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Environmental Changes to Promote Physical Activity and Healthy Dietary Behavior

Guest Editors: S. P. J. Kremers, F. F. Eves, and R. E. Andersen

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Editorial Board

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Editorial

Environmental Changes to Promote Physical Activity and Healthy Dietary Behavior

S. P. J. Kremers,[1] F. F. Eves,[2] and R. E. Andersen[3]

[1] *Department of Health Promotion, NUTRIM School for Nutrition, Toxicology and Metabolism, Maastricht University Medical Centre, 6200 MD Maastricht, The Netherlands*
[2] *School of Sport & Exercise Sciences, the University of Birmingham, Birmingham B15 2TT, UK*
[3] *Department of Kinesiology and Physical Education and School of Medicine, McGill University, Montreal, QC, Canada H2W 1S4*

Correspondence should be addressed to S. P. J. Kremers, s.kremers@maastrichtuniversity.nl

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This special issue is devoted to the study of environments that make physical activity and/or healthy dietary behaviors more likely. Empirical evidence regarding the influence of environmental factors on physical activity and dietary behavior is growing rapidly. The evidence base, however, is typically built on (cross-sectional) studies, based on self-reports. There is a dearth of studies with a longitudinal design and proper measurements of the environment, as well as studies that apply isolated (small-scale) environmental manipulations or those that involve (large-scale) intersectoral collaborations in the implementation of sustained environmental interventions. The papers in this special issue address a wide variety of studies towards environmental influences on dietary behavior and physical activity. For example, studies in this special issue are aimed at developing good measurement instruments, applying systematic observations, longitudinal research designs, or focusing at environmental interventions and intersectoral collaboration. Multiple distinct target groups, settings, and behaviors are examined. The effects on children and adolescents as well as adults were included in this special issue. Some papers concern only the physical activity environment or only the dietary behavior environment, while other investigations reflect environments with a focus on both physical activity and diet. While reading the special issue, the reader will note that the settings investigated include the neighborhood environment, the school environment, child care, health care setting, food stores, and local government.

Studies such as those presented in this volume will help us design interventions and health policies that change the environment in order to make physical activity and healthy dietary behavior more likely. In this respect, it is encouraging to realize that relatively small changes to cues in the physical environment may induce relatively large behavioral changes. Environmental changes, sometimes referred to as "nudges", can be separated meaningfully into two different approaches. Passive nudges involve changes to the choice architecture of the environment to bias choices away from unhealthy options. Thus, changing the layout of cafeteria food [1] or even the positioning of items on the menu [2] can bias behavior towards more healthy choices. Similarly, stairs that are reached before an escalator are more likely to be chosen by pedestrians leaving a station on the way to work [3]. Of these two examples, it is clear that retrofitting the physical activity landscape towards more physically active choices would entail considerably more costs than reconfiguring the choice architecture of the canteen environment. Conversely, changing the pricing structure of meal choices (e.g., [4]) entails greater costs than changing the speed at which elevators transport individuals within a building [5] or restricting the number of floors at which elevators stop [6] to promote stair usage. Environmental changes cannot be considered in isolation from issues of costeffectiveness, and the latter often requires action at a policy level.

Active environmental nudges involve positioning of prompts in the environment at the time choice is made to

Table 1: Physical, social-cultural, economic, and political environmental changes to promote healthy dietary behavior and physical activity (PA).

	Physical	Social-cultural	Economic	Political
Food	Nutrition labeling Point-of-purchase prompts Placing of healthy foods in more prominent places Increasing availability and accessibility of healthy foods Decreasing the availability and accessibility of unhealthy foods Restricting the use of logos Restricting the scheduling of commercials promoting unhealthy food to children	Providing social norm feedback Increasing visibility of healthy role models Facilitating healthy food group activities	Decreasing the price of healthy food Increasing the price of unhealthy food	Implementing policies towards the provision of physical, social, and economic environmental changes Rewarding healthy food choices Punishing unhealthy food choices Changes in the laws governing advertising
Physical activity	Point-of choice prompts Tailoring prompts to target certain populations Increasing attractiveness of the PA environment Decreasing the availability and accessibility of inactive choices Placing of active alternatives (e.g., stairs) at more prominent places Increasing visibility of active alternatives Increasing availability and accessibility of active alternatives	Providing social norm feedback Increasing visibility of healthy models Facilitating group PA activities	Decreasing price of structured PA activities Increasing the cost of car parking Congestion charging in major cities Fair subsidies for public transport	Implementing policies towards the provision of physical, social, and economic environmental changes Provision of pedestrianized areas Rewarding physically active alternatives Punishing choices for physically inactive alternatives Transport planning

encourage more healthy choices. Thus, point-of-purchase labeling of calorific content of food (e.g., [7]) and point-of-choice prompts for stair climbing (e.g., [8]) provide health relevant information in the environment when the choice is considered. We term these "active" nudges because they remind individuals of the health plans that they may have made before encountering the choice point. As such, active nudges require individuals to have a prior intention or plan to change behavior [8, 9] and the prompts remind individuals of these prior plans at the time choice is made. These active nudges can link to health promotion policy at the government level that disseminates information on behavior and health. Changes to the visibility of healthy alternatives such as prominent displays of fruit and vegetables can also be termed active in that they can link to prior planning, though they provide no explicit reminder about an individual's prior planning to encourage active consideration of the healthy alternative to counter the prominent effects of taste on food choice [10]. In contrast, curtailing the provision of sweets at the supermarket checkout removes cues to consumption in the environment, in effect, passively nudging consumers away from unhealthy choice by removing it. Of course, curtailing availability of cues or enforcing menu labeling (e.g., [7]) requires action at the policy level.

