast, and South region. On the other hand, as stated earlier that overall estimated mean AAI of male older persons is lower than female older persons, it also revealed from the results that the above is also true for every five regions. Also, the test results for regional differences for mean AAI of male older persons follow the same pattern as for female older persons.

As active ageing level in Thailand is not high (evidenced as far behind the goal), so, for promoting active ageing, focus should be given to the identified determinant factors of active ageing. As determinant factors are latent, hence focus should be given to their corresponding indicator variables (i.e., measured variables) aiming to promote active ageing. To make results more understandable, relation of directly measured variables with active ageing level should be interpreted which may be helpful for other researchers and policy makers. Using measured variables for each model, correlations between AAI and measured variables could be estimated. Correlation coefficient between measured variables and AAI for older persons has been calculated in the study by Haque et al. (2016). As data are the same for this study and Haque et al.'s study, so recommendations depending on the results regarding correlation coefficients (as in Haque et al.'s study) [3] could be appropriate for this study also. Haque et al.'s study urged that good health condition, opportunities of longer working lives, continuous income, participation in social group(s), and lifelong learning influence active ageing among the Thai older persons [3]. So, an Integrated Active Ageing Package (IAAP) would be helpful for increasing older persons' active ageing level. The IAAP should include policies for older persons to improve their health and economic security, to promote participation in social groups and longer working lives, and to arrange learning programs.

4. Conclusions

As active ageing level of older persons in Thailand is not high, so, some policy recommendations should be considered to increase the active ageing level of future older persons. The Thai government's national policy on the elderly (NPE) should include a new strategy on increasing active ageing level of elderly. Special emphasis should be given to Central region, as older persons in Central region are lower in respect to active ageing level compared to other regions. Policy should be focused for older persons on improving health and economic security, on promoting participation in social groups and longer working lives, and on arranging education (e.g., lifelong learning) programs for increasing their active ageing level. All the above policies should be integrated into one package as Integrated Active Ageing Package (IAAP). Along with the policy for extension of compulsory retirement age, incentives for elderly workers, and incentives for employers (who employed older persons), the IAAP should include some programs. The IAAP programs may include health programs—curative care for illness and continuous mental health care, easy access for assistive devices (e.g., walker/mover, eye glasses), and preventive and promotive health measures such as exercise and annual health checkup; community and elderly group participation programs; tobacco cessation counseling program; special knowledge and information for quality of life development program for elderly; and vocational training (including occupational retraining) program.

The proposed strategy, for NPE, on increasing active ageing level of older persons can be fulfilled by implementing the IAAP. The Ministry of Social Development and Human Security (MoSDHS), Thailand, may lead the implementation of IAAP. The MoSDHS may collaborate with the Ministry of Health and the Department of Non-Formal Education for full implementation of those programs. Implementation of IAAP would be helpful for increasing active ageing level of older persons which, in turn, is helpful for prolonging good health and independent living of older persons, that is, for increasing the quality of older persons' lives.

Competing Interests

The author declares that there are no competing interests regarding the publication of this paper.

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References

[1] A. Walker, "A strategy for active ageing," *International Social Security Review*, vol. 55, no. 1, pp. 121–139, 2002.

[2] World Health Organization, Active ageing. A policy framework, a contribution of the World Health Organization (WHO) to the second United Nations World Assembly on Ageing, http://whqlibdoc.who.int/hq/2002/WHO_NMH_NPH_02.8.pdf.

[3] Md. N. Haque, K. Soonthorndhada, P. Hunchangsith, and M. Kanchanachitra, "Active ageing level in Thailand: a comparison between female and male elderly," *Journal of Health Research*, vol. 30, no. 2, pp. 99–107, 2016.

[4] United Nations, *World Population Aging and Development*, United Nations, New York, NY, USA, 2012.

[5] J. Knodel and N. Chayovan, "Older persons in Thailand: a demographic, social and economic profile," *Ageing International*, vol. 33, no. 1, pp. 3–14, 2008.

[6] J. Knodel, V. Prachuabmoh, and N. Chayovan, *The Changing Well-Being of Thai Elderly: An Update from the 2011 Survey of Older Persons in Thailand Populations Studies Center Research Report 13–793*, Institute for Social Research, University of Michigan, 2013.

[7] P. Jory, "Multiculturalism in Thailand: cultural and regional resurgence in a diverse kingdom," *Harvard Asia Pacific Review*, vol. 4, no. 1, pp. 18–22, 2000.

[8] Reach to Teach, Country Guides, Thailand Country Guide, Culture in Thailand, 2015.

[9] National Statistical Office (NSO), *Survey of Older Persons in Thailand, 2011*, National Statistical Office, Bangkok, Thailand, 2012 (Thai).

[10] J. B. Ullman, "Structural equation modeling: reviewing the basics and moving forward," *Journal of Personality Assessment*, vol. 87, no. 1, pp. 35–50, 2006.

[11] K. A. Bollen, *Structural Equations with Latent Variables*, John Wiley & Sons, New York, NY, USA, 1989.

[12] A. P. Field, *Discovering Statistics Using SPSS*, Sage, London, UK, 2nd edition, 2005.

[13] L.-T. Hu and P. M. Bentler, "Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives," *Structural Equation Modeling*, vol. 6, no. 1, pp. 1–55, 1999.

[14] D. Hopper, J. Coughlan, and M. R. Mullen, "Structural equation modeling: guidelines for determining model fit," *The Electronic Journal of Business Research Methods*, vol. 6, no. 1, pp. 53–60, 2008.

[15] Z. Zimmer and V. Prachuabmoh, "Comparing the socioeconomic status—health gradient among adults 50 and older across rural and urban areas of Thailand in 1994 and 2007," *Social Science and Medicine*, vol. 74, no. 12, pp. 1921–1928, 2012.

[16] United Nations Development Programme (UNDP), *Human Development Report 2014*, United Nations Development Programme (UNDP), New York, NY, USA, 2014.

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Research Article

The Impact of Social and Cultural Engagement and Dieting on Well-Being and Resilience in a Group of Residents in the Metropolitan Area of Naples

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Social isolation and exclusion are associated with poor health status and premature death. A number of related isolation factors, inadequate transportation system and restrictions in individuals' life space, have been associated with malnutrition in older adults. Since eating is a social event, isolation can have a negative effect on nutrition. Cultural involvement and participation in interactive activities are essential tools to fight social isolation, and they can counteract the detrimental effects of social isolation on health. To provide data supporting the hypothesis that encouraging participation might represent an innovative preventive and health promoting strategy for healthy living and aging, we developed an *ad hoc* questionnaire to investigate the relationship between cultural participation, well-being, and resilience in a sample of residents in the metropolitan area of Naples. The questionnaire includes a question on adherence to diet or to a special nutritional regimen; in addition, the participants are asked to mention their height and weight. We investigated the relationship between BMI, adherence to diet, and perceived well-being (PWB) and resilience in a sample of 571 subjects over 60 years of age. Here, we present evidence that engagement into social and cultural activities is associated with higher well-being and resilience, in particular in females over 60 years of age.

1. Introduction

Social isolation and exclusion are associated with poor health status and premature death, while social cohesion, the quality of social relationships and the existence of trust, mutual obligations, and respect in communities, helps to protect people and their health. Since social and family relationships are embedded within the definition of a "good quality of life" for all age groups, and particularly for older adults, it is social isolation inversely correlates with well-being [1–5]. A number of social isolation factors, inadequate transportation system and restrictions in individuals' life–space, have been associated with poor nutrition in older adults. Good nutrition is important for health and well-being at all stages of the life course; however, its determinants change with age. Older adults are particularly prone to slipping into a pattern of an inadequate diet because of decreased mobility associated with physical disabilities and/or fewer financial resources to spend on food [6, 7]. Moreover, past evidence support that socially isolated older adults are at a greater risk of dietary inadequacy because they lack social support, which promotes good diet. In recent years, several studies focused on the relationship between cultural access and physical and psychological health. Their results suggest that participation in social and cultural activities is beneficial for health, since it helps people to remain active and socially connected, avoiding social isolation and loneliness [8, 9]. In elderly people, participation in social and cultural activities correlates with decreased medication consumption and hospitalization. The association between cultural activities and health outcomes has been analyzed in the medical field, in the context of mental health, cognitive decline, onset of dementia, and related disorders [10–16].

Moreover, data are growing in support of the relationship between cultural and social engagement and well-being [17–23]. Well-being is shaped by not only the absence of disease and reduced physical functioning, but also by the presence of positive physical, mental, and psychosocial state. In this view, well-being is crucial to many aspects of our daily lives, since it includes global judgments such as emotions and resilience, quality of relationships, and overall life satisfaction [24–27]. In particular, cultural participation is the second predictor of psychological well-being after (presence/absence of) major diseases, and in this respect, it has a significantly stronger impact than variables such as income, place of residence, age, gender, or occupation. Finally, links have been documented between well-being and multiple aspects of physical health and mortality, cardiovascular disease, biological risk factors for infectious diseases, dementia, and disability in later life [28–31]. Considering the close relationship of high well-being with key health outcomes, tracking and improving well-being is becoming increasingly important for global organizations, governments, companies, and communities worldwide [31, 32].

Therefore, recently a number of studies explored losses in well-being caused by 2008 economic crisis. The findings reveal the negative impact of GDP fall, unemployment rising, and banking crashes on subjective and psychological well-being [33–38]. In addition, several reports provide evidence of an increased prevalence of suicides because of the recent great recession [39–41].

Finally, according to the United Nations Interregional Crime and Justice Research Institute, the global economic crisis has disproportionate effects on women [42].

The average Italian household has been severely affected by the crisis, with impacts that are particularly visible when looking at household income, jobs, life satisfaction, and civic engagement. From 2007 to 2011, Italy recorded a cumulative decline in real household disposable income of around 7%, one of the largest declines among the OECD countries. Market income inequality (before taxes and transfers) increased by 2% between 2007 and 2010, well above the OECD average of 1.2%. The largest impact of the crisis on people's well-being has come through lower employment and deteriorating labour market conditions. Between 2007 and 2012, the employment rate decreased by more than 1 percentage point in Italy, while the long-term unemployment rate increased by almost 3 percentage points. The poor employment situation had a major impact on life satisfaction. From 2007 to 2013, the percentage of Italian people declaring being very satisfied with their lives fell from 58% to 40% [42]. Moreover, according to data from the Italian Institute of Statistics (ISTAT), the crisis have worsened both the north–south and the gender gap in in terms of life satisfaction. The data indicate that in Italy the males are on average more satisfied of their life than females (M 36% > F 34%) and in addition that both males and females living in the north, that is, Lombardy region, are more satisfied of their life than those living in the south, that is, Campania region, (Lombardy: males 42%, females 41%; Campania: males 21,9%, females 19,4%). The 2008 crisis has deeply affected the city of Naples, the capital of the Campania region, and its metropolitan area worsening both the north > south gap and the chronic structural local problems. In that, the report of the Italian Institute of Statistics (ISTAT) shows that in 2014 Naples ranks 101 over the 107 Italian province in terms of quality of life. In addition, ISTAT reports that in 2014 the unemployment rate in Italy was 12,4% and in Naples 24,26% and that in the same year employment rate was slowly growing in Northern (+0,4%) and Central (+1,8%) Italy, while further declining in the South (−0,8%, −45.000 units) [43].

Long-lasting progressive and strong deindustrialization, high level of unemployment, and a large influx of illegal immigrants had explosive consequences on the breakdown of the social fabric that from the specific suburbs spreads like wildfire to the entire city of Naples. At present, local degradation and impoverishment, overlapping with welfare cut, consequent to nation-wide crisis, make day-by-day life difficult, in particular for the more fragile part of the population such as the elderly people living in the metropolitan area of Naples. On the other hand, Naples and its surrounding areas display an extraordinary richness of both tangible and intangible cultural heritage. The value of Naples monuments building, ancient ruins together with its location on the Mediterranean sea, gained the city to be listed by Unesco as a World Heritage Site in 1995 (http://whc.unesco.org/en/list/726/). Moreover, a number of artists, actors, directors, writers, and gallerists, some of them well-recognized world-wide, struggle every day to keep the city long history of creativity alive that represents the worldwide recognized Naples intangible heritage.

In this scenario, we considered the investigation of how citizens of the Metropolitan area of Naples react to adversities and how and if cultural tangible and intangible heritage would influence their subjective well-being valuable. The oldest-old are the fastest-growing sector in society, due to life expectancy increases and improved treatments for life-threatening diseases. Understanding the determinants of psychological well-being and their relationship with health outcomes at older ages is particularly important, since a high proportion of the budget for health and social care is devoted to the care of older people.

Due to the particularly high ageing index (A.I. = 120,3 in 2014) [43] and to the economic difficulties of the Metropolitan area of Naples, it is important to consider new affordable tools and strategies to promote a healthy ageing and to face the “burden” of this demographic change.

On these bases, we decided to take a snapshot of the metropolitan area of the city of Naples investigating the relationship between adherence to diet or nutritional regimen, BMI, and subjective well-being and the impact of social and cultural participation. In particular, we focused on the population over 60 years of age and on gender difference. To our knowledge, this is the first survey investigating subjective well-being in the metropolitan area of the city of Naples.

2. Methods

Within the framework of the A3 Action Group of the European Innovation Partnership on Active and Healthy Ageing and of the “Getting Optimize Aging Life Quality” (GOAL) project, Fondazione GENS Onlus developed an *ad hoc* anonymous questionnaire to assess perceived well-being, resilience, and perceived health and their relation with engagement into social and cultural experiences. The questionnaire comprises the following sections:

(a) Sociodemographic information, age, sex, place of birth, education, employment, and marital status.

(b) Psychological well-being: investigated by means of Psychological General Well-Being-Short (PGWB-S) questionnaire developed and validated in the Italian version by Grossi and coworkers in 2006 [44]. Grossi and coworkers reduced the number of items from the original 22-item PGWBI to 6 items to achieve a higher acceptability of the questionnaire in the population, to shorter time of administration and to obtain a better response rate together with lower rate of missing data. The authors reported that PGWB-S 6 showed that the PGWB-S maintained validity, reliability, and good acceptability for the use in various settings in Italy [44]. PGWB-S 6-item questionnaire analyzes the following domains: Anxiety, Vitality (positive), Depressed Mood, Self-Control, Positive Well-Being, and Vitality (negative) on a 0 to 5 scale referring to the four weeks before the date of the survey [44].

(c) Resilience according to Connor-Davidson resilience scale CD-RISC2 2 items: item 1 (“able to adapt to change”) and item 8 (“tend to bounce back after illness or hardship”) on a scale from 0 to 4 [45].