Environmental changes in microenvironmental settings (e.g., supermarkets, schools, worksites, neighborhoods, and restaurants) can be divided in different types [11]: physical, social-cultural, economic, and political environmental

changes, often with interlinkage between the different spheres of influence [12]. An overview with examples is provided in Table 1. Although the table is not systematically constructed and cannot be considered as complete, it does show that environmental changes consist of a wide range of possibilities. Some of the environmental changes mentioned in the table can be considered as "drastic" (e.g., punishing policies for unhealthy choices such as car use [13]), other examples can be considered as "subtle" (e.g., footsteps as prompts to promote stair use [14]). Most of the mentioned changes have been empirically studied in one or more relevant areas. These studies generally show small to moderate effect sizes, especially when they are used in combination with behavioral-didactic intervention components that might be expected to promote planning for a healthier lifestyle. Moreover, often relatively small environmental changes in specific settings, such as increasing the availability of healthy choices in worksites, can be regarded as an effective first step towards sustained interventions (e.g., by integrating them into policies). Note that relatively few studies have formally assessed changes to the economic environment (e.g., [4]) as well as studies assessing the impact of changes in policy (e.g., to prepare and offer healthy foods). Policies need to be written, approved, implemented, promoted, and sustained. Moreover, they are more successful when they have been formed on the basis of an integrated collaborative process among decision makers. Evaluation of a policy intervention should follow this entire process, making such interventions more difficult to evaluate than other types of environmental interventions, which may account for the lack of such studies in the literature.

Observational research towards the influence of environmental influences has often applied an isolated approach, while an ecological perspective would be more appropriate to understand the complex dynamics underlying physical activity and dietary behavior. The ecological perspective of health behavior has been central to public health concepts and methods since the nineteenth century. In a broad sense, the term "ecology" refers to the interrelations between organisms and the environments they inhabit. One feature of ecological models needs extra attention here: context. The feature of context refers to multiple spheres of the social, physical, economic, and political environment (micro-, meso-, exo-, and macrosystems) that influence behavior. Ecological studies in the field of child development have shown that the impact of microlevel factors (e.g., parental support for a child to play outside) on individual behavioral developmental variability can vary as a function of contextual macrolevel conditions (e.g., the presence of playgrounds in the neighborhood). The existence of such "higher order moderation" has also been suggested in the field of physical activity and dietary behavior [15–19]. The operation of higher order moderation processes underlines the importance of distal, so-called "upstream" determinants of physical activity and dietary behavior, that, to date, have mostly been operationalized as confounders in causal chain determinants research. In contrast, a contextual rather than mechanistic orientation in operationalizing such broader environments will bring us further in explaining and predicting changes in physical activity and dietary behavior.

S. P. J. Kremers
F. F. Eves
R. E. Andersen

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Clinical Study

Trends in Nutrition and Exercise Counseling among Adolescents in the Health Care Environment

Tasha Peart and Patricia B. Crawford

College of Natural Resources and the School of Public Health, Dr. Robert C. and Veronica Atkins Center for Weight and Health, University of California, Berkeley, CA 94704, USA

Correspondence should be addressed to Tasha Peart, tpeart@berkeley.edu

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Purpose. Obesity is a serious health threat, particularly among racial/ethnic minorities and those who are uninsured, yet little is known about the implementation of nutrition or exercise counseling or the combination of both among these groups. Trends in counseling by race/ethnicity and types of insurance were examined. *Methods*. Trend analyses were conducted with the California Health Interview Surveys among those ages 12–17 for the period 2003–2009. *Results*. *Race/Ethnicity*: Receipt of both counseling methods declined from 2003–2009 for all racial/ethnic groups, except Hispanics and Whites, for whom increases in counseling began after 2007. Hispanics and African Americans generally reported higher levels of nutrition than exercise counseling, while Whites generally reported higher levels of exercise than nutrition counseling for the study period. *Insurance Type*: Receipt of both counseling methods appeared to decline from 2003–2009 among all insurance types, although after 2007, a slight increase was observed for the low-cost/free insurance group. Those with private health insurance generally received more exercise counseling than nutrition counseling over the study period. *Conclusions*. Counseling among all racial/ethnic groups and insurance types is warranted, but particularly needed for African Americans, American Indian/Alaska Natives, and the uninsured as they are at highest risk for developing obesity. Institutional and policy changes in the health care environment will be beneficial in helping to promote obesity-related counseling.

1. Introduction

The prevalence of obesity among adolescents in the United States has increased dramatically in the past 30 years [1], with particularly high rates among Hispanic, African American, and Native American youth [1–4]. Currently 33.6% of all adolescents 12–19 years of age in the United States are either overweight or obese [2]. Although the causes of obesity are complex, it is widely recognized that poor nutrition and physical inactivity play important roles [5]. For this reason, public health interventions targeting youths frequently focus on health promotion programs in schools [6–9], as well as calling for nutrition and exercise counseling in the health care setting [10–12].

The potential for physicians to influence behavioral changes among patients through simple nutrition and exercise advice, as opposed to more time-intensive counseling is crucial. Some studies have documented the value of physician-counseling either used as a stand-alone strategy [13] or as part of a coordinated effort to help patients make changes in their diet and physical activity patterns [14]. National health organizations have also recognized the importance of clinician counseling and have called for an increase in the provision of both nutrition and exercise counseling given to adolescents during physician visits [15, 16]. The Surgeon General's recent Vision for a Healthy and Fit Nation (2010) encourages clinicians to recommend healthy eating and increased physical activity to their patients and recommends training for clinicians and health care students on effective ways to counsel patients on lifestyle behavior change [17].

In California, where adolescent overweight and obesity rates are comparable to national levels [18], major programmatic and policy responses aimed at obesity prevention in adolescents have been undertaken at schools to limit

nonnutritious foods and beverages sold on campus and in communities to increase access to nutritious foods and safer places to exercise [8, 9, 19]. However, little is known about the frequency of weight-related counseling given to different racial/ethnic groups or those with limited access to care, over the course of treating or preventing obesity in the health care environment. A recent study [20] found that race was an important factor that explained the prevalence of nutrition or physical activity counseling among California adolescents: African Americans compared to Whites were more likely to receive nutrition counseling, while Hispanics compared to Whites were more likely to receive both nutrition and physical activity counseling. With regards to insurance type, data suggests that California adolescents who are uninsured or who qualify for low-cost/free insurance are at greatest risk for overweight or obesity [21], yet a recent national study found that adolescents with private insurance generally receive more counseling, compared to those who have low-cost insurance [22]. Changes in the frequency of obesity-related counseling overtime by race/ethnicity or insurance type are yet to be examined.

Previous research in California suggests that physician obesity-related counseling has been declining, with overall counseling rates between 2003 and 2007, shifting from 75% to 59% for nutrition and 74% to 60% for physical activity [20]. Insufficient time, lack of resources, inadequate reimbursement, and patient noncompliance are typically cited as barriers to provision of routine advice by health care practitioners [23].

The objectives of this current study were to document trends from 2003 to 2009 in either nutrition or exercise counseling or a combination of both among California adolescents by race/ethnicity and by insurance type. These findings can provide guidance for policies and programs in a state with high rates of adolescent overweight or obesity and large ethnic populations at particular risk. Further, we hypothesized that physicians would favor dietary counseling over exercise counseling when providing counseling. In an earlier study, Stafford et al. [24] found that physicians offered dietary counseling to obese patients 41.5% of the time, while exercise counseling was offered only 32.8% of the time [24]. Among healthy weight participants, Branner and colleagues found higher rates of nutrition compared with exercise counseling among children and adolescents (42.1% and 26.1%, resp.) [22].

2. Materials and Methods

Data demonstrating trends in nutrition and exercise counseling by race/ethnicity and by insurance type were obtained using four biennial California Health Interview Surveys (2003–2009), the largest state surveys in the United States. The California Health Interview Survey (CHIS) is a two stage sampling, weighted, random digital dialing telephone survey, representative of the California noninstitutionalized population. Within households, an adult and adolescent were randomly selected and interviewed by trained CHIS interviewers; adolescents were directly interviewed. The CHIS program obtained informed consent from all individuals participating in the survey and this current study was deemed exempt or waived for human subjects review by the University of California, Berkeley, Institutional Review Board.

3. Measures

3.1. Obesity-Related Counseling. In this study, obesity-related counseling refers to simple advice about nutrition and/or exercise practices, as opposed to more time-intensive counseling. Adolescents self-reported whether they discussed nutrition or exercise habits with their physician at their last routine exam: "When you had your last routine physical exam, did you and a doctor talk about nutrition or healthy eating?" and "When you had your last routine physical exam, did you and a doctor talk about exercise or physical activity?"

3.2. Statistical Analyses. Data were analyzed using STATA version 10, with the "svy" module to account for weighting and the raking method in variance estimation. Obesity-related counseling proportions are presented graphically by race/ethnicity and by insurance type for the period 2003–2009. To better represent the obesity-related counseling construct, we categorized this variable as respondents having no discussions of nutrition or exercise with their physician, discussing either nutrition or exercise, or discussing both nutrition and exercise with their physician. Participants' self-reported their weight and height, which were used to generate the Centers for Disease Control and Prevention (CDC) BMI age and gender specific percentiles, categorized into underweight (<5th percentile), normal weight (5th–<85th percentile), overweight (85th–<95th percentile), and obese (≥95th percentile). The CDC recommends the use of BMI percentiles when assessing children's weight status [25]. In addition, insurance type variables (uninsured, Medicaid, Healthy Families, employer-based, privately owned insurance, and other public insurance) were collapsed into the categories (uninsured, low-cost/free, employer-based, and private insurance). Medicaid is the United States health insurance program for certain low-income individuals and families, which is jointly funded by state and federal governments [26], while Healthy Families is a low-cost health insurance program for children and adolescents who do not have health insurance and who do not qualify for Medicaid [27].

4. Results

4.1. Characteristics of the Study Sample (CHIS, 2009). Table 1 presents the study sample characteristics, using the CHIS (2009). Participants ranged in age from 12 to 17 years, with 51.0% being male and 49.0% being female. The sample consisted primarily of Hispanics (49.3%) and non-Hispanic whites (33.5%). Most adolescents had some form of health insurance, with almost 60% being covered through their parents'/guardians' employer-sponsored health insurance. Less than half of all adolescents (44.8%) were at or above 300% of the federal poverty level. Based on self-reported data,

Table 1: Characteristics of california adolescents ages 12–17, (CHIS, 2009) $n = 3,379$.

Characteristics	n (%)
Age ± standard deviation	14.6 ± 1.7 range = 12–17
Gender	
Male	1767 (51.0)
Female	1612 (49.0)
Household income status	
<300% FPL	1692 (55.2)
≥300% FPL	1687 (44.8)
Race/ethnicity	
Hispanic	1226 (49.3)
American Indian/Alaska Native, not Hispanic	46 (0.7)
Asian, not Hispanic	363 (10.0)
African American, not Hispanic	100 (6.5)
White, not Hispanic	1480 (33.5)
Insurance types	
Uninsured	204 (6.3)
Low-cost/free	1055 (32.3)
Employer	1920 (56.9)
Private insurance	200 (4.5)
Weight status	
Healthy weight	2518 (71.3)
Overweight	497 (16.7)
Obese	364 (12.0)
Nutrition and/or exercise counseling	
No Discussion about nutrition or exercise	843 (24.9)
Discussion about nutrition or exercise	890 (26.9)
Discussion of both nutrition and exercise	1473 (48.2)
Last physical exam at physician visit	
Respondent never had a physical exam	38 (1.0)
≤12 months ago	2859 (84.7)
>1 year ago	482 (14.3)

Final sample size, $n = 3,379$, but may be less for some variables due to missing values.
Data presented as n (%), unless otherwise indicated.
FPL—Federal Poverty Level.