(d) Extent of social network.

(e) Participation in cultural and social activities.

(f) Life-style habits, PC use, smoke, diet, physical activity, transportation, number and type of diagnosed diseases, and self-reported perceived health status.

The anonymous questionnaire was submitted to volunteer participants covering wealthy, middle class, and poor neighborhoods of the metropolitan area of Naples. Trained GENS personnel explained the questionnaire and assisted volunteer participants while filling the questionnaire.

2.1. Statistical Analysis. Descriptive statistics were computed for all the indicators analyzed. Student’s t-test and ANOVA with Bonferroni correction were performed to test continuous variables. Chi-square was used to test categorical variables. Linear regression analysis was performed to test the relationship between two variables. All statistical analysis were performed using Stata software (Stata Corp., College Station, TX, USA).

3. Results

3.1. Analysis of the Sample Population. Within 2014, we have collected 571 questionnaires of subjects over 60 years of age and this sample population is the object of the present work. Mean age of the 571 subjects over 60 years of age (from now on >60) is 70,05 ± 6,94 years. The >60 sample consists of 285 males and 286 females with a mean age of 70,35 ± 6,923 and 69,78 ± 6,980 years, respectively. The Subjective Well-Being (SWB) was assessed by measuring both psychological well-being and resilience. Self-reported psychological well-being referred to the past 4 weeks according to 6-item PGWB-S analyzing the following domains: Anxiety, Vitality (positive), Depressed Mood, Self-Control, Positivity, and Vitality (negative) on a 0 to 5 scale [45]. In physics, the term “resilience” indicates the power or the ability of a material to return to the original form, position, and so forth, after being bent, compressed, or stretched, and also elasticity. In the health field, resilience applies to the ability to adapt to changes and to readily recover from stressful situation like illness, depression, adversity, or the like. Thus, resilience is a key part of SWB. Resilience was assessed according to Connor-Davidson resilience scale, 2-item CD-RISC2, on a scale of 0 to 4 [45]. According to Chassany et al. and Grossi et al., PGWB scores have been grouped into the following divided categories: 0–60 Severe Distress, 61–71.0 Moderate Distress, 72–92 No Distress, and 93–110 Positive Well-Being [46, 47]. PWB score for all 571 >60 subjects was 68,22 ± 19,71, falling in the area of Moderate Distress. Males and females differently contribute to the PWB score of the whole >60 group, where the PWB score for >60 males is 71,61 ± 18,83 while that for >60 females is 64,92 ± 20,11 ($P < 0,0001$). Our results indicate that the PWB score of >60 males falls borderline between the area of No Distress and Moderate Distress, while that of the >60 female population falls within the area of Moderate Distress. It is interesting to note that PWB score of both >60 males and females, living in metropolitan area of the city of Naples, is largely below that reported for males and females living in Northern and Central Italy and in particularly in the city of Milan [47, 48]. To get a better insight in the PWB score gender difference, we analyzed the six PWB dimensions separately in males and females. The results reported in Table 1 show that females score is lower than that of males in all dimensions but Vitality (positive). On the other hand, resilience score of the whole >60 group was 5,867 ± 1,687, which resulted to be similar in >60 males and females, 5,91 ± 1,57 and 5,84 ± 1,8 respectively. However, when we analyzed resilience item 1 and item 2 separately, it came out that item (1) “able to adapt to change” and item (2) “tend to bounce back after illness or hardship” differently contribute to the cumulative resilience

Table 1: Comparison of the six dimensions of PWB, between females and males. Results are reported as mean ± SD. P value has been calculated by Student's t-test between each two groups.

PWB dimensions	Females	Males	P value
Anxiety	3,34 ± 1,311	3,63 ± 1,19	0,003
Vitality (positive)	3,16 ± 1,229	3,18 ± 1,191	0,835
Depressive mood	3,10 ± 1,237	3,44 ± 1,161	0,0004
Self-control	2,71 ± 1,293	3,14 ± 1,358	<0,0001
Positive WB	2,59 ± 1,139	2,84 ± 1,238	0,008
Vitality (negative)	3,03 ± 1,103	3,21 ± 1,16	0,0423

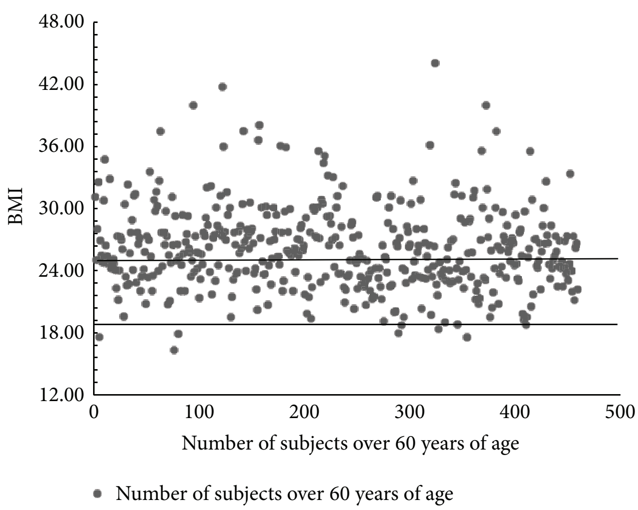

Figure 1: BMI values of all subjects over 60 years of age examined in the study.

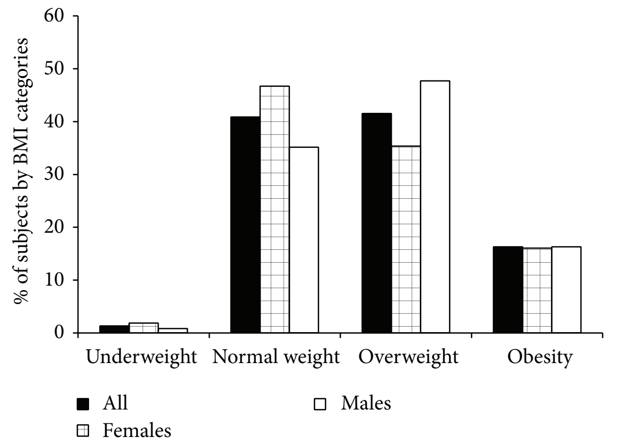

Figure 2: Distribution of >60 all, females, and males by BMI categories. Percentage per each group has been calculated over the total number of >60 years of age in all, females, and males groups separately.

score. In particular, both males and females >60 are less "able to adapt to change" (resilience item 1 score, females 2,71 ± 1,08 and males 2,728 ± 1,03) but "tend to bounce back after illness or hardship" more easily (resilience item 2 score, females 3,15 ± 0,9710 and males 3,20 ± 0,87). The difference between item 1 and item 2 score resulted to be statistically significant ($P < 0{,}0001$) both in >60 males and females. Finally, our data indicate a correlation between resilience and PWB (R 0,4708, R square 0,2217, P value < 0,0001). Same correlation was observed when >60 females and males were analyzed separately (F = R 0,418, R square 0,1810, P value < 0,0001; M = R 0,545, R square 0,2891, P value (two-tailed) < 0,0001).

3.2. Body Mass Index. Within the section related to perceived health status, participants indicated their weight and height. Body mass index (BMI), computed by dividing weight in kilograms by height in meters squared, was categorized according to WHO guidelines, underweight: BMI less than 18.5 kg/m^2; normal weight: BMI 18.5–24.9 kg/m^2 (reference category); overweight: BMI 25–29.9 kg/m^2; obesity: BMI 30–40+ kg/m^2 [49]. All subjects were requested to indicate weight and height. Mean BMI for all subjects resulted to be 25.58 ± 4.20 which falls in the range of overweight, according to the NIH indication [49]. BMI distribution of the all >60 subjects is depicted in Figure 1, and it indicates that 60% of the >60 subjects fall within the overweight and obesity category, 40% are in the range of normal weight, and only 1% are underweight.

Then we examined all females and males distribution BMI classes and the results indicated that 51% of the >60 female subjects and 64% of the >60 male subjects fall in the range of overweight and obesity (Figure 2) while 47% of female and 35% of male subjects were in the range of normal weight. Since the relation between obesity and psychological and subjective well-being is becoming a hot issue, in both the health and the economic field, we compared the BMI, well-being, and resilience in the obese group versus the normal weight one. As it is shown in Table 2(a), in all the >60 subjects, there was no significant difference in PWB and resilience score according to BMI categories. On the other hand, when we analyzed women and men separately, we found that both PWB and resilience decrease in >60 obese females with respect to normal weight group, while BMI increases (Table 2(b)). Also, in >60 males, PWB and resilience score are almost superimposable in both the normal weight and the obesity group (Table 2(c)), while BMI increases. In addition, the opposite trend of PWB and resilience score between obese males and females amplifies the gender difference that remained significant ($P < 0,05$).

Moreover, correlation analysis between BMI and PWB and resilience indicates no correlation in all the population (BMI > PWB = R 0,049, R square 0,002, P value = 0,299; BMI > resilience = R 0,056, R square 0,003, P value 0,231) and in the male population (BMI > PWB R 0,085, R square 0,007, P value = 0,191; BMI > resilience = R 0,114, R square, 0,013, P value 0,081). On the contrary, in the female population a significant correlation was found both between BMI and PWB and between BMI and resilience (BMI > PWB = R 0,171, R square 0,029, P value 0,012; BMI > resilience = R 0,173, R square 0,029, P value 0,011).

Subjects indicate eventual diagnosed disease/s within the following list of diseases: diabetes, respiratory diseases, skin diseases, gastritis, anemia, depression, osteoporosis,

Table 2: *Panel a*: comparison of PWB and resilience scores between normal weight and obese all > 60 subjects. Results are reported as mean ± SD. P value has been calculated by Student's t-test between each two groups. *Panel b*: comparison of PWB and resilience scores between normal weight and obese > 60 Females results are reported as mean ± SD. P value has been calculated by Student's t-test between each two groups. *Panel c*: comparison of PWB and resilience scores between normal weight and obese > 60 males. Results are reported as mean ± SD. P value has been calculated by Student's t-test between each two groups.

	BMI categories	All > 60					
		BMI	P value	Resilience	P value	PWB	P value
a	Normal weight	22,57 ± 1,77	<0,0001	6,09 ± 1,52	NS	70,11 ± 18,48	NS
	Obesity	32,79 ± 3,06		5,85 ± 1,89		66,99 ± 23,44	
	BMI categories	Females > 60					
		BMI	P value	Resilience	P value	PWB	P value
b	Normal weight	22,33 ± 1,7	<0,0001	6,25 ± 1,45	<0,05	69,63 ± 16,95	0,0093
	Obesity	33,72 ± 3,4		5,36 ± 2,19		55,61 ± 22,18	
	BMI categories	Males > 60					
		BMI	P value	Resilience	P value	PWB	P value
c	Normal weight	23,22 ± 1,23	<0,0001	5,98 ± 1,54	NS	72,15 ± 18,89	NS
	Obesity	31,75 ± 1,76		6,17 ± 1,55		72,86 ± 21,78	

Table 3: The table depicts the number of >60 male and female subjects distributed according to self-reported diagnosed diseases.

BMI distribution	Females > 60					Males > 60				
	Diabetes	Hypertension	Obesity	CVD	Depression	Diabetes	Hypertension	Obesity	CVD	Depression
Normal weight	9	32	1	23	5	17	28	1	45	7
Overweight	12	31	2	16	9	21	38	2	56	7
Obesity	6	16	16	14	8	10	19	16	20	3

kidney diseases, migraine, anxiety, heart failure, arrhythmias, ischemic heart diseases, cancer, allergy, arthrosis, myocardial infarction, hypertension, obesity, liver disease, back pain, and colitis. The frequency of diabetes, hypertension, obesity, cardiovascular diseases (CVD), comprising heart failure, arrhythmias, ischemic heart disease, and myocardial infarction and depression, categorized according to BMI classes, is shown in Table 3. Hypertension resulted to be the most reported diagnosed disease within normal weight, overweight, and obesity classes in >60 females, while CVD was the most frequently reported by the >60 male group.

3.3. BMI, Resilience, and PWB in >60 Females and Males Participating and Nonparticipating in Cultural and Social Activities. Among the 571 >60 subjects, 78,45% are engaged into cultural and social activities, while 21,54% are not. Within the P population 52% are women and 48% are men, while in the NP population 57% are women and 43% are men. Interestingly, when we compared BMI of subjects participating (P) and nonparticipating (NP) to cultural and social activities, we observed that BMI was higher in females NP versus females P (<0,05) (Table 4(b)). On the other hand, no difference in BMI is observed between >60 males P and NP. More importantly, the >60 NP population displays PWB and resilience score significantly lower the >60 P. In particular, the >60 P male population frankly falls into the area of positive well-being, while that of NP goes in the area of moderate distress (Table 4). As for women, the PWB of the NP population dramatically crashes in the area of severe distress. These observations show an association between participation in cultural and social activities and subjective well-being, by means of PWB and resilience score. In addition, in the case of the female group, and in particular the NP females, we observed an inverse relation between BMI and PWB and resilience, since BMI increases while PWB and resilience decrease. The last observation suggests an intriguing and apparently new association between BMI, subjective well-being indicators, and participation in cultural and social activities.

3.4. Adherence to a Diet or a Nutritional Regimen. We then analyzed answers of >60 subjects to the question: Do you follow a diet or a nutritional regimen? The results indicate that 35% of males > 60 and 43% of females > 60 follow a diet or a nutritional regimen. Thereafter, we investigated the relation between perceived well-being and resilience and adherence to diet or nutritional regimen. Interestingly, women P adhering to diet display significantly higher PWB ($P = 0,013$) and resilience ($P = 0,043$) than the NP following diet (Table 5). In addition, a significant difference was observed in PWB and resilience between >60 female P and NP ($P < 0,0001$) nondieting. On the other hand, while PWB was higher in the >60 males of the P group with respect to the NP following a diet, resilience was similar in the two groups (Table 5). In addition, differently from females, NP males who do not follow a diet or nutritional regimen apparently are overall "happier" then NP following a diet. We then analyzed obese females and males dieting and nondieting. The results show

Table 4: *Panel a*: comparison of BMI, PWB, and resilience between >60 P and NP. Results are reported as mean ± SD. P value has been calculated by Student's t-test between each two groups. *Panel b*: comparison of BMI, PWB, and resilience between >60 P and NP Females. Results are reported as mean ± SD. P value has been calculated by Student's t-test between each two groups. *Panel c*: comparison of BMI, PWB, and resilience between >60 P and NP males. Results are reported as mean ± SD. P value has been calculated by Student's t-test between each two groups.

	>60 all	BMI	*P* value	Resilience	*P* value	PWB	*P* value
a	P	25,8 ± 3,932	0,004	6,07 ± 1,581	<0,0001	70,53 ± 17,98	<0,0001
	NP	27,1 ± 4,21		5,14 ± 1,83		58,95 ± 23,2	
	>60 males	BMI	*P* value	Resilience	*P* value	PWB	*P* value
b	P	26,18 ± 3,31	NS	6,02 ± 1,53	0,009	73,05 ± 16,93	0,015
	NP	26,6 ± 3,30		5,41 ± 1,64		65,38 ± 18,67	
	>60 females	BMI	*P* value	Resilience	*P* value	PWB	*P* value
c	P	25,25 ± 4,36	0,008	6,11 ± 1,53	<0,0001	68,16 ± 18,67	<0,0001
	NP	27,42 ± 5,25		4,75 ± 2,02		50,31 ± 20,48	

Table 5: *Panel a*: BMI, PWB, and resilience in >60 subjects following or nonfollowing a diet in relation to participation to cultural and social activities. Results are reported as mean ± SD. P value has been calculated by Student's t-test between each two groups. *Panel b*: BMI, PWB, and resilience in females >60 following or nonfollowing a diet in relation to participation in cultural and social activities. Results are reported as mean ± SD. P value has been calculated by Student's t-test between each two groups. *Panel c*: BMI, PWB, and resilience in males >60 following or nonfollowing a diet in relation to participation in cultural and social activities. Results are reported as mean ± SD. P value has been calculated by Student's t-test between each two groups.

		All > 60							
		Yes diet				No diet			
		PWB	*P* value	Resilience	*P* value	PWB	*P* value	Resilience	*P* value
a	P	70,79 ± 18,56	0,001	6,10 ± 1,58	0,02	70,08 ± 17,92	0,002	6,04 ± 1,58	<0,001
	NP	57,73 ± 22,47		5,43 ± 1,66		59,78 ± 23,69		5,05 ± 1,92	
		Males > 60							
		Yes diet				No diet			
		PWB	*P* value	Resilience	*P* value	PWB	*P* value	Resilience	*P* value
b	P	73,33 ± 18,59	0,028	6,15 ± 1,57	0,192	72,68 ± 16,34	NS	5,94 ± 1,54	NS
	NP	57,59 ± 26,01		5,59 ± 1,66		71,94 ± 19,83		5,65 ± 1,53	
		Females > 60							
		Yes diet				No diet			
		PWB	*P* value	Resilience	*P* value	PWB	*P* value	Resilience	*P* value
c	P	68,35 ± 18,22	0,013	6,05 ± 1,60	0,043	67,60 ± 19,05	<0,001	6,13 ± 1,63	<0,001
	NP	57,09 ± 20,14		5,24 ± 1,70		43,73 ± 19,27		4,22 ± 2,17	

that obese females dieting present both PWB and resilience scores higher than the nondieting obese females (PWB 61,69 ± 17,26 > 54,72 ± 16,69, $P < 0,009$; resilience 6 ± 1,57 > 5,429 ± 1,4, $P < 0,003$). Conversely, obese males dieting show both PWB and resilience scores lower than the nondieting obese males (PWB 67,35 ± 16,43 > 81,53 ± 17,18, $P < 0,05$; resilience 5,842 ± 1,46 > 6,706 ± 1,44, $P < 0,05$).

4. Discussion

To our knowledge, this is the first assessment of PWB and resilience conducted in the Metropolitan area of Naples. Our data show that a sample of 571 subjects over 60 years of age resident in the Metropolitan area of Naples display a PWB score of 68,22 ± 19,71 on a scale of 0 > 110, largely below PWB scores previously reported for the Italian population. In particular, Grossi et al. [47–50] reported a PWB score of 77.76 (17.73 SD) for the Italian population (1500 subjects) in 2011. The PWB score was geographically distributed as follows: north (696 subjects) 79.34 (17.71 SD), centre (293 subjects) 78.04 (17.12 SD), south (511 subjects) 75.47 (17.91 SD). Moreover, in 2013 the same authors reported that a sample of 1000 citizens of Milan displayed a PWB score of 82, 14 (15.63 SD) while that of the population over 60 years was 80,39.

The questionnaires analyzed here have been collected within 2014 when, as reported above [43], the Metropolitan area of Naples was still suffering for the economic crisis. Our results are in agreement with those reporting a relationship between unemployment and low level of PWB. Thus, we cannot exclude that the low PGWB score of this sample population of residents in the Metropolitan area of Naples reflects the detrimental effects of the economic and social crisis at local level. In particular, of note 50% of the 571 subjects over 60 years of age are retired, and retirement benefits represent for most families in the area, in a time of high unemployment, the only income to count on.

When PWB score was measured in >60 males and females separately, a gender difference was observed. It is generally reported that women have a score higher than men do in happiness, when happiness is measured as life satisfaction. It is also reported that the advantage of women in terms of happiness and life satisfaction is not uniform along the life cycle: women are less happy than men before the age of 18, happier than men until their fifties, and less happy again thereafter [51]. Moreover, the "paradox of declining female happiness" seems to indicate that the traditional gender gap in happiness (in favour of women) is progressively shrinking since the 1970s in spite of the type of technological progress, civil liberties, and gender-conscious policies that characterize modern Western societies [52].

On the other hand, it is well recognized that women score lower than men do, on measures that capture short-term positive and negative emotions and are more subject to depression symptoms [51].

The gender difference observed in PWB score in the sample of women >60 analyzed here is in line with results already reported by Grossi et al., using the same PGWB questionnaires we have used. Grossi and coworkers reported gender difference PWB scores in 2011 for the Italian population (PWB score females 74.82 and males 81) and in 2013 for citizens of Milan (PWB score females 78.32 and males 83) [47, 48]. We have reported that in a sample population of people nonparticipating in social and cultural activities, women PWB and resilience scores are lower than that of nonparticipating men [50] Moreover, in 2003, Ruini et al. reported a gender difference in favour of men by assessing well-being by means of different questionnaire [53]. Psychological well-being gender gap in favour of men was also reported by Pinquart and Sörensen in elderly [54] and by Hori and Kamo in their comparison of 33 countries [55] The latter authors as well as Ruini et al. suggest that different socialization and expectations by gender and different role of men and women in society explain gender gap in psychological well-being.

Biological factors such as hormones, neurotransmitter, and cytokines have been associated to well-being, differently in men and women [56–61]. Taking into account that, in the present work, we examined a female population with mean age 69,78 ± 6,980 living in the Metropolitan area of city of Naples, located in the South of Italy, we cannot exclude that the PWB gender gap mainly reflects women's "traditional" social role in this area.

According to Havighurst "activity theory," higher levels of participation in social and leisure activities, and role replacement when roles must be relinquished, promote well-being in older adults [62]. Thus, to achieve a healthy aging it is crucial to have equal opportunities for health, follow healthy diets, maintain social relations, participate in meaningful activities, and enjoy financial security. Participation in social and leisure activities means being willing to reach people, to stay connected, to keep learning, and to be curios, in one word to stay alive [17–23]. Social participation is closely linked to self-esteem, life satisfaction, and mental health status, which makes it a very important factor for quality of life. Engagement with community activities, friendships, and meaningful volunteer work are perceived as strategies for maintaining social participation, especially for people with a chronic disease [9]. Thus, encouraging participation in social and cultural activities could be a key tool to fight social isolation and its health detrimental outcomes.

Our results are in line with data in the literature showing positive association between engaging in leisure and well-being [17–23, 47–63]. In addition, some intervention studies seem to strengthen this observation. In particular, through interventions focused on the development of positive emotions, it is possible to improve well-being and reduce disability in the general population, and in most, if not all, mental disorders. These data indicate that well-being can be modified and that leisure and social activities may be affordable tools to improve well-being [64–72]. Moreover, data coming from research on "happiness genes," suggesting a genetic root of happiness/well-being, do not rule out gene-environment interaction on the expression "happiness genes." Availability and access to cultural and social activities are a key element of healthy environment and especially of urban environment [73–75].

Social isolation has been associated with malnutrition in older adults. Since eating is a social event, social isolation can have a negative effect on nutrition, and thus we speculated that social and cultural participation might influence adherence to diet [76–78]. Adequate nutrition is a key factor to healthy aging and to preventing disease onset; nevertheless eating appropriately and, even more, following a diet or a nutritional regimen are never an easy task. Motivations are important factors to eat healthy or to stay on a diet, and they change with age. In >60 subjects, dieting, by-and-large required by health problem, is perceived as a punishment. Social and cultural participation, fighting social isolation, may help >60 to follow healthier life styles, among which is healthy eating, or to accept more "easily" to face stressful situation, like being forced to diet. The results presented here suggest that >60 subjects, in particular females, participating in cultural and social activities, apparently "accept" diet or nutritional regimen better then NP subjects as it is shown by an overall higher score in both PWB and resilience. The higher PWB score observed in P females >60 following a diet deserves, in our view, a special consideration. Pampel in 2012 reported a more consistent association between cultural activities and low body weight in the Western country than elsewhere and that the relationship emerges more consistently for women than men [79].

Subjective well-being significantly correlates with high self-esteem, and self-esteem shares significant variance in both mental well-being and happiness. Self-esteem has been found to be the most dominant and powerful predictor of happiness. Quoting Mann, "Indeed, while low self-esteem leads to maladjustment, positive self-esteem, internal standards and aspirations actively seem to contribute to 'well-being'" [80]. Body image bears relationship to self-esteem and psychosocial adjustment (e.g., eating disturbances, depression, social anxiety, and sexual functioning) [81]. The association between body image and women's mental and physical health has been investigated with mainly focusing on young women's appearance concerns. However, in the "aging society" body concerns are becoming an issue also for older women, because of age-related changes in both appearance and functioning. In particular, aesthetic appearance is becoming relevant to older women and may lead some women to feel that their bodies are inadequate or lacking. Because of the association between beauty and youth, women lose their social value simply by growing old [82, 83]. The ideal of a thinner body image persists in older adult females, as also suggested by the observation that higher BMI predicts lower psychological well-being only among women. Moreover, body-image concerns are significant to self-esteem in older adulthood [84–86].

Conversely, improvements in body image are related to improvements in self-esteem and psychological well-being [87, 88]. On this basis, we cannot rule out that an "esthetic element" may play a role in the higher score in PWB and resilience reported by this sample of over 60 women participating in cultural and social activities and dieting, independently and far beyond health consciousness.

5. Conclusion

The aim of the study presented here was to assess subjective well-being in a sample of residents of the Metropolitan area of Naples, when the city is going through a very difficult time of its long history. To our knowledge, this is the first survey on this topic, and our data represent a suggestive baseline.

The present study has been designed to explore the possible association between cultural and social participation and well-being, which our results apparently support. Much larger and more in-depth studies than ours failed to find a causal link between cultural and social participation and well-being and health [29–89]. However, the association is well-documented and apparently is so appealing that several governments include engagement in cultural and social activities among their strategies to improve well-being and health [90–92]. Since welfare costs are one of the major sources of public finance deficits in the EU, investing in "cultural welfare," an affordable health preventive and promoting strategy for healthy living and aging, could result in a substantial saving of public resources [93].

Competing Interests

The authors declare that there are no competing interests.

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References

[1] S. Cacioppo, A. J. Grippo, S. London, L. Goossens, and J. T. Cacioppo, "Loneliness: clinical Import and Interventions," *Perspectives on Psychological Science*, vol. 10, no. 2, pp. 238–249, 2015.

[2] J. T. Cacioppo and S. Cacioppo, "Social relationships and health: the toxic effects of perceived social isolation," *Social and Personality Psychology Compass*, vol. 8, no. 2, pp. 58–72, 2014.

[3] A. Steptoe, A. Shankar, P. Demakakos, and J. Wardle, "Social isolation, loneliness, and all-cause mortality in older men and women," *Proceedings of the National Academy of Sciences of the United States of America*, vol. 110, no. 15, pp. 5797–5801, 2013.

[4] J. Holt-Lunstad, T. B. Smith, M. Baker, T. Harris, and D. Stephenson, "Loneliness and social isolation as risk factors for mortality: a meta-analytic review," *Perspectives on Psychological Science*, vol. 10, no. 2, pp. 227–237, 2015.

[5] J. H. Fowler and N. A. Christakis, "Dynamic spread of happiness in a large social network: longitudinal analysis over 20 years in the Framingham Heart Study," *The British Medical Journal*, vol. 2008, article 337, 2008.

[6] S. Brownie, "Why are elderly individuals at risk of nutritional deficiency?" *International Journal of Nursing Practice*, vol. 12, no. 2, pp. 110–118, 2006.

[7] M. Dean, M. M. Raats, K. G. Grunert, and M. Lumbers, "Factors influencing eating a varied diet in old age," *Public Health Nutrition*, vol. 12, no. 12, pp. 2421–2427, 2009.

[8] T. J. VanderWeele, L. C. Hawkley, and J. T. Cacioppo, "On the reciprocal association between loneliness and subjective well-being," *American Journal of Epidemiology*, vol. 176, no. 9, pp. 777–784, 2012.

[9] V. Toepoel, "Ageing, leisure, and social connectedness: how could leisure help reduce social isolation of older people?" *Social Indicators Research*, vol. 113, no. 1, pp. 355–372, 2013.

[10] H. X. Wang, W. Xu, and J. J. Pei, "Leisure activities, cognition and dementia," *Biochimica et Biophysica Acta*, vol. 1822, no. 3, pp. 482–491, 2012.

[11] F. Takeda, H. Noguchi, T. Monma, N. Tamiya, and T. Ojima, "How possibly do leisure and social activities impact mental health of middle-aged adults in japan?: an evidence from a national longitudinal survey," *PLoS ONE*, vol. 10, no. 10, Article ID e0139777, 2015.

[12] C. Chiao, L.-J. Weng, and A. L. Botticello, "Social participation reduces depressive symptoms among older adults: an 18-year longitudinal analysis in Taiwan," *BMC Public Health*, vol. 11, article 292, 2011.

[13] Y. Iwasaki, C. P. Coyle, and J. W. Shank, "Leisure as a context for active living, recovery, health and life quality for persons with mental illness in a global context," *Health Promotion International*, vol. 25, no. 4, pp. 483–494, 2010.

[14] N. Agahi, "Leisure in late life: pattern of participation and relationship to health," in *Neurobiology, Care Sciences and Society*, Karolinska Institutet, Stockholm, Sweden, 2008.