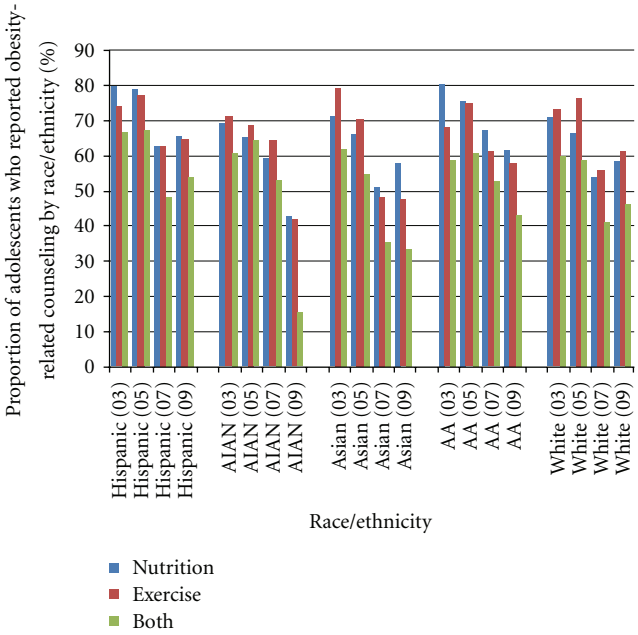

Figure 1: Trends in obesity-related counseling by race/ethnicity (CHIS, 2003–2009).

28.7% of California adolescents were either overweight or obese, while 48.2% of all California adolescents received counseling on both nutrition and exercise subjects (Table 1). The majo-rity of respondents (84.7%) reported having a physical exam within the past year (Table 1). Previously published data indicate how California adolescent demographics have changed from 2003 to 2007 [20].

4.2. Either Nutrition or Exercise Counseling. Figure 1 and Table 2 present data for obesity-related counseling stratified by race/ethnicity. When examining nutrition or exercise counseling separately for the period from 2003 to 2009, African Americans generally reported higher levels of nutrition than exercise counseling, while Whites generally reported higher levels of exercise than nutrition counseling. Hispanics generally reported higher levels of nutrition than exercise counseling during 2003–2005, after which counseling levels remained consistent.

4.3. Both Counseling Methods . Overall, trends show that counseling declined between 2003 and 2009 for all groups, except for Hispanics and Whites which started to increase again after 2007; American Indians/Alaska Natives reported a sharp decline in 2009.

Between 2003 and 2009, the proportion of adolescents who reported counseling on both nutrition and exercise decreased from 66.8% to 53.7% among Hispanics; from 60.7% to 15.1% among American Indians/Alaska Natives; from 61.7% to 33.4% among Asians; from 58.8% to 42.9% among African Americans; and from 60.0% to 46.2% among Whites (Figure 1).

4.4. Either Nutrition or Exercise Counseling . Figure 2 and Table 3 present data for obesity-related counseling stratified by insurance type. Those who had private insurance generally received exercise counseling more frequently than nutrition counseling over the study time period. There appeared to be no imbalance in frequency of nutrition or exercise counseling for the uninsured, low-cost/free or employer-based groups, except in 2003 when adolescents who were underinsured or had low-cost insurance reported more nutrition than physical activity counseling.

4.5. Both Counseling Methods. Counseling appeared to decline from 2003–2009 among all insurance types, although after 2007, a slight increase was observed for the low-cost/free insurance group. Among those who were uninsured

Table 2: Sample sizes for counseling variables stratified by race/ethnicity.

Race/ethnicity	2003	2005	2007	2009
Hispanic	1327	1240	1158	1164
American Indian/Alaska Native (AIAN)	41	32	21	40
Asian	237	289	246	345
African American (AA)	193	177	121	99
White	1625	1796	1657	1412

Table 3: Sample sizes for counseling variables stratified by insurance type.

Insurance type	2003	2005	2007	2009
Uninsured	235	210	177	172
Low-cost/free	872	893	759	1004
Employer	2359	2402	2276	1842
Private Insurance	209	251	198	188

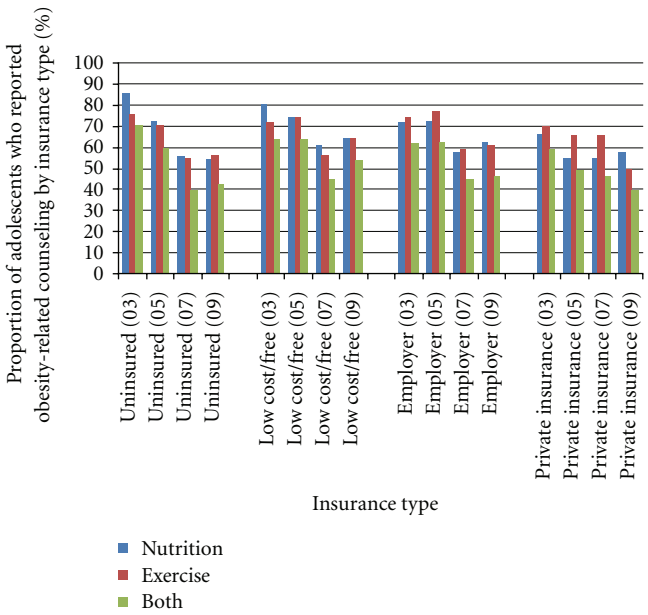

Figure 2: Trends in obesity-related counseling by insurance type (CHIS, 2003–2009).

counseling declined from 70.8% to 42.2%; among the low-cost/free group, counseling declined from 64% to 53.4%; among the employer group, counseling declined from 61.8% to 46.6% and among the private insurance group, counseling declined from 58.9% to 39.8% (Figure 2).

5. Discussion

As early as the 1950s, the American Medical Association Council on Food and Nutrition cited the benefits of nutrition counseling, as well as inadequacies in nutrition education in U.S. medical schools [28]. Further, counseling has been shown to be valuable in helping patients to change their behavior and to achieve weight loss and can be even more beneficial if used as part of a coordinated approach with health education materials. Kreuter and colleagues reported that patients who received a combination of health education materials, followed by physician counseling were 51% more likely to increase their leisure time physical activity, and 35% more likely to reduce fat from dairy sources at follow-up [14].

Some groups that need obesity prevention counseling the most may still be missing out, including American Indians/Alaska Natives, African Americans, and the uninsured. Time trend findings from 2003 to 2009 indicate that nutrition and exercise counseling decreased for all racial/ethnic groups except for Hispanics and Whites, for whom it started to increase after 2007.

Our findings also suggest that counseling levels in California for racial/ethnic groups and for patients with different types of insurance are generally higher compared to national levels [22]. The higher counseling levels reported in this study, compared with national figures, may have been due to fewer barriers or more public health awareness of the obesity epidemic in California and stronger health care leadership. Previously reported barriers to counseling include insufficient reimbursement rates, lack of time, lack of training for medical providers in policy advocacy related to improved nutrition and activity environments, and the need for information on evidence-based obesity-related messages and referral networks for nutrition counseling [23].

When examining nutrition or exercise counseling separately during the study period (2003–2009), interesting differences were found by race/ethnicity: Hispanic and African American CHIS adolescents generally reported higher levels of nutrition than exercise counseling, while whites generally reported higher levels of exercise, than nutrition counseling. Meanwhile, participants who had private insurance generally received more exercise than nutrition counseling during the study period. Further research is needed to investigate the underlying factors that may explain the differences in the findings for racial/ethnic groups.

6. Limitations

The CHIS surveys were only able to identify the existence of discussions or conversations that adolescents may have had with their physicians regarding nutrition and exercise messages, but were not able to ascertain the depth of these discussions. Given the limited time physicians have in working with patients, it is unlikely that any advice given would be in-depth psychological advice. Further, it is difficult to ascertain whether these conversations were initiated by the physician or the patient. These data were unable to measure specific evidence-based obesity-related messages (limiting sugar sweetened beverages, increasing fruit and vegetables, reducing television viewing, and increasing moderate-to-vigorous physical activity) [7, 29]. Future studies should measure the impact of these areas on behavior changes.

The potential for recall bias also exists since adolescents were asked to self-report nutrition and/or exercise data that occurred during their last physical exam, however, most adolescents (84.7%) had a physical exam at their physician visit within the past year.

7. Conclusion

This is the first study to examine trends in obesity-related counseling by race/ethnicity and by insurance type among California adolescents. Additionally, this is one of the first studies to examine trends in counseling among American Indians/Alaska Natives, a group that is also disproportionately affected by overweight and obesity [3, 4].

The findings from our study have demonstrated that the downward trend in obesity prevention counseling in California among racial/ethnic groups and health insurance groups has changed course and has begun to increase. Future analysis of the biennial CHIS surveys will indicate if the trend continues in this direction.

It is widely accepted that obesity prevention should follow a socioecological approach, combining multiple interventions tailored to specific demographic groups [30]. While a vast amount of work has already been conducted in California to implement population-wide obesity prevention policies in schools [8] and in low-income communities [9], this momentum must also be applied to California primary health care settings. However, for physician-based counseling to continue to increase among the general adolescent population and among vulnerable high-risk groups in particular, this will require institutional and policy changes. Research on effective ways to support clinicians' use of the aforementioned evidence-based obesity-related messages is still in its infancy, although preliminary data from clinic-based obesity interventions have begun to show promising results. At least one US state (Washington) has adopted clinic-based programs to address the childhood obesity epidemic by establishing partnerships with hospitals, health care plans, and community-based organizations [31]. Other states may consider adopting such a program in the primary care setting in order to build on obesity prevention programs and policies previously implemented in schools and low-income communities.

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Research Article

The Influence of the Local Neighbourhood Environment on Walking Levels during the Walking for Wellbeing in the West Pedometer-Based Community Intervention

L. B. Robertson,[1] C. Ward Thompson,[1] P. Aspinall,[1] C. Millington,[1] C. McAdam,[2] and N. Mutrie[2]

[1] *OPENspace Research Centre, Edinburgh School of Architecture and Landscape Architecture (ESALA), University of Edinburgh, Lauriston Place, Edinburgh EH3 9DF, UK*
[2] *Department of Sport, Culture and the Arts, University of Strathclyde, 76 Southbrae Drive, Glasgow G13 1PP, UK*

Correspondence should be addressed to L. B. Robertson, lynette.robertson@ed.ac.uk

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We investigated the relationship between walking levels and the local neighbourhood physical environment during the Walking for Wellbeing in the West (WWW) randomised pedometer-based community intervention. Walking activity was recorded as step counts at baseline ($n = 76$), and at 3 months ($n = 57$), 6 months ($n = 54$), and 12 months ($n = 45$) post-intervention. Objective physical environment data were obtained from GIS datasets and street surveys conducted using the SWAT audit tool. Sixty-nine environment variables were reduced to eight environment factors using principal axis factoring, and the relationship between environment factors and (i) step counts, and (ii) the change in step counts relative to baseline, was examined using hierarchical multiple linear regression, controlling for age, gender, income, and deprivation. Five environment factors were significant predictors of step counts, but none were significant predictors of the change in step counts relative to baseline. None of the demographic variables included in the analysis were significant predictors at any stage of the study. Total variance explained by the environment ranged from 6% ($P < 0.05$) to 34% ($P < 0.01$), with lowest levels during the initial stages of the study. The physical environment appears to have influenced walking levels during the WWW intervention, and to have contributed to the maintenance of walking levels post-intervention.

1. Introduction

Physical activity is crucial for our health and well being, providing physiological and mental health benefits and helping to prevent chronic illnesses such as diabetes, cancer, and heart disease, which are the leading cause of death in most industrialised nations and many developing countries [1–3]. Walking is the most common form of physical activity among adults in many populations [4] and has been suggested as the mode of physical activity which is most likely to appeal to the least active of the population [5, 6]. Promotion of moderate physical activities such as walking is associated with longer-term changes in behaviour [7], and as such walking is increasingly highlighted in national and international physical activity health promotion strategies (e.g., [5, 8]).