[15] I. Nilsson, F. Nyqvist, Y. Gustafson, and M. Nygard, "Leisure engagement: medical conditions, mobility difficulties, and activity limitations—a later life perspective," *Journal of Aging Research*, vol. 2015, Article ID 610154, 8 pages, 2015.

[16] C. Opdebeeck, C. Quinn, S. M. Nelis, and L. Clare, "Is cognitive lifestyle associated with depressive thoughts and self-reported depressive symptoms in later life?" *European Journal of Ageing*, vol. 13, no. 1, pp. 63–73, 2016.

[17] E. Grossi, P. L. Sacco, G. T. Blessi, and R. Cerutti, "The impact of culture on the individual subjective well-being of the Italian population: an exploratory study," *Applied Research in Quality of Life*, vol. 6, no. 4, pp. 387–410, 2011.

[18] W. R. Holmes and J. Joseph, "Social participation and healthy ageing: a neglected, significant protective factor for chronic non communicable conditions," *Globalization and Health*, vol. 7, article 43, 2011.

[19] P.-J. Chang, L. Wray, and Y. Lin, "Social relationships, leisure activity, and health in older adults," *Health Psychology*, vol. 33, no. 6, pp. 516–523, 2014.

[20] C. F. Mendes de, T. A. Leon, and L. F. Berkman, "Social engagement as a longitudinal predictor of objective and subjective health," *European Journal of Ageing*, vol. 2, no. 1, pp. 48–55, 2005.

[21] K. M. Bennett, "Social engagement as a longitudinal predictor of objective and subjective health," *European Journal of Ageing*, vol. 2, no. 1, pp. 48–55, 2005.

[22] L. Kuykendall, L. Tay, and V. Ng, "Leisure engagement and subjective well-being: a meta-analysis," *Psychological Bulletin*, vol. 141, no. 2, pp. 364–403, 2015.

[23] V. Ateca-Amestoy, M. Gerstenblüth, I. Mussio, and M. Rossi, "How do cultural activities influence happiness? The relation between self-reported well-being and leisure," (working papers) 0614, Department of Economics—dECON, 2014, http://cienciassociales.edu.uy/departamentodeeconomia/wp-content/uploads/sites/2/2014/11/0614.pdf.

[24] G. V. Ostir, K. S. Markides, S. A. Black, and J. S. Goodwin, "Emotional well-being predicts subsequent functional independence and survival," *Journal of the American Geriatrics Society*, vol. 48, no. 5, pp. 473–478, 2000.

[25] G. V. Ostir, K. S. Markides, M. K. Peek, and J. S. Goodwin, "The association between emotional well-being and the incidence of stroke in older adults," *Psychosomatic Medicine*, vol. 63, no. 2, pp. 210–215, 2001.

[26] E. Diener, "Subjective well-being: the science of happiness and a proposal for a national index," *American Psychologist*, vol. 55, no. 1, pp. 34–43, 2000.

[27] D. Kahneman and J. Riis, "Living and thinking about it: two perspectives on life," in *The Science of Well-Being*, F. A. Huppert, N. Baylis, and B. Keverne, Eds., pp. 285–304, Oxford University Press, New York, NY, USA, 2006.

[28] C. D. Ryff, B. T. Radler, and E. M. Friedman, "Persistent psychological well-being predicts improved self-rated health over 9-10 years: longitudinal evidence from MIDUS," *Health Psychology Open*, vol. 2, no. 2, 2015.

[29] A. Steptoe, A. Deaton, and A. A. Stone, "Subjective wellbeing, health, and ageing," *The Lancet*, vol. 385, no. 9968, pp. 640–648, 2015.

[30] L. E. Sears, S. Agrawal, J. A. Sidney et al., "The well-being 5: development and validation of a diagnostic instrument to improve population well-being," *Population Health Management*, vol. 17, no. 6, pp. 357–365, 2014.

[31] F. A. Huppert and T. T. C. So, "Flourishing across Europe: application of a new conceptual framework for defining well-being," *Social Indicators Research*, vol. 110, no. 3, pp. 837–861, 2013.

[32] J. Burton, "WHO healthy workplace framework and model: background and supporting literature and practices," http://www.who.int/occupational_health/healthy_workplace_framework.pdf.

[33] A. Deaton, "The financial crisis and the well-being of Americans," *Oxford Economic Papers*, vol. 64, pp. 1–26, 2014.

[34] A. Montagnoli and M. Moro, *Everybody Hurts: Banking Crises and Individual Wellbeing*, Sheffield economic Research Paper Series no. 2014010, 2014.

[35] N. Drydakis, "The effect of unemployment on self-reported health and mental health in Greece from 2008 to 2013: a longitudinal study before and during the financial crisis," IZA Discussion Paper 8742, 2014, http://ftp.iza.org/dp8742.pdf.

[36] E. Flint, M. Bartley, N. Shelton, and A. Sacker, "Do labour market status transitions predict changes in psychological well-being?" *Journal of Epidemiology and Community Health*, vol. 67, no. 9, pp. 796–802, 2013.

[37] G. Van Hal, "The true cost of the economic crisis on psychological well-being: a review," *Psychology Research and Behavior Management*, vol. 8, pp. 17–25, 2015.

[38] WHO Regional Office for Europe report Impact of economic crisis on mental health, http://www.euro.who.int/__data/assets/pdf.../e94837.pdf.

[39] R. De Vogli, M. Marmot, and D. Stuckler, "Strong evidence that the economic crisis caused a rise in suicides in Europe: the need for social protection," *Journal of Epidemiology and Community Health*, vol. 67, no. 4, pp. 298–307, 2013.

[40] R. De Vogli, M. Marmot, and D. Stuckler, "Excess suicides and attempted suicides in Italy attributable to the great recession," *Journal of Epidemiology and Community Health*, vol. 67, no. 4, pp. 378–379, 2013.

[41] "The Impacts of the Crisis on Gender Equality and Women's Wellbeing in European Union (EU) Mediterranean Countries," 2014, http://www.unicri.it/news/files/VAW_draft_last_lowq.pdf.

[42] http://www.oecd.org/statistics/BLI%202014%20Italy%20country%20report.pdf.

[43] ISTAT, http://www.istat.it.

[44] E. Grossi, N. Groth, P. Mosconi et al., "Development and validation of the short version of the Psychological General Well-Being Index (PGWB-S)," *Health and Quality of Life Outcomes*, vol. 4, article 88, 2006.

[45] S. Vaishnavi, K. Connor, and J. R. T. Davidson, "An abbreviated version of the Connor-Davidson Resilience Scale (CD-RISC), the CD-RISC2: psychometric properties and applications in psychopharmacological trials," *Psychiatry Research*, vol. 152, no. 2-3, pp. 293–297, 2007.

[46] A. Chassany, E. Dimenäs, D. Dubois et al., *The Psychological General Well-Being Index (PGWBI) Manual User*, MAPI Research Institute, Lyon, France, 2004.

[47] E. Grossi, G. T. Blessi, P. L. Sacco, and M. Buscema, "The interaction between culture, health and psychological well-being: data mining from the Italian culture and well-being project," *Journal of Happiness Studies*, vol. 13, no. 1, pp. 129–148, 2012.

[48] E. Grossi, A. Compare, C. Lonardi, R. Cerutti, E. Callus, and M. Niero, "Gender-related effect of cultural participation in psychological well-being: Indications from the well-being project in the municipality of Milan," *Social Indicators Research*, vol. 114, no. 2, pp. 255–271, 2013.

[49] BMI WHO, "World Health Organization (WHO) expert committee on physical status. The use and interpretation of anthropometry," in *Report of a World Health Organization Expert Committee*, Series 854, WHO Technical Support, Geneva, Switzerland, 1995.

[50] M. Quarto, A. Kisslinger, and D. Tramontano, "The sick city sickens," in *Urbanistica Informazioni*, M. Sepe, Ed., Happiness and Public Space, pp. 111–115, 2015.

[51] C. Senik, "Gender Gaps in Subjective Wellbeing European Commission—Directorate-General for Justice," European Union, 2015, http://ec.europa.eu/justice/gender-equality/files/equal_economic_independence/160129_happiness_report_en.pdf.

[52] B. Stevenson and J. Wolfers, "The paradox of declining female happiness," IZA Discussion Paper 4200, 2009, http://ftp.iza.org/dp4200.pdf.

[53] C. Ruini, F. Ottolini, C. Rafanelli, E. Tossani, C. D. Ryff, and G. A. Fava, "The relationship of psychological well-being to distress and personality," *Psychotherapy and Psychosomatics*, vol. 72, no. 5, pp. 268–275, 2003.

[54] M. Pinquart and S. Sörensen, "Gender differences in self-concept and psychological well-being in old age: a meta-analysis," *Journals of Gerontology B: Psychological Sciences and Social Sciences*, vol. 56, no. 4, pp. P195–P213, 2001.

[55] M. Hori and Y. Kamo, "A multi-level analysis of psychological well-being related to work and family in 33 countries," in *Family and Health: Evolving Needs, Responsibilities, and Experiences*, vol. 8 of *Contemporary Perspectives in Family Research*, pp. 1–25, Emerald Group Publishing Limited, 2014.

[56] A. Steptoe, P. Demakakos, C. de Oliveira, and J. Wardle, "Distinctive biological correlates of positive psychological well-being in older men and women," *Psychosomatic Medicine*, vol. 74, no. 5, pp. 501–508, 2012.

[57] A. Steptoe, J. Wardle, and M. Marmot, "Positive affect and health-related neuroendocrine, cardiovascular, and inflammatory processes," *Proceedings of the National Academy of Sciences of the United States of America*, vol. 102, no. 18, pp. 6508–6512, 2005.

[58] A. Steptoe, K. O'Donnell, E. Badrick, M. Kumari, and M. Marmot, "Neuroendocrine and inflammatory factors associated with positive affect in healthy men and women: the Whitehall II study," *American Journal of Epidemiology*, vol. 167, no. 1, pp. 96–102, 2008.

[59] B. E. Kok, K. A. Coffey, M. A. Cohn et al., "How positive emotions build physical health: perceived positive social connections account for the upward spiral between positive emotions and vagal tone," *Psychological Science*, vol. 24, no. 7, pp. 1123–1132, 2013.

[60] E. M. Friedman, M. Hayney, G. D. Love, B. H. Singer, and C. D. Ryff, "Plasma interleukin-6 and soluble IL-6 receptors are associated with psychological well-being in aging women," *Health Psychology*, vol. 26, no. 3, pp. 305–313, 2007.

[61] C. D. Ryff, G. Dienberg Love, H. L. Urry et al., "Psychological well-being and ill-being: do they have distinct or mirrored biological correlates?" *Psychotherapy and Psychosomatics*, vol. 75, no. 2, pp. 85–95, 2006.

[62] R. Havighurst, "Successful aging," in *Processes of Aging*, R. Williams, C. Tibbits, and W. Donahue, Eds., vol. 1, Atherton Press, New York, NY, USA, 1963.

[63] G. Fernández-Mayoralas, F. Rojo-Pérez, P. Martínez-Martín et al., "Active ageing and quality of life: factors associated with participation in leisure activities among institutionalized older adults, with and without dementia," *Aging & Mental Health*, vol. 19, no. 11, pp. 1031–1041, 2015.

[64] M. J. Zawadzki, J. M. Smyth, and H. J. Costigan, "Real-time associations between engaging in leisure and daily health and well-being," *Annals of Behavioral Medicine*, vol. 49, no. 4, pp. 605–615, 2015.

[65] L. Becchetti, E. Giachin Ricca, and A. Pelloni, "The relationship bethween social leisure and life satisfaction: causality and policy implications," *Social Indicators Research*, vol. 108, no. 3, pp. 453–490, 2015.

[66] E. M. Friedman, C. Ruini, R. Foy, L. Jaros, H. Sampson, and C. D. Ryff, "Lighten UP! A community-based group intervention to promote psychological well-being in older adults," *Aging and Mental Health*, vol. 13, pp. 1–7, 2015.

[67] M. Levasseur, H. Lefebvre, M. Levert et al., "Personalized citizen assistance for social participation (APIC): a promising intervention for increasing mobility, accomplishment of social activities and frequency of leisure activities in older adults having disabilities," *Archives of Gerontology and Geriatrics*, vol. 64, pp. 96–102, 2016.

[68] C. R. Cloninger, "The science of wellbeing: an integrated approach to mental health and its disorders," *Psychiatria Danubina*, vol. 18, no. 3-4, pp. 218–224, 2006.

[69] L. Bolier, M. Haverman, G. J. Westerhof, H. Riper, F. Smit, and E. Bohlmeijer, "Positive psychology interventions: a meta-analysis of randomized controlled studies," *BMC Public Health*, vol. 13, article 119, 2013.

[70] S. Ballesteros, E. Kraft, S. Santana, and C. Tziraki, "Maintaining older brain functionality: a targeted review," *Neuroscience and Biobehavioral Reviews*, vol. 55, pp. 453–477, 2015.

[71] M. E. Paggi, D. Jopp, and C. Hertzog, "The importance of leisure activities in the relationship between physical health and well-being in a life span sample," *Gerontology*, 2016.

[72] L. Tay and L. Kuykendall, "Promoting happiness: the malleability of individual and societal subjective wellbeing," *International Journal of Psychology*, vol. 48, no. 3, pp. 159–176, 2013.

[73] J. E. De Neve, N. A. Christakis, J. H. Fowler, and B. S. Frey, "Genes, economics, and happiness," *Journal of Neuroscience, Psychology, and Economics*, vol. 5, no. 4, 2012.

[74] M. Bartels, "Genetics of wellbeing and its components satisfaction with life, happiness, and quality of life: a review and meta-analysis of heritability studies," *Calcified Tissue International*, vol. 96, no. 3, pp. 137–156, 2015.

[75] A. Okbay, B. M. Baselmans, J. E. De Neve et al., "Genetic variants associated with subjective well-being, depressive symptoms, and neuroticism identified through genome-wide analyses," *Nature Genetics*, 2016.

[76] V. H. Taylor, M. Forhan, S. N. Vigod, R. S. McIntyre, and K. M. Morrison, "The impact of obesity on quality of life," *Best Practice and Research: Clinical Endocrinology and Metabolism*, vol. 27, no. 2, pp. 139–146, 2013.

[77] M. L. Yan, K. Daviglus, K. Liu et al., "BMI and health-related quality of life in adults 65 years and older," *Obesity Research*, vol. 12, no. 1, pp. 69–76, 2004.

[78] H. A. Doll, S. E. K. Petersen, and S. L. Stewart-Brown, "Obesity and physical and emotional well-being: associations between body mass index, chronic illness, and the physical and mental components of the SF-36 questionnaire," *Obesity Research*, vol. 8, no. 2, pp. 160–170, 2000.