A number of individual, social, cultural, and economic factors affect physical activity levels, and the environment also plays a role [9]. Although causality between the physical environment and physical activity levels has yet to be established, there is now substantial evidence based on environment and physical activity and walking levels which indicates that the environment is an important contributory factor [9–13]. Policy and interventions to increase walking, therefore, need to target both people and places [14, 15], and it has been suggested that modifying the environment has the potential for much longer-lasting effects than individual level interventions, as environmental changes are assimilated

into structures, systems, policies, and sociocultural norms [16], and thereby penetrate more widely and deeply into the complex socioecological system in which we live.

The potential to create physical environments that support increased levels of activity is now being embraced, with many countries producing guidance on the creation and promotion of built and natural environments that encourage and support physical activity (e.g., [17, 18]). Environmental characteristics which have been identified to be positively associated with walking and/or physical activity in adults include aesthetics [19, 20]; safety from traffic [11]; residential density, land use mix, and street connectivity [21–23]; well-maintained footpaths [11, 24, 25] and street lighting [23]; the presence of facilities that function as destinations, for example, shops [11, 23–25]; access to facilities for physical activity for example, parks, and recreation centres [11, 12, 20, 24]; accessible, safe green spaces [26–29].

This paper reports on findings in the context of a walking intervention study and for a European city, for which there is a relatively limited evidence base. The study was carried out in Glasgow, UK, as part of the Scottish Physical Activity Research Collaboration (SPARColl) "Walking for Well-being in the West" (WWW) pedometer-based community walking intervention, conducted between August 2006 and October 2010 [30, 31]. The purpose of the current study was to investigate if characteristics of the environment around WWW particpants' homes was related to their walking levels, and to investigate if an environment seemingly more supportive of walking was associated with a change to, and maintenance of, higher levels of walking post-intervention. Identifying the relative importance of the environment compared to individual, social, or economic factors was beyond the scope of the study, but demographic variables known to have a bearing on walking levels were controlled for in the analysis [32].

2. Context: Walking for Wellbeing in the West (WWW)

The WWW study was designed to assess whether a pedometer-based walking programme in combination with physical activity consultations would increase walking over a 12 week (3 month) period, and whether any increases gained could be sustained at 12 months [30]. The study sample (n = 79) was drawn from men and women aged 18–65 years who were living in the west of Glasgow, Scotland, and who were not achieving the recommendation of at least 30 minutes of moderate-intensity physical activity on at least five days of the week [33]. Initially, the aim was to recruit participants from the lowest socioeconomic groups who lived within a 1.5 km radius of the University of Strathclyde Jordanhill campus, since areas of high deprivation are located in close proximity to this campus. However, due to recruitment of insufficient numbers, less deprived areas were also included in the study. The WWW intervention was delivered in two forms; a maximal and a minimal intervention. The maximal intervention consisted of a pedometer and a 12-week-individualised walking programme with graduated step count goals and additional behavioural and cognitive support via a series of physical activity consultations. As part of these physical activity consultations, participants were given a map of the local area with their home address highlighted. If participants found it helpful, this map was used to facilitate discussion of potential places or routes to walk in their local neighbourhood. Following a waiting-list control condition, the minimal intervention consisted only of the pedometer and walking programme. For the purpose of the study, participants were randomised into two groups: Group 1—immediate (maximal) intervention; Group 2—waiting list control (minimal intervention). Physical activity levels were assessed objectively, using pedometer step counts, and subjectively, using the International Physical Activity Questionnaire (IPAQ) [34]. Monitoring was carried out at baseline, and at 3 months, 6 months and 12 months post-intervention. Full details of the WWW study and design rationale can be found in Fitzsimons et al. [30]. The main findings to date are (i) the pedometer-based walking programme combined with a physical activity consultation was effective at promoting walking over 3 months [35]; (ii) anthropometric and metabolic measurements made during this time period showed that health outcomes remained stable [35, 36]; (iii) the minimal intervention was also successful at increasing step counts [31]; (iv) both groups maintained the increased step counts to 12 months, and both interventions were deemed cost effective [37]. Subjective physical environment data in the form of participants' perceptions of the local physical environment were obtained using the Neighbourhood Quality of Life Survey (NQLS, no date), IPAQ, and focus group discussions. Participants generally thought that characteristics of the built environment and safety in their neighbourhoods were important to support and enable active behaviour intentions and sustain longer term increases in activity and also felt that their neighbourhoods were supportive of walking [38].

3. Methods

3.1. Study Area and Population Sample. The WWW study site encompassed an area of approximately 25 km^2 north of the River Clyde in Glasgow, Scotland (Figure 1). The land use of this area is predominantly residential, with some commercial destinations and industries bordering the river, and there are four main parks and a botanical garden. The site covers some of the most and least deprived areas within Scotland, based on the Scottish Index of Multiple Deprivation (SIMD) [39]. The location of participants and the SIMD zones for the study area are shown in Figure 2. At the time of participant recruitment (2006), the population density of the area was c. 3300 persons per km^2. As three individuals lived outside the main study area, they were excluded from the environmental analysis reported here, giving a total adjusted sample of n = 76 at baseline, of which only 16 individuals were male. At baseline, the age of participants ranged from 27–66 years, with a mean age of 51 years (SD = 9). At 12 months post-intervention 45 participants returned (59%), and 13 of these were men. The mean age was 53 years (SD = 7.5, range 28–66 years). A significant challenge with