[79] F. C. Pampel, "Does reading keep you thin? Leisure activities, cultural tastes, and body weight in comparative perspective," *Sociology of Health and Illness*, vol. 34, no. 3, pp. 396–411, 2012.

[80] M. Mann, C. M. H. Hosman, H. P. Schaalma, and N. K. de Vries, "Self-esteem in a broad-spectrum approach for mental health promotion," *Health Education Research*, vol. 19, no. 4, pp. 357–372, 2004.

[81] J. K. Thompson, M. D. Coovert, and S. M. Stormer, "Body image, social comparison, and eating disturbance: a covariance structure modeling investigation," *International Journal of Eating Disorders*, vol. 26, no. 1, pp. 43–51, 1999.

[82] C. M. Peat, N. L. Peyerl, and J. J. Muehlenkamp, "Body image and eating disorders in older adults: a review," *Journal of General Psychology*, vol. 135, no. 4, pp. 343–358, 2008.

[83] J. D. Garner, "Feminism and feminist gerontology," *Journal of Women and Aging*, vol. 11, no. 2–23, pp. 3–12, 1999.

[84] F. R. Ferraro, J. J. Muehlenkamp, A. Paintner, K. Wasson, T. Hager, and F. Hoverson, "Aging, body image, and body shape," *Journal of General Psychology*, vol. 135, no. 4, pp. 379–392, 2008.

[85] L. Baker and E. Gringart, "Body image and self-esteem in older adulthood," *Ageing & Society*, vol. 29, no. 6, pp. 977–995, 2009.

[86] J. Bookwala and J. Boyar, "Gender, excessive body weight, and psychological well-being in adulthood," *Psychology of Women Quarterly*, vol. 32, no. 2, pp. 188–195, 2008.

[87] A. L. Palmeira, T. L. Branco, S. C. Martins et al., "Change in body image and psychologicalwell-being during behavioral obesity treatment: associations with weight loss and maintenance," *Body Image*, vol. 7, no. 3, pp. 187–193, 2010.

[88] P. N. Vieira, J. Mata, M. N. Silva et al., "Predictors of psychological well-being during behavioral obesity treatment in women," *Journal of Obesity*, vol. 2011, Article ID 936153, 8 pages, 2011.

[89] K. Cuypers, S. Krokstad, T. L. Holmen, M. S. Knudtsen, L. O. Bygren, and J. Holmen, "Patterns of receptive and creative cultural activities and their association with perceived health, anxiety, depression and satisfaction with life among adults: The HUNT study, Norway," *Journal of Epidemiology and Community Health*, vol. 66, no. 8, pp. 698–703, 2012.

[90] The European Commission: Quality of life in Europe: Subjective wellbeing Luxembourg: Publications Office of the European Union 2013, http://digitalcommons.ilr.cornell.edu/cgi/viewcontent.cgi?article=1318&context=intl.

[91] https://www.gov.uk/government/publications/quantifying-the-social-impacts-of-sport-and-culture.

[92] http://www.statcan.gc.ca/pub/82-003-x/2012004/article/11720/ref-eng.htm#n33.

[93] P. L. Sacco, "Culture 3.0: A new perspective for the EU 2014-2020 structural funds programming, on behalf of the European Expert Network on Culture (EENC)," Produced for the OMC Working Group on Cultural and Creative Industries, April 2011.

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Research Article

Weekly Physical Activity Levels of Older Adults Regularly Using a Fitness Facility

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The aim of this paper was to determine if weekly physical activity levels were greater in an independent-living older adult population that was regularly participating in structured fitness activities. Also, lifetime exercise history and sex differences were investigated in an effort to understand how they relate to current weekly step activity. Total weekly step counts, measured with a pedometer, were assessed in two older adult groups; the first consisted of members of a local senior center who regularly used the fitness facility (74.5 ± 6.0 yrs; mean ± SD) while the second group consisted of members who did not use the fitness facility (74.8 ± 6.0 yrs). Participants also completed the Lifetime Physical Activity Questionnaire (LPAQ). No significant difference was found in the total number of weekly steps between groups ($p = 0.88$) or sexes ($p = 0.27$). The LPAQ suggested a significant decline in activity with aging ($p = 0.01$) but no difference between groups ($p = 0.54$) or sexes ($p = 0.80$). A relationship was observed between current step activity and MET expenditure over the past year ($p = 0.008$, $r^2 = 0.153$) and from ages 35 to 50 years ($p = 0.037$, $r^2 = 0.097$). The lack of difference in weekly physical activity level between our groups suggests that independent-living older adults will seek out and perform their desired activity, in either a scheduled exercise program or other leisure-time activities. Also, the best predictor of current physical activity level in independent-living older adults was the activity performed over the past year.

1. Introduction

Maintaining aerobic capacity and increasing muscular strength are known to lead to improvements in overall function in the aging population. An increase or maintenance of regular physical activity levels with aging would likely aid in the improvement in the functional capacity of the older adult. After 16 weeks of an exercise program focusing on improving aerobic capacity, muscular strength, and muscular endurance, Fahlman et al. [1] reported improvements in older adults on measures of aerobic fitness and functional ability. Nakamura et al. [2] demonstrated similar results in which participation in physical activity (walking, recreational activities, and resistance training) at least three times a week over a twelve-week period led to improvements in body composition. Importantly, participation in a regular structured exercise program has been found to improve health and well-being [1–3] and lead to an increase in the amount of physical activity performed outside of the exercise class on nonstructured exercise days [4]. Therefore, participation in regular structured exercise programming would likely benefit the aging population.

In addition, past research has shown that those who participate in exercise during youth and adolescent years have increased exercise levels in adulthood and lower body mass index levels [5, 6]. Those who report moderate to vigorous physical activity in midlife have been observed to possess better mobility later in life [6]. However, research is limited in this area; therefore identifying possible relationships between past exercise and current fitness levels remains an important goal for gerontological studies. In the current study a sample of both males and females were studied, ranging in age from 65 to 95 years. The use of a Lifetime Physical Activity Questionnaire [7] allowed for a look at physical activity across the lifespan to provide evidence as to whether past exercise can be used as a predictor of future levels of physical activity in later adulthood.

The purpose of this study was to assess total weekly steps taken in two older adult groups who frequent a local senior center using a pedometer. The first group consisted of members of a senior center who used the fitness facility at least two times a week (FIT). The second group consisted of members who have never used a fitness facility (NFIT). We hypothesized that those who participate in using the exercise facility at a senior center would have a greater total number of steps than those who did not use the fitness facility. Also, we hypothesized that those who regularly participated in exercise earlier in life would perform a greater number of total steps compared to those less active earlier in life. Finally, based on the past literature [6, 8–11] we hypothesized that males would exhibit a greater number of weekly steps compared to the female participants.

2. Methods

2.1. Participants. Eighteen males and 27 females ranging in age from 65 to 95 years were recruited from the Charlotte-Mecklenburg Senior Center in Charlotte, North Carolina. This study consisted of mostly European American participants ($n = 42$), two African Americans ($n = 2$), and one Asian ($n = 1$). Volunteers were recruited from advertising for interested individuals who regularly frequented the facility. This study was approved by the Institutional Review Board of the University of North Carolina at Charlotte.

2.2. Study Design. Participants were placed into one of two groups. The first group consisted of 13 males and 16 females who were members of the senior center and regularly used the fitness facility at least two times a week (FIT). The second group was composed of 5 males and 11 females who were members of the senior center but never used a fitness center, either in the senior center or elsewhere (NFIT).

The potential benefits and risks of participating in this study were fully explained to each participant. Participants were required to complete a medical history form and provide written informed consent before receiving a pedometer to measure daily steps for one full week. Subjects were also instructed about completing the Lifetime Physical Activity Questionnaire (LPAQ) [7] throughout the one-week period during which daily steps were measured. Height (cm) and body mass (kg) were recorded at the start of the study period, with body mass also recorded on the last day of the study period to monitor any changes. Subject's body mass (kg) was measured on a standard scale (J.A. King and Company, Inc., Greensboro, NC). From the height and initial mass measurements, body mass index (BMI) was calculated in kg/m^2.

2.3. Measurement of Physical Activity Levels

2.3.1. Pedometers. All volunteers were provided with a Digi-Walker SW-200 pedometer (New Lifestyles, Inc., Lees Summit, Missouri) at the beginning of the study period. Subjects were instructed on the proper way to wear the pedometer (on the waistband or belt close to the hip joint) and were reminded to wear the device at all times except when bathing, showering, swimming, or sleeping at night. Participants were asked to put on the pedometer first thing in the morning and remove the pedometer from the belt or waistline, complete the provided daily step log, and zero the pedometer before going to bed for seven consecutive days. Daily step totals were added together and the calculated sum equaled the weekly total for each participant. All subjects were asked to maintain their typical daily routine and leisure activities for the duration of the study.

2.3.2. Lifetime Physical Activity Questionnaire (LPAQ). Each subject was given a LPAQ [7] on the first day of the study. They were instructed on how to complete the questionnaire and were asked to fill it out and return it at the end of the study period with the pedometer. When the participant returned the LPAQ [7], the completed questionnaire was reviewed with the principal investigator. Intensity was determined by asking each participant how intensely they were working while performing a certain activity. Intensity was measured in multiples of metabolic equivalents (MET, 3.5 mL/kg/min) with intensity levels being assigned using the *Compendium of Physical Activities* [12].

The data from the LPAQ [7] were scored by calculating the minutes per year a person was performing a certain activity multiplied by the MET levels assigned to that activity. Total MET expenditure was determined for each age period (15–21 years, 22–34 years, 35–50 years, 51–65 years, and the past year) and for total lifetime.

2.4. Statistical Analyses. All descriptive data were analyzed using a one-way analysis of variance between groups. A two-way analysis of variance by group and sex was used to determine any differences in the total number of weekly steps taken between groups (FIT versus NFIT) and between males and females. Group changes in body mass during the study period were compared using a two-way analysis of variance with repeated measures. Any relationships between the LPAQ [7] MET levels for each age period and current weekly step count were determined by performing linear squares regression analyses for all participants and for each group. Also, linear regression analyses were performed for all participants and for each group between pre body mass and BMI versus total weekly steps. The LPAQ [7] MET levels for each age period were compared by two-way analysis of variance with repeated measures between groups (group × age) and sexes (sex × age). All statistical conclusions were based on an alpha level of 0.05 and performed using JMP Statistical Analysis software (SAS Institute, Cary, NC).

3. Results

3.1. Subject Characteristics. A total of 29 people in the FIT group (female $n = 16$, male $n = 13$) and a total of 16 people in the NFIT group (female $n = 11$, male $n = 5$) participated in the study. There was no difference in age between the two

Table 1: Mean (±SD) descriptive characteristics of fitness and nonfitness participants.

	Fitness	Nonfitness
Age (yr)		
All	74.5 ± 6.0	74.8 ± 6.0
Female	73.8 ± 6.2	73.6 ± 5.4
Male	75.4 ± 5.9	77.4 ± 7.3
Height (cm)		
All	168.7 ± 9.7	165.4 ± 8.1
Female	161.5 ± 5.6	161.5 ± 5.6
Male	177.5 ± 4.6	173.2 ± 7.1
Pre mass (kg)		
All	73.3 ± 14.3	75.5 ± 9.4
Female	63.6 ± 7.1	74.5 ± 10.3
Male	85.1 ± 11.6	77.7 ± 7.7
Post mass (kg)		
All	73.5 ± 14.4	75.4 ± 9.4
Female	63.7 ± 7.1	74.2 ± 10.2
Male	85.5 ± 11.6	77.9 ± 7.6
BMI (kg/m^2)*		
All	25.6 ± 3.3	27.7 ± 3.9
Female	24.3 ± 2.3	28.5 ± 3.8
Male	27.0 ± 3.8	26.1 ± 3.9

*Denoting significant difference between groups ($p = 0.05$).

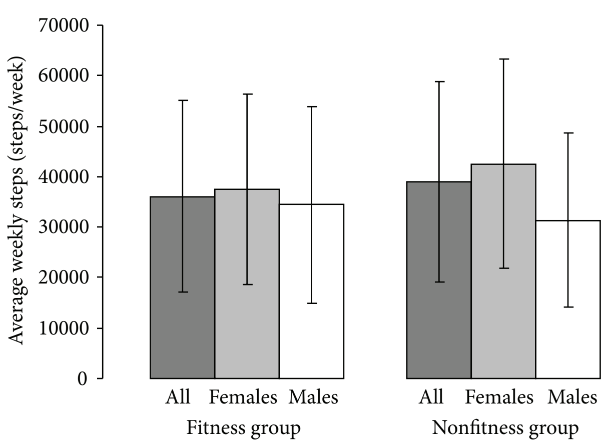

Figure 1: Mean (±SD) of average weekly steps for the participants in the fitness and nonfitness group.

groups ($p = 0.88$). A summary of the descriptive data can be found in Table 1. Also, there was no difference in height between groups ($p = 0.22$). There was no difference between groups for pre body mass ($p = 0.58$), post body mass ($p = 0.60$), or across time ($p = 0.55$). However, BMI was found to be different between groups ($p = 0.05$), with FIT exhibiting a greater BMI than the NFIT group.

3.2. Total Number of Weekly Steps. Analysis of total number of weekly steps between FIT and NFIT exhibited no significant difference ($p = 0.88$; Figure 1). No difference in total number of weekly steps was observed between males and females ($p = 0.27$). Also, no interaction was observed for total weekly steps for sex and group ($p = 0.53$).

Table 2: Correlation table (r^2 values) of total weekly steps and LPAQ MET levels for all subjects and each group.

	Past year	51–65 yrs	35–50 yrs	22–34 yrs	15–21 yrs
All	0.153*	0.040	0.097*	0.034	0.010
Fitness	0.150*	0.030	0.098	0.017	0.037
Nonfitness	0.254*	0.057	0.095	0.132	0.030

*Denoting significant relationship with total weekly steps ($p < 0.05$).

3.3. Lifetime Physical Activity Questionnaire MET Levels. A two-way analysis of variance for group and age with Lifetime Physical Activity Questionnaire (LPAQ) [7] MET levels found no difference between groups ($p = 0.54$) but a significant decrease in activity level with age ($p = 0.01$). There was no significant interaction effect ($p = 0.37$).

A two-way analysis of variance for sex and age with the LPAQ [7] found no difference between sexes ($p = 0.80$), a significant decrease with age ($p = 0.01$), and a significant interaction ($p = 0.003$). The sex by age interaction effect suggests that male activity decline begins after 22–34 years while female activity declines after 35–50 years.

3.4. Comparing Total Weekly Steps and LPAQ MET Levels. Linear least squares regression was performed between total weekly steps and the different age periods with the LPAQ METs per year [7]. Total weekly steps were significantly related for all subjects to the past year MET levels ($p = 0.008$; $r^2 = 0.153$) and 35–50 yr age period ($p = 0.037$; $r^2 = 0.097$). There were no other relationships between total weekly steps and the remaining age periods. All r^2 values are displayed in Table 2.

For FIT participants, total weekly steps were significantly related with past year MET expenditure ($p = 0.038$; $r^2 = 0.150$). For NFIT participants, total weekly steps were significantly related to past year MET expenditures ($p = 0.047$; $r^2 = 0.254$). There were no other relationships between total weekly steps and the remaining age periods within each group. All r^2 values are displayed in Table 2.

3.5. Comparing Pre Body Mass and BMI with Total Weekly Steps. Linear least squares regression values between pre body mass and total weekly steps for all participants were not significantly related ($p = 0.78$; $r^2 = 0.002$). For the FIT group, pre body mass and total weekly steps were not significantly correlated ($p = 0.93$; $r^2 = 0.0003$). With all NFIT participants pre body mass was not related with total weekly steps ($p = 0.39$; $r^2 = 0.053$).

There was no significant relationship between BMI and total weekly steps for all participants ($p = 0.63$; $r^2 = 0.006$). For FIT, BMI was not related with total weekly steps ($p = 0.95$; $r^2 = 0.0002$). Additionally, BMI was not related to total weekly steps for the NFIT group ($p = 0.38$; $r^2 = 0.055$).

4. Discussion

We found no difference in total number of weekly steps between older adults who regularly participate in the exercise facility at a senior center and those who do not use an exercise facility. Depending on the age period, the current study found a relationship between current steps per week and past activity levels over the past year and from the age period of 35–50 years. Additionally, both groups (i.e., FIT and NFIT) were analyzed by sex to determine any sex-related differences in regular physical activity level. No sex-related differences in physical activity level were observed in this study.

Our first hypothesis was not supported by the findings, which indicate no significant difference in the total number of weekly steps taken between those who regularly use and those who do not use an exercise facility (Figure 1). To our knowledge this is the first study to compare weekly step counts in two groups of older adults who do and do not participate in structured exercise. The findings of the current study may be a result of the observations of Whaley and Ebbeck [13] who interviewed older adults at a senior center to find perceived constraints to participating in structured exercise. Nine females and eight males were interviewed to better understand perceived barriers to exercise class participation. The authors reported that older adults might choose to not participate in structured exercise because they are frequently active elsewhere. The researchers found that some older adults would rather walk around the neighborhood, swim, or ride bikes [13]. They also discovered that older adults claimed that they were too busy to exercise or exercise conflicted with other appointments. Some found structured exercise to be inconvenient [13].

Several studies have outlined how important it is for older adults to participate in structured exercise in order to meet exercise guidelines. Rejeski et al. [14] examined the influence of a physical activity intervention program on satisfaction with self-efficacy along with physical function for older adults who ranged in age from 70 to 89 years. The researchers found that older adults who participated in physical activity (aerobic, strength, balance, and flexibility) had better profiles for satisfaction with physical function and self-efficacy for the 400-meter walk compared to those in a successful aging program. In addition, Tudor-Locke et al. [4] found that older adults who participated in structured exercise experienced an increase in physical activity on the exercise program days relative to other days of the week. The researchers found that walking for exercise was the most prevalent form of exercise outside of a structured exercise class [4].

A previous study assessing physical activity levels of older adults using a pedometer recruited 415 participants [15]. Strath et al. [15] wanted to examine walking volume in older adults by examining personal characteristics associated with walking behavior. These authors showed that race and ethnicity significantly influenced one's average steps per day. They noted that African American older adults took approximately 750 fewer steps per day than European American of the same age [15]. The demographics of our FIT and NFIT groups did not differ significantly in this study and consisted of 42 European Americans, two African Americans, and one Asian participant(s). The current study did not recruit a wide range of ethnic diversity, which could be why there was no statistically significant difference between races.

The current study also found that body mass and BMI did not relate to weekly step count in an older adult population. Body mass and total weekly step counts were not significantly related for all study participants ($p = 0.78$). Scott et al. [16] investigated the effects of pedometer use as a means of encouraging and assessing ambulatory activity in a group of older adults. This study was part of a larger cohort study (Tasmanian Older Adult Cohort Study) to look at the progression of osteoarthritis and osteoporosis in older adults aged 50 to 79 years. These authors [16] observed a negative relationship between body fatness and daily step activity ($p < 0.001$, $r = -0.54$). Although we observed no relationship of step activity and BMI for any of the groups, past studies [16, 17] suggesting body fatness or BMI influencing step activity recruited significantly larger and more heterogeneous sample sizes compared to the current study. These studies incorporated younger adults and individuals with a larger variance in body composition compared to the current study population. Therefore, lack of a relationship in weekly step counts and BMI could be attributed to the lack of a large number of overweight or obese subjects in our groups. Strath et al. [15] reported that older adults considered overweight took about 2,000 steps less than those in the normal weight category while those in the obese category took about 2,500 fewer steps than those in the normal weight category. With only 11.1% of the males and 6.6% of the females in the current study being classified as obese with respect to their BMI, we expect that the high number of normal BMI subjects could be influencing our lack of relationship between BMI and total weekly steps.

The second hypothesis of a relationship between past activity levels and current steps per week was only supported by past year MET expenditure and MET expenditure from ages 35 to 50 years. Other studies have found that past sport participation in childhood can lead to lower BMI values in adult women [5]. Also, results from Patel et al. [6] who studied physical activity levels during three age periods in life (20–40 years, 40–60 years, and the past year) indicated that physical activity performed during two of the age periods (ages 20–40 and 40–60 years) was associated with better mobility and slower onset of chronic disease states in older adulthood determined by functional assessments.

The current study observed a significant decrease in activity level with an increase in age. This is in line with past studies [6, 8, 18, 19]. Norman et al. [19] conducted a study that examined recalled physical activity at 15, 30, and 50 years of age in a large sample of older Swedish men. It was concluded that a decrease in physical activity over time was due to a reduction in leisure-time activities [19]. Patel et al. [6] reported that physical activity levels in older adults over the past year were significantly lower than levels reported for midlife. The Centers for Disease Control and Prevention (CDC) has reported the prevalence of leisure-time physical activity declined for the US population from the years 1994 to 2004 [18]. The largest decline was in the older adult population (men aged 50–59 years and women aged 60–69 years) [18]. In addition, Armstrong et al. [8] showed that men and women generally had declining levels of activity across the lifespan.

Friedman et al. [20] argue that activity levels are somewhat stable from childhood into middle and late adulthood. Friedman et al. [20] continued the Terman Life-Cycle Study, which was started in 1922 by Lewis Terman. The original Life-Cycle Study was composed of 1528 mostly middle class European American boys and girls. Subjects' activity levels were followed throughout their lives with assessments every 5 to 10 years. Data were reviewed for subjects born between the years 1904–1915. The researchers concluded that, after studying significant associations across almost six decades, active children grow into active, energetic adults. Friedman et al. [20] also argued that it is not important to know whether individuals are more active than others, but it is more beneficial to understand past activity levels from the last decade in order to understand current activity levels. Our findings are in agreement with this statement by Friedman et al. [20] with the relationship of current activity levels matching past year's MET expenditures.

Lastly, the current study observed no sex differences in total weekly steps between males and females whether they were in the FIT or NFIT group. This finding does not agree with most research. Past research generally indicates that men are more active than women [6, 8–11]. Lee [10] found that women were significantly less active than men in duration of exercise. The study also noted that 26% of older adult males and 12% of older adult females engaged in the recommended amount of physical activity (30 minutes a day, 5 days a week) [10]. In addition, Yasunaga et al. [11] measured physical activity levels in older adults and concluded that older adult men accumulated more step counts than their female counterparts. Armstrong et al. [8] found that walking was greater in older adult males compared to older adult females. However, recent reviews of physical activity by Friedman et al. [20] and Strath et al. [15] reported little difference between sexes in older adult populations. Friedman et al. [20] found patterns of physical activity across the lifespan to be about the same for males and females. Strath et al. [15] found no significant differences between males and females in any race or ethnic category when investigating steps per day in an older adult population.

4.1. Study Limitations. Limitations of this study include the sample population. This research was conducted at a senior center where the majority of individuals were very independent and mostly of high socioeconomic status. Also, the population was all healthy individuals who did not exhibit a wide range of BMI values, with only 11.1% of males and 6.6% of females being categorized as obese. The CDC national averages for BMI in the older adult population show that 32.2% of men and 30.5% of women over the age of 65 years are obese [19]. Additionally, there were few males in the NFIT group. The pedometer was used for the daily assessment of physical activity in our older adult population. Recently Colbert et al. [21] compared the validity values of physical activity measures in older adults using three different activity models. The authors discovered that more expensive devices did not rank physical activity any better than the pedometer, and the pedometer was the most cost-effective method for ranking physical activity level in older adults [21].

Another limitation of this study was the Lifetime Physical Activity Questionnaire (LPAQ) [7]. This questionnaire was used to assess physical and leisure-time activities throughout the lifespan. The decades in which the questionnaire asked about were past activity amounts categorized into different age periods (15–21 years, 22–34 years, 35–50 years, 51–65 years, and the past year). Certain activities and ages may have been missed with this survey tool. For example, an individual who filled out this survey who was 72 years of age was not asked about the age period of 66–71 years. This creates age gaps that could miss pertinent information in regard to lifetime physical activity. Also, with any questionnaire recall can be a problem. Asking an older adult to recall activities they did decades earlier can certainly be a difficult task, especially with regard to intensity levels.

5. Conclusions

In conclusion, no difference was observed in the total number of weekly steps taken by older adults who regularly participate at an exercise facility and those who do not use an exercise facility. This finding suggests that independent-living older adults will seek out and perform weekly physical activity, whether in a scheduled exercise program or with other leisure-time activities. To our knowledge the current study is the first to compare weekly step counts in two groups of older adults who do and do not participate in structured exercise. In addition, using questionnaire recall with the LPAQ [7] we observed that physical activity declined with age (3, 5, 15, and 17) [6, 8, 19]. Using the LPAQ [7] we only observed a relationship between current steps per week and MET expenditure over the past year and from ages 35 to 50 years. Also, the current study observed no sex differences in weekly step count between males and females, for all participants or in the FIT or NFIT group.

Competing Interests

The authors have no conflict of interests to declare.

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References

[1] M. M. Fahlman, R. Topp, N. McNevin, A. L. Morgan, and D. J. Boardley, "Structured exercise in older adults with limited functional ability," *Journal of Gerontological Nursing*, vol. 33, no. 6, pp. 32–39, 2007.

[2] Y. Nakamura, K. Tanaka, N. Yabushita, T. Sakai, and R. Shigematsu, "Effects of exercise frequency on functional fitness in older adult women," *Archives of Gerontology and Geriatrics*, vol. 44, no. 2, pp. 163–173, 2007.

[3] K. R. Fox, A. Stathi, J. McKenna, and M. G. Davis, "Physical activity and mental well-being in older people participating

in the Better Ageing Project," *European Journal of Applied Physiology*, vol. 100, no. 5, pp. 591–602, 2007.

[4] C. Tudor-Locke, G. R. Jones, A. M. Myers, D. H. Paterson, and N. A. Ecclestone, "Contribution of structured exercise class participation and informal walking for exercise to daily physical activity in community-dwelling older adults," *Research Quarterly for Exercise and Sport*, vol. 73, no. 3, pp. 350–356, 2002.

[5] C. M. Alfano, R. C. Klesges, D. M. Murray, B. M. Beech, and B. S. McClanahan, "History of sport participation in relation to obesity and related health behaviors in women," *Preventive Medicine*, vol. 34, no. 1, pp. 82–89, 2002.

[6] K. V. Patel, A. K. Coppin, T. M. Manini et al., "Midlife Physical Activity and Mobility in Older Age. The InCHIANTI Study," *American Journal of Preventive Medicine*, vol. 31, no. 3, pp. 217–224, 2006.

[7] L. Chasan-Taber, J. B. Erickson, J. W. McBride, P. C. Nasca, S. Chasan-Taber, and P. S. Freedson, "Reproducibility of a self-administered lifetime physical activity questionnaire among female college alumnae," *American Journal of Epidemiology*, vol. 155, no. 3, pp. 282–289, 2002.

[8] T. Armstrong, A. Bauman, and J. Davies, *Physical Activity Patterns of Australian Adults: Results of the 1999 National Physical Activity Survey*, Australian Institute of Health and Welfare, Canberra, Australia, 2000.

[9] A. M. Kavanagh and R. Bentley, "Walking: a gender issue?" *Australian Journal of Social Issues*, vol. 43, no. 1, pp. 45–64, 2008.

[10] Y.-S. Lee, "Gender differences in physical activity and walking among older adults," *Journal of Women and Aging*, vol. 17, no. 1-2, pp. 55–70, 2005.

[11] A. Yasunaga, F. Togo, E. Watanabe et al., "Sex, age, season, and habitual physical activity of older Japanese: the Nakanojo Study," *Journal of Aging and Physical Activity*, vol. 16, no. 1, pp. 3–13, 2008.

[12] B. E. Ainsworth, W. L. Haskell, M. C. Whitt et al., "Compendium of physical activities: an update of activity codes and MET intensities," *Medicine and Science in Sports and Exercise*, vol. 32, no. 9, pp. S498–S504, 2000.

[13] D. E. Whaley and V. Ebbeck, "Older adults' constraints to participation in structured: exercise classes," *Journal of Aging and Physical Activity*, vol. 5, no. 3, pp. 190–212, 1997.

[14] W. J. Rejeski, A. C. King, J. A. Katula et al., "Physical activity in prefrail older adults: confidence and satisfaction related to physical function," *Journals of Gerontology: Psychological Sciences and Social Sciences*, vol. 63, no. 1, pp. P19–P26, 2008.

[15] S. J. Strath, A. M. Swartz, and S. E. Cashin, "Ambulatory physical activity profiles of older adults," *Journal of Aging and Physical Activity*, vol. 17, no. 1, pp. 46–56, 2009.

[16] D. Scott, L. Blizzard, J. Fell, and G. Jones, "Ambulatory activity, body composition, and lower-limb muscle strength in older adults," *Medicine and Science in Sports and Exercise*, vol. 41, no. 2, pp. 383–389, 2009.