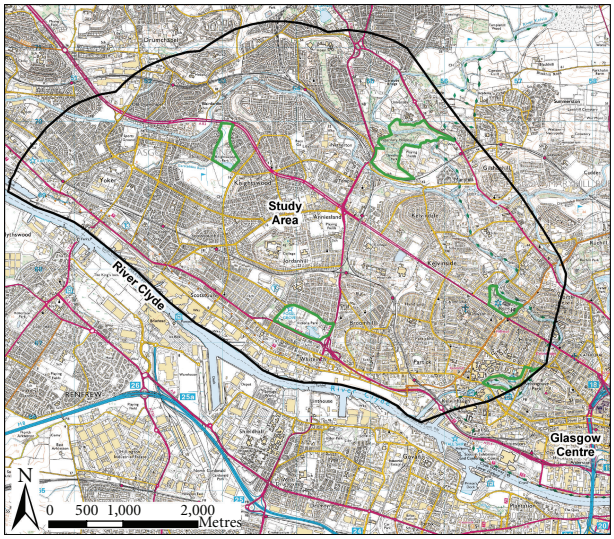

Figure 1: Location of the study area. Major green spaces within the study area are highlighted with a green border (Knightswood Park, Dawsholm Park, Victoria Park, Glasgow Botanics, and Kelvingrove Park). © Crown Copyright/database right 2008. An Ordnance Survey/EDINA supplied service.

a longitudinal study of this nature is to maintain participant numbers throughout the intervention and minimise drop out. Participants were lost from the study for a number of reasons including: being noncontactable; injury; personal reasons; lack of time; dissatisfaction with the pedometer [31].

3.2. Step Counts. Step counts were recorded using sealed Omron HJ-109-E pedometers (Omron Healthcare UK, Ltd.). The Omron pedometer includes a cover to prevent accidental resetting and has a 7-day memory, therefore, avoiding the need for participants to record their daily steps which can act as an incentive. Also, as the pedometers are sealed, no feedback is available whilst in use during monitoring. At baseline, participants were instructed to continue their normal activity levels and were asked to wear their pedometer continuously, except when sleeping, showering, or undertaking structured exercise. Any significant changes in step counts recorded should, therefore, largely reflect changes in walking behaviour [35]. Monitoring was conducted over a 1-week period on four occasions: baseline ($n = 76$), and at 3 months ($n = 57$), 6 months ($n = 54$), and 12 months ($n = 45$) post-intervention. In this controlled trial, the maximal intervention was successful in significantly increasing daily step-counts over 3 months by 3175 steps compared to a nonsignificant increase of 154 steps amongst those who were on a waiting list [35]. At 12 months, there was no significant difference between the walking levels of participants who received the maximal or minimal intervention, with both leading to an average increase of 1509 steps/day [31].

3.3. Environment Data

3.3.1. SWAT Audit. The Scottish Walkability Assessment Tool (SWAT) [40], developed drawing on the work of Pikora et al. [41], was used to objectively record features of the physical environment which could be related to walking. The total audit area was defined by applying the audit tool to an area of 1600 m radius around each participant's home [42], a distance that could be accessed within approximately 30 minutes total walk time. Overlap of the 1600 m zones resulted in a continuous survey covering approximately 25 km^2, which constitutes the current study area (Figure 1). Locations within the 1600 m zones south of the river were excluded from the study as the river provides a natural barrier to walking. Following the protocol developed by Pikora et al. [25], streets were divided into segments, defined as a length of street between two consecutive junctions. A total of 2030 street segments were audited during the summer of 2007, by three pairs of trained auditors. SWAT was designed to be administered from one side of the street (side 1), to describe separately the opposite side of the street (side 2). Further details of SWAT and the results of audit reliability tests can be found in Millington et al. [40]. Only audit items that were found to be reliably recorded were included in the current analysis, a total of 81 of 112 audit items, a number of which were combined to give meaningful environment characteristics/variables for the analysis (Table 1). Variables that were found to be unreliable were generally those which are subjective in nature and/or time dependent, for example, perceptions of safety and aesthetics. Methods of reducing the audit data to the initial set of variables used in the factor analysis ($n = 56$) are described in Section 3.3.3 below.

3.3.2. GIS. A total of 13 environmental variables were derived from local and national GIS datasets and digital Ordnance Survey maps (Multipmap data from Digimap). Variables included measures of land use, residential density, street connectivity, and road accidents (Table 1). Land use data were obtained from the Macaulay Land Use Research Institute (now James Hutton Institute); road accident data (April 2004–March 2007) were supplied by the Strathclyde Police; bus stop data were provided by the Medical Research Council (Glasgow). The Scottish Index of Multiple Deprivation (SIMD) rank was also obtained [39], and values used in the analysis were for the SIMD data zone in which the participant resided. SIMD is a composite variable, derived from seven domains scores: income, employment, health, education, access, housing, and crime. Attempts to obtain more detailed crime statistics for use towards developing a separate "crime rate" variable proved unsuccessful. The SIMD measure, therefore, is the only indication in the study of crime as a variable. Given the environmental information that contributes to the access domain in SIMD, it was not included in the factor analysis of environment variables.

3.3.3. Summarising Street Audit and GIS Data for Individual Neighbourhood Zones. A circular neighbourhood zone of

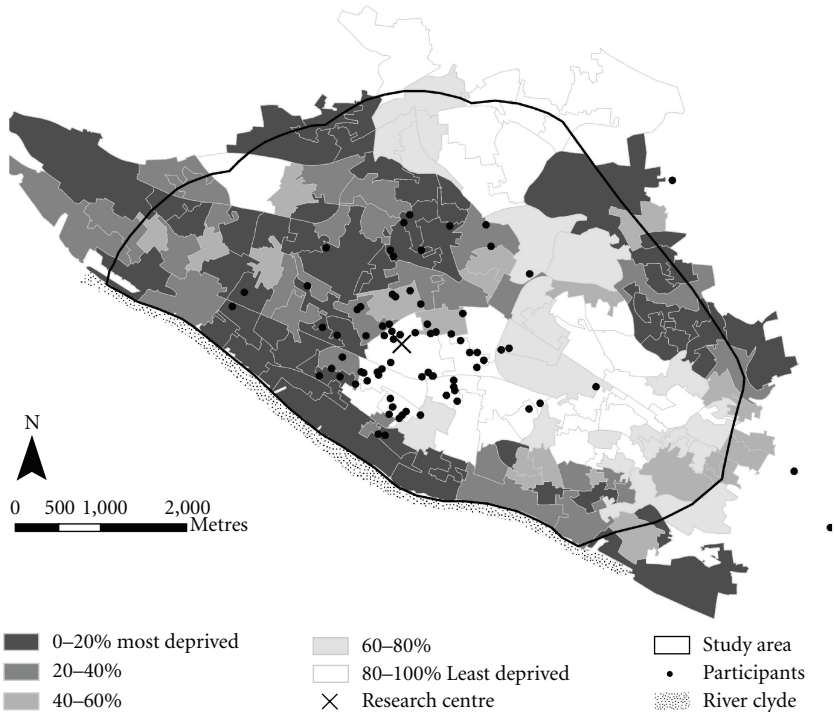

Figure 2: Participant locations and Scottish Index of Multiple Deprivation (SIMD) zones.