[17] C. Tudor-Locke, D. R. Bassett Jr., W. J. Rutherford et al., "BMI-referenced cut points for pedometer-determined steps per day in adults," *Journal of Physical Activity and Health*, vol. 5, no. 1, pp. S126–S139, 2008.

[18] Centers for Disease Control and Prevention, "Trends in leisure-time physical inactivity by age, sex, and race/ethnicity—United States, 1994–2004," *Morbidity and Mortality Weekly Report*, vol. 54, no. 39, pp. 991–994, 2005.

[19] A. Norman, R. Bellocco, F. Vaida, and A. Wolk, "Age and temporal trends of total physical activity in Swedish men," *Medicine and Science in Sports and Exercise*, vol. 35, no. 4, pp. 617–622, 2003.

[20] H. S. Friedman, L. R. Martin, J. S. Tucker, M. H. Criqui, M. L. Kern, and C. A. Reynolds, "Stability of physical activity across the lifespan," *Journal of Health Psychology*, vol. 13, no. 8, pp. 1092–1104, 2008.

[21] L. H. Colbert, C. E. Matthews, T. C. Havighurst, K. Kim, and D. A. Schoeller, "Comparative validity of physical activity measures in older adults," *Medicine and Science in Sports and Exercise*, vol. 43, no. 5, pp. 867–876, 2011.

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Research Article

Effect of Electronic Messaging on Physical Activity Participation among Older Adults

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The purpose of this study was to determine if electronic messaging would increase min of aerobic physical activity (PA) among older adults. Participants were active older adults ($n = 28$; M age = 60 years, SD = 5.99, and range = 51–74 years). Using an incomplete within-subjects crossover design, participants were randomly assigned to begin the 4-week study receiving the treatment condition (a morning and evening text message) or the control condition (an evening text message). Participants self-reported min of completed aerobic PA by cell phone text. The 1-way within-subjects ANOVA showed significant group differences ($p < 0.05$). Specifically, when participants were in the treatment condition, they reported significantly greater average weekly min of aerobic PA (M = 96.88 min, SD = 62.9) compared to when they completed the control condition (M = 71.68 min, SD = 40.98). Electronic messaging delivered via cell phones was effective at increasing min of aerobic PA among older adults.

1. Introduction

Regular physical activity (PA) has many physical and mental health benefits for older adults including lowering the risk of early death, improving bone health, increasing cardiorespiratory and muscular fitness, decreasing levels of body fat, and reducing anxiety and depression [1]. To achieve these benefits, the 2008 Physical Activity Guidelines for Americans (PAG) recommend that adults should complete 150 min a week of moderate intensity aerobic PA or 75 min a week of vigorous intensity aerobic PA (or a combination of both), as well as two days a week of muscle strengthening activities [2]. PA participation progressively declines as people age, and currently only 17.1% and 15.9% of adults 55–64 years and 65 years and older, respectively, meet these guidelines; therefore, interventions to increase PA participation among older adults are warranted [3].

Meta-analytic evidence demonstrated that interventions are effective for increasing PA participation [4, 5], and specific characteristics of the intervention produced larger effects on behavior. For instance, in a review of 141 studies, Dishman and Buckworth [5] found significantly larger effect sizes for interventions that used behavior modification strategies such as reinforcement, stimulus control, or behavioral contracts ($r = 0.92$ weighted; $r = 0.56$ not weighted) and for those that were delivered using a mediated approach via indirect implementation through mailings or telecommunications ($r = 0.91$ weighted; $r = 0.41$ not weighted). Behavior modification techniques are based on the premise that the antecedents and consequences (including expected consequences) of the activity influence behavior [6]. Stimulus control involves manipulating environmental conditions, such as using prompts or reminders to decrease the problem behavior (physical inactivity) and increase the targeted behavior (PA participation [6]) and this strategy has frequently been incorporated into health behavior interventions.

In a systematic review of 19 weight loss, PA, and diet interventions that used periodic prompts, Fry and Neff [7] found that 11 studies reported positive intervention effects. The type of prompt (i.e., messages, reminders, and feedback), delivery periodicity (i.e., delivered daily, weekly, or monthly), and method of administration (i.e., sent using e-mail, telephone, and mail) were examined to determine which prompt characteristics had the greatest impact on behavior change. Of the 11 studies with positive results, 5 studies showed significant increases in PA when messages were delivered weekly by telephone and e-mail. Overall, these findings demonstrated that prompts delivered periodically are effective for promoting behavior change, and specifically can increase PA participation. Furthermore, Fry and Neff [7] acknowledge that the use of mobile technology as an alternative method for prompt delivery may be another cost-effective way to promote behavior change that warrants future research.

The use of cell phones, and specifically text messaging, to prompt PA participation is advantageous for promoting healthy behaviors because (a) there is a high penetration of mobile telephones across income and ethnic groups; (b) mobile phones are popular, portable, and convenient; and (c) information can be delivered quickly [8]. Gerber et al. [8] found that participants reported positive feedback and attitudes toward text messaging as a way to cultivate healthy behaviors. In a review of 14 health behavior change interventions that were delivered via mobile telephone short-message service (SMS) text messages, Fjeldsoe et al. [9] observed significant positive behavioral changes in 8 studies, and an additional 5 studies demonstrated positive behavior trends using SMS as a reminder to increase adherence to treatment programs.

Fanning et al. [10] conducted a recent meta-analysis of 11 studies that used mobile devices to increase PA. Specifically, interventions were delivered via SMS (eight studies), mobile software (four studies), and a personal digital assistant (PDA; two studies). The results of the meta-analysis showed that interventions delivered via mobile devices produced significant moderate effects on PA behavior ($g = 0.54$, 95% CI = 0.17 to 0.91, and $p = 0.01$). Moreover, a significant moderate effect was found for those interventions delivered with a mobile phone ($g = 0.52$, 95% CI = 0.11 to 0.94, and $p = 0.01$). However, of the 11 studies reviewed, only 2 reported samples with an average age of at least 60 years [11, 12].

King et al. [11] compared an intervention group that received a programmed alert on their PDA twice a day to a control group that received standard health educational written materials about PA. They found significantly larger increases in PA among older-aged adults when the intervention was delivered via a handheld computer (i.e., PDA). Nguyen et al. [12] compared a mobile self-monitored group to a mobile coached group that sent daily text message updates on exercise and symptoms of COPD. In return, both groups received a weekly thank-you standard text message. However, the mobile self-monitored group did not receive personalized feedback regarding exercise and symptoms of COPD. Although both groups increased PA, the mobile self-monitored group showed significant improvements in total steps per day compared to the mobile coached group. Therefore, using cell phones as a way to merge communication technologies with intervention strategies to increase PA participation in adults warrants more research in general and specifically among older adults.

To date, a limited number of research studies have examined the use of mobile technology to promote PA among adults aged 50 years and older [13–15]. Now that many older adults own and use a mobile phone, the purpose of this study was to determine if electronic prompts delivered via cell phones would increase min of aerobic PA among adults aged 50 years and older. It was hypothesized that participants would report significantly greater average weekly min of aerobic PA during the intervention condition than when they were in the control condition.

2. Methods

2.1. Participants. Participants were recruited from a certified personal training studio within the Metro-Atlanta area. Study participants met the following inclusion criteria: (1) 50 years of age or older, (2) worked with a personal trainer for at least six consecutive months, (3) currently working with a personal trainer at least twice a week for strength training, but did not meet the PAG for weekly aerobic PA, and (4) able to send and receive e-mail and/or text messages from a cell phone during a 4-week period. Thirty volunteers signed the university IRB approved informed consent form and were given information about the study. Volunteers were between 51 and 74 years of age.

2.2. Design and Procedures. This study used an incomplete within-subjects crossover design with counterbalancing of conditions to control for carryover effects between the treatment and control conditions. At the beginning of the 4-week period, the Principal Investigator (PI; the first author) met face to face with each volunteer for about 15 min. During the meeting, the PI explained and received a signature on the informed consent form. Participants also completed the personal history questionnaire. Participants were then randomly assigned to the treatment condition (Group 1) or the control condition (Group 2). During the first two weeks of the study, Group 1 (treatment condition) participants received a morning and evening text message to prompt aerobic PA three days a week. The morning prompt stated "Don't forget to do cardio today" and the evening prompt stated "Did you do your cardio today?" Prompting aerobic PA three days a week was chosen to supplement the two days a week of strength training participants were completing with their personal trainers. Although the participants were not currently meeting the PAG of 150 min a week of aerobic PA, the objective of the research was to test the efficacy of the intervention for increasing weekly min of aerobic PA, not necessarily to achieve 150 min or more. Participants in Group 2 (control condition) received only the evening text message (i.e., "Did you do your cardio today?") three days a week for two weeks.

All participants completed the electronic PA participation form by cell phone e-mail or text message on the days the text messages were received. Participants were informed that with a "*yes*" response to the evening message, they should report the type of aerobic PA, duration in min, and intensity (moderate or vigorous). With a "*no*" response to the evening message, participants were asked to report the reason for not performing aerobic PA (e.g., barriers). At the end of the first two weeks, participants crossed over to the other condition (i.e., Group 1 completed the control condition and Group 2 completed the treatment condition) and the procedures were executed exactly the same as described during the first two weeks.

2.3. Measures

2.3.1. Personal History Questionnaire. Participants reported age, gender, marital status, race/ethnicity, education, and income. Marital status was categorized as married and other (e.g., domestic partner, single, widowed, and divorced); race/ethnicity was categorized as White and other (e.g., Hispanic or Latino); education was categorized as high school or less, some college or associate's degree, and bachelor's degree or more; and income was categorized as low (<$1306 per month), medium ($1307–$1836 per month), high (≥$25,000 per year), and not reported.

2.3.2. Electronic Physical Activity Participation Form. The electronic PA participation form was used to record the participants' responses to the evening text message during the treatment and control conditions (i.e., "Did you do your cardio today? If yes, what did you do and if no, why not?"). Participants who reported "*yes*" to the completion of aerobic PA provided the type performed (walk, bike, swim, etc.), duration in min, and intensity (moderate or vigorous). Participants who reported "*no*" to the completion of aerobic PA reported barriers that prevented them from engaging in aerobic PA (e.g., no time, work, bad weather, etc.).

2.4. Analyses. Tests of outliers and normality were conducted. Participant demographic characteristics were described using frequencies, means, and standard deviations. If outliers were identified and removed from the sample, ANOVA and Chi-square were used to compare group differences between the outliers and remaining sample across demographic variables (e.g., age, gender, marital status, race, education level, and income level). ANOVA and Chi-square were also used to examine group differences across demographic variables between the participants who began the study in Group 1 (treatment condition) and those who began the study in Group 2 (control condition). Self-reported weekly min of aerobic PA and barriers to aerobic PA were summarized using frequencies. Weekly min of aerobic PA were categorized as 0–29 min, 30–59 min, 60–89 min, 90–119 min, 120–149 min, and 150 min or more. Finally, a 1-way within-subjects ANOVA was used to determine significant differences in average weekly min of aerobic PA by condition. SPSS version 18.0 was used to perform all data analyses denoting a statistically significant value of alpha levels at $p < 0.05$.

3. Results

Thirty older adults volunteered to participate in the study; however, two were identified as multivariate outliers and removed from the analyses. There were no significant group differences between the outliers and the remaining sample across demographic characteristics except on income level. One of the participants removed as an outlier reported a significantly lower income level (e.g., $1306 or less monthly versus $25,000 or more annually) than the other study participants, χ^2 (2, $N = 30$) = 14.63, $p = 0.001$; however, it should be noted this was the only volunteer in the sample who reported low income. The final sample included 28 male and female older adults (M age = 60 years, SD = 5.99, Range = 51–74 years; see Table 1). There were no significant group differences between the participants initially randomized into Group 1 (treatment condition) and those who began the study in Group 2 (control condition) across demographic characteristics.

The weekly min of aerobic PA for Group 1 and Group 2 were summarized using frequencies (see Table 2). The 1-way within-subjects ANOVA showed significant differences between conditions on total min of aerobic PA, Wilks' Lambda = 0.82, $F(1, 27) = 5.76$, $p = 0.024$, $\eta p^2 = 0.18$, and observed power = 0.64. Specifically, while participants were in the treatment condition they reported significantly greater average weekly min of aerobic PA (M = 96.88 min, SD = 62.90) compared to when they were in the control condition (M = 71.68 min, SD = 40.98; see Figure 1).

There were seven common barriers reported among participants that prevented them from engaging in aerobic PA (see Figure 2). The most commonly reported barriers during the treatment condition were (a) did not make time (31%) and (b) work (31%) and the most commonly reported barriers to aerobic PA during the control condition were (a) did not make time (28%), (b) work (26%), and (c) not feeling well (e.g., sick/injury; 18%).

4. Discussion

The purpose of this study was to determine if electronic prompts on cell phones would increase aerobic PA participation among adults aged 50 years and older. Average weekly min of aerobic PA were significantly greater during the treatment condition than during the control condition. Although future studies are warranted, current findings are consistent with previous research in that prompts effectively increase PA behavior and demonstrate the promise of using cell phone technology to deliver prompts to older adults. The clinical implications of these findings suggest that this is a feasible and effective intervention strategy for promoting aerobic PA among those 50 years and older who are members and regular users of fitness facilities because this intervention strategy was tested in a real-world setting.

As hypothesized, participants reported significantly greater average weekly min of aerobic PA during the treatment condition when they received the electronic reminder in the morning than during the control condition when the morning reminder was not delivered, and this treatment effect ($p = 0.024$; $\eta p^2 = 0.18$) was found despite a small sample size and reduced statistical power (0.64). These results are consistent with previous research that demonstrated the effectiveness of prompt interventions with mediated delivery [5, 7–10]. A recent meta-analysis by Fanning et al. [10] found a significant moderate effect for physical activity interventions that were specifically delivered via mobile phones; however, few of the studies reviewed included older adults. Therefore, the findings from this study extend the literature by providing evidence that electronic prompts delivered via cell phones can also be a successful strategy for increasing PA levels among adults aged 50 years and older.

Table 1: Demographics for Group 1 and Group 2 participants.

Characteristic	Group 1 (n = 13) M (SD)		Group 2 (n = 15) M (SD)		Total (n = 28) M (SD)	
Age	58.23 (6.59)		61.60 (5.15)		60.04 (5.99)	
Gender						
Male	$n = 2$	15.4%	$n = 3$	20.0%	$n = 5$	17.9%
Female	$n = 11$	84.6%	$n = 12$	80.0%	$n = 23$	82.1%
Marital status						
Married	$n = 7$	53.8%	$n = 13$	86.7%	$n = 20$	71.4%
Other	$n = 6$	46.2%	$n = 2$	13.3%	$n = 8$	28.6%
Race						
White	$n = 12$	92.3%	$n = 15$	100%	$n = 27$	96.4%
Other	$n = 1$	7.7%			$n = 1$	3.6%
Education level						
High school or less	$n = 2$	15.4%	$n = 1$	6.7%	$n = 1$	3.6%
Some college or associate's degree	$n = 11$	84.6%	$n = 4$	26.7%	$n = 6$	21.4%
Bachelor's degree or more			$n = 10$	66.7%	$n = 21$	75.0%
Income level						
$25,000 or more annually	$n = 12$	92.3%	$n = 10$	66.7%	$n = 22$	78.6%
Did not report	$n = 1$	7.7%	$n = 5$	33.3%	$n = 6$	21.4%
History of disease*						
Cardiovascular	$n = 3$	23.1%	$n = 2$	13.3%	$n = 5$	17.9%
Cancer	$n = 0$	0.0%	$n = 3$	20.0%	$n = 3$	10.7%
Thyroid	$n = 0$	0.0%	$n = 3$	20.0%	$n = 3$	10.7%
Bone	$n = 1$	7.7%	$n = 1$	6.7%	$n = 2$	7.1%
Spine	$n = 2$	15.4%	$n = 0$	0.0%	$n = 2$	7.1%
Other	$n = 3$	23.1%	$n = 2$	13.3%	$n = 5$	17.9%
No disease reported	$n = 6$	46.2%	$n = 5$	33.3%	$n = 11$	39.3%

Note. Group 1 = treatment condition first. Group 2 = control condition first. *Frequencies may not equal total sample sizes or 100% because 3 participants reported 2 illnesses.

Table 2: Weekly min of aerobic physical activity for Group 1 and Group 2 participants.

Categories	0–29 min		30–59 min		60–89 min		90–119 min		120–149 min		≥150 min	
Week 1												
Group 1 (TX)	$n = 2$	15.4%	$n = 3$	23.1%	$n = 1$	7.7%	$n = 1$	7.7%	$n = 4$	30.8%	$n = 2$	15.4%
Group 2	$n = 1$	6.7%	$n = 5$	33.3%	$n = 3$	20.0%	$n = 3$	20.0%	$n = 1$	6.7%	$n = 2$	13.3%
Week 2												
Group 1 (TX)	$n = 2$	15.4%	$n = 2$	15.4%	$n = 2$	15.4%	$n = 2$	15.4%	$n = 1$	7.7%	$n = 4$	30.8%
Group 2	$n = 4$	26.7%	$n = 1$	6.7%	$n = 3$	20.0%	$n = 2$	13.3%	$n = 4$	26.7%	$n = 1$	6.7%
Week 3												
Group 1	$n = 2$	15.4%	$n = 3$	23.1%	$n = 2$	15.4%	$n = 6$	46.2%	$n = 0$	0.0%	$n = 0$	0.0%
Group 2 (TX)	$n = 5$	33.3%	$n = 1$	6.7%	$n = 3$	20.0%	$n = 0$	0.0%	$n = 3$	20.0%	$n = 3$	20.0%
Week 4												
Group 1	$n = 3$	23.1%	$n = 4$	30.8%	$n = 3$	23.1%	$n = 1$	7.7%	$n = 1$	7.7%	$n = 1$	7.7%
Group 2 (TX)	$n = 1$	6.7%	$n = 3$	20.0%	$n = 1$	6.7%	$n = 1$	6.7%	$n = 7$	46.7%	$n = 2$	13.3%

Note. TX = treatment condition. Group 1 (n = 13) = treatment condition first. Group 2 (n = 15) = control condition first.

In addition to examining the use of electronic messaging via cell phones to increase PA participation among older adults, common barriers to aerobic PA participation were recorded. The most common barriers during both conditions were "did not make time" and "work," which are consistent with previous research [16]. However, fewer barriers were reported while participants were in the treatment intervention ($n = 32$) than in the control ($n = 39$), suggesting that

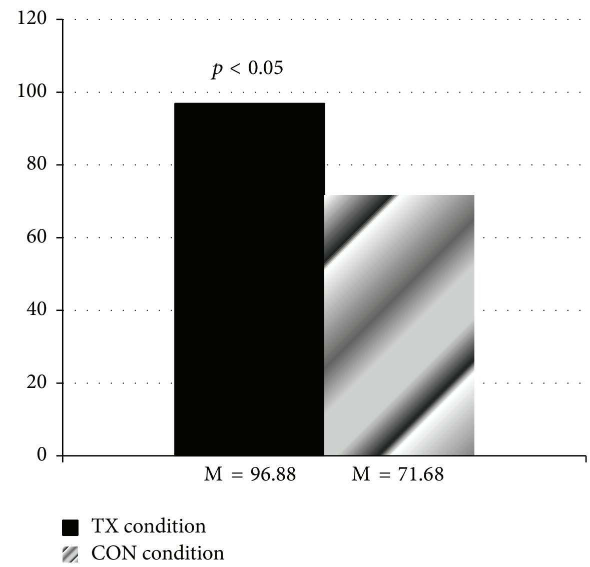

Figure 1: Average weekly min of aerobic physical activity. TX = treatment condition. CON = control condition.

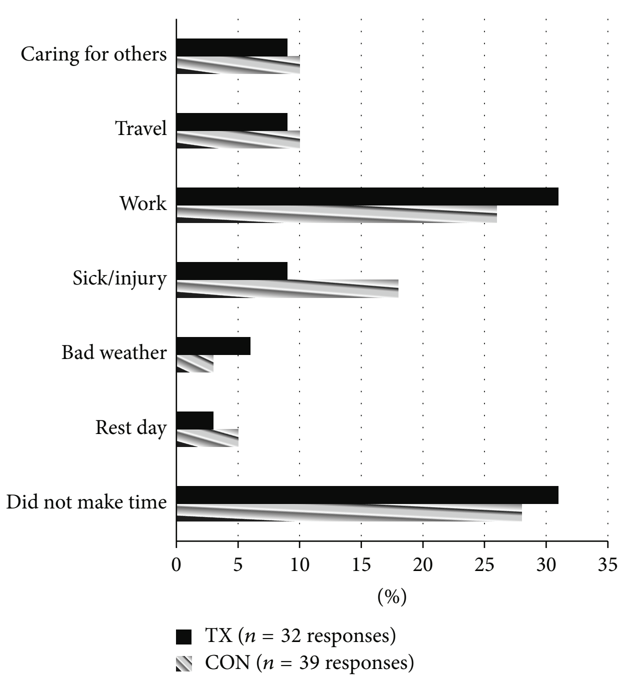

Figure 2: Barriers to aerobic physical activity. TX = treatment condition. CON = control condition.

the electronic prompts may have assisted with barrier removal. These findings show promise for using electronic prompts delivered via cell phones to increase PA participation as well as to assist with barrier removal.

Although the results of this study suggest that use of electronic prompts delivered via cell phones to promote aerobic PA among older adults is effective, it is not without limitations. First, the generalizability of the findings is limited to a small sample of mostly White, wealthy, well-educated women with access to cell phones who were already physically active (e.g., working with a personal trainer for strength training) and relatively healthy; however, it should be noted that the study sample was representative of the facility population from which volunteers were recruited. Moreover, the study sample was similar to samples included in previous studies that used mobile devices to prompt PA among older adults [11, 12]. These studies also included small samples of mostly White women that held at least a bachelor's degree and earned more than $50,000 a year with an average age of 60 years or more. Second, within a crossover design, although participants were randomized into Group 1 and Group 2, contamination between the groups did occur in participants that partnered together during personal training sessions. Specifically, a husband and wife pair began the study in opposite groups, and the husband in Group 1 asked his wife in Group 2 to walk with him. This contamination may have resulted in increased PA among the control participants.

Finally, the duration of the intervention and the frequency of the electronic prompt delivery may be considered inadequate despite the demonstration of positive results. However, this intervention should be viewed in the context of previous research that shares similar characteristics and also demonstrated the effectiveness of prompts for changing behavior. For instance, interventions that were less than six weeks were included in the Fry and Neff [7] review (see [17, 18]), and the frequency of electronic prompt delivery in this study is within a range of frequencies (e.g., daily, once a week, and once a month) found in studies included in the Fry and Neff [7] and Fjeldsoe et al. [9] reviews (see [11, 12, 17, 19, 20]). In addition, it should be noted that during the treatment condition participants were averaging about 32 min of aerobic PA per bout (6 bouts during 2-week condition) versus 24 min of aerobic PA during the control condition. These values suggest that if the treatment had been delivered 5 times per week, participants were on track to meet the 150 weekly min of aerobic activity. Although longer interventions are necessary to determine the effectiveness of electronic prompts for the maintenance of aerobic PA in older adults, the evidence is promising for the effects of this strategy for promoting adoption and short-term aerobic PA.

5. Conclusions

Few studies have examined electronic prompts on cell phones to increase PA participation among older adults [13–15], and few have been tested in real-world settings. The results of this study are consistent with previous research and indicate that electronic prompts can increase aerobic PA among older adults and may assist with barrier removal. Future research interventions using mobile technology are needed to confirm the study findings using a randomized between-subjects design with a larger sample size of older adults across different income levels, educational backgrounds, ethnicities, and health status. Future research interventions should also test the use of the video components (i.e., FaceTime and Skype) of mobile technology for prompt delivery. In summary, the use of electronic prompts on cell phones may be a feasible, cost-effective, and convenient method to increase aerobic PA among older adults. Physicians, physical therapists, and personal trainers may want to consider integrating mobile technology into their practice by using cell phones to deliver reminder, informational, and even instructional prompts to patients and clients.

Competing Interests

There is no financial conflict of interests to report. It should be noted that Chantrell Antoine Parker was an employee at BodyFitz when this research was conducted.

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References

[1] US Department of Health and Human Services, National Institute on Aging, 2011, http://nihseniorhealth.gov/exerciseforolderadults/toc.html.

[2] U.S. Department of Health and Human Services, "*Physical activity guidelines for Americans*," 2008, http://www.health.gov/paguidelines/guidelines/summary.aspx.

[3] Centers for Disease Control and Prevention, "Adult participation in aerobic and muscle strengthening physical activities: United States, 2011," *Morbidity and Mortality Weekly Report (MMWR)*, vol. 62, no. 17, pp. 326–330, 2013.

[4] V. S. Conn, A. R. Hafdahl, and D. R. Mehr, "Interventions to increase physical activity among healthy adults: meta-analysis of outcomes," *American Journal of Public Health*, vol. 101, no. 4, pp. 751–758, 2011.

[5] R. K. Dishman and J. Buckworth, "Increasing physical activity: a quantitative synthesis," *Medicine & Science in Sports & Exercise*, vol. 28, no. 6, pp. 706–719, 1996.

[6] J. M. Williams, Ed., *Applied Sport Psychology: Personal Growth to Peak Performance*, Mayfield Publishing Company, Mountain View, Calif, USA, 2001.

[7] J. P. Fry and R. A. Neff, "Periodic prompts and reminders in health promotion and health behavior interventions: systematic review," *Journal of Medical Internet Research*, vol. 11, no. 2, pp. e16–e52, 2009.

[8] B. S. Gerber, M. R. Stolley, A. L. Thompson, L. K. Sharp, and M. L. Fitzgibbon, "Mobile phone text messaging to promote healthy behaviors and weight loss maintenance: a feasibility study," *Health Informatics Journal*, vol. 15, no. 1, pp. 17–25, 2009.

[9] B. S. Fjeldsoe, A. L. Marshall, and Y. D. Miller, "Behavior change interventions delivered by mobile telephone short-message service," *American Journal of Preventive Medicine*, vol. 36, no. 2, pp. 165–173, 2009.

[10] J. Fanning, S. P. Mullen, and E. Mcauley, "Increasing physical activity with mobile devices: a meta-analysis," *Journal of Medical Internet Research*, vol. 14, no. 6, pp. e161–e177, 2012.

[11] A. C. King, D. K. Ahn, B. M. Oliveira, A. A. Atienza, C. M. Castro, and C. D. Gardner, "Promoting physical activity through hand-held computer technology," *American Journal of Preventive Medicine*, vol. 34, no. 2, pp. 138–142, 2008.

[12] H. Q. Nguyen, D. P. Gill, S. Wolpin, B. G. Steele, and J. O. Benditt, "Pilot study of a cell phone-based exercise persistence intervention post-rehabilitation for COPD," *International Journal of Chronic Obstructive Pulmonary Disease*, vol. 4, pp. 301–313, 2009.

[13] D. Bossen, C. Veenhof, K. E. Van Beek, P. M. Spreeuwenberg, J. Dekker, and D. H. De Bakker, "Effectiveness of a web-based physical activity intervention in patients with knee and/or hip osteoarthritis: randomized controlled trial," *Journal of Medical Internet Research*, vol. 15, no. 11, article e257, 2013.

[14] B. H. Kim and K. Glanz, "Text messaging to motivate walking in older african americans: a randomized controlled trial," *American Journal of Preventive Medicine*, vol. 44, no. 1, pp. 71–75, 2013.

[15] M. Tabak, H. Op den Akker, and H. Hermens, "Motivational cues as real-time feedback for changing daily activity behavior of patients with COPD," *Patient Education and Counseling*, vol. 94, no. 3, pp. 372–378, 2014.

[16] J. Salmon, D. Crawford, N. Owen, A. Bauman, and J. F. Sallis, "Physical activity and sedentary behavior: a population-based study of barriers, enjoyment, and preference," *Health Psychology*, vol. 22, no. 2, pp. 178–188, 2003.

[17] A. Prestwich, M. Perugini, and R. Hurling, "Can implementation intentions and text messages promote brisk walking? A randomized trial," *Health Psychology*, vol. 29, no. 1, pp. 40–49, 2010.

[18] R. Sirriyeh, R. Lawton, and J. Ward, "Physical activity and adolescents: an exploratory randomized controlled trial investigating the influence of affective and instrumental text messages," *British Journal of Health Psychology*, vol. 15, no. 4, pp. 825–840, 2010.

[19] P. P. Cheung, B. C. Chow, and G. Parfitt, "Using environmental stimuli in physical activity intervention for school teachers: a pilot study," *International Electronic Journal of Health Education*, vol. 11, pp. 47–56, 2008.

[20] R. Hurling, M. Catt, M. De Boni et al., "Using internet and mobile phone technology to deliver an automated physical activity program: randomized controlled trial," *Journal of Medical Internet Research*, vol. 9, no. 2, article e7, 2007.