400 m radius was defined for each participant, centred on their home. Although the audit data were initially collected for a radius of 1.6 km around participants' homes, these zones revealed considerable overlap, and so a 400 m radius zone was chosen for the analysis to reflect that of Pikora et al. [25], on whose work the SWAT audit tool had also been drawn. The 400 m radius zone was also chosen in order to maximise potential variability between neighbourhoods as low variability had been noted for a number of variables when assessing the reliability of the audit data [40]. A larger buffer zone, indicative of 10–15 mins walking distance, would have resulted in much reduced variability in characteristics between the defined "local neighbourhood" for each participant, and, therefore, of limited capacity to explain variability in walking levels.

For each 400 m zone, the audit ($n = 81$) and GIS ($n = 13$) data were summarised for each segment that lay within or intersected with the 400 m neighbourhood zone. Then, depending on the nature of the data collected, a number of summary methods were used to obtain a single value for each environment characteristic/variable for each neighbourhood zone, resulting in a total of 69 environment variables for the analysis (56 from the audit data, and 13 from the GIS data).

(i) Presence/absence variables. For simple presence/absence data, in the case of GIS data, the number of items present in the neighbourhood was summed, for example, total number of bus stops. In the case of the audit data, the proportion of segments displaying a specific variable characteristic was calculated, for example, the proportion of segments in the neighbourhood with traffic signals. Where an item was recorded individually for both sides of the street, the data were combined to give a proportion for presence/absence on either side of the street.

(ii) Interval variables from the audit data. Interval data were summarised using a weighted average (variables denoted with an asterisk in Table 1). Audit items were coded with 0 or 1 as the lowest interval and up to a maximum of 8 depending on the number of intervals present for example, for the Garden maintenance variable: ">75% of gardens well maintained" was coded as 3; "50–75% of gardens well maintained" was coded as 2, and "<50% of gardens well-maintained" was coded as 1. Thus, in the above example, higher values equate to a greater proportion of the neighbourhood area with well maintained gardens. In the case of the Path material type variable, paths made from man-made materials (asphalt, paving blocks, paving slabs, setts, hoggin, and gravel) were assigned lower codes (1 to 6, resp.,) and paths made from natural materials (mud/earth/unpaved, grass) were assigned higher codes (7 and 8, resp.). Where interval variables were recorded individually for both sides of the street the mean of the weighted average for each side was used.

(iii) Other variables. Land use mix index was calculated for each 400 m radius zone as described by Frank et al. [21]. This variable represents the evenness of the distribution of domestic, commercial, and green space land use. Possible values range from 0 to 1, with higher values representing more mixed-use neighbourhoods. Dwellings per hectare

Table 1: Environment variables included in the analysis ($n = 69$), arranged according to theme and element after Pikora et al. [25]. GIS data variables (i.e. those not derived from the street audit data) are shown in italic ($n = 13$), and variables that were included in the factor analysis are shown in bold ($n = 58$). Variables which are weighted scores are indicated with an asterisk. Unless otherwise stated (e.g. %, number, mean), the values used in the analysis were the proportion of segments in the 400 m radius neighbourhood zone where the environmental feature in question was present.

Theme	m45Functional	Safety		Aesthetic		Destination					
Elements	Walking surface	Streets	Traffic	Permeability	Personal	Traffic	Streetscape	Views		Facilities	
Items	Path continuity	**Car lanes (mean no. of)**	**Traffic signals**	*Paths area (%)*	**Hedge height**	***Accidents injury (no. of)***	**Garden maintenance***	**Hill views**	***Land use mix index***[b]	**Park**	***Bus stops (no. of)***
	Path obstructions		**Driveway crossovers**	***Paths and roadside area (%)***	**Street lights**	***Accidents injury to pedestrians (no. of)***	**Hedge % coverage***	**Nature views**	***Land uses (no. of)***	**Playground**	Bus stop
	Bridge overpass		**Road narrowing**	***Junctions:three legged (no. of)***	**Path well lit**	***Accidents noninjury (no. of)***	**Verge maintenance***	**Wild nature views**	***Green space area (%)***	**Sports/playing field or tennis court**	Coach stop
	Underpass		**Speed humps**	**Steet closing but walking access through**	**Road names visible**	**Crossing with lights**	**Derelict land**	**Water views**	***Commercial area (%)***	**Sports track**	Train station
	Path: none		**Cycle lane**	**Cul de sac or permanent street closing**[a]	**Pedestrian signage**	Zebra crossing	**Dog fouling***	**Urban views**	***Domestic area (%)***	Pool	**Transport stops (mean no. of)**
	Path material type*		Bike locker			**Median refuge**		**Commercial views**	***Dwellings per hectare***	Golf course	
	Path material natural		Bike rack			**Path distance from kerb***			**Government buildings (mean no. of)**	**Fitness facility: indoor**	
						Raised kerb			**Parking provision***	**Recreation facility: other**[c]	
						Kerb extension			**Parking on street amount***	**Recreation facility (mean no. of)**	
						Tactile paving					

[a] At either end of the segment.
[b] After Frank et al. [21].
[c] Recreation facility other than an indoor fitness facility, park, playground, pool, golf course, sports/playing field, sports track or tennis court.
* Variable is a weighted score.

values (derived from land use data) are for the SIMD data zone in which the participant resided. It was not possible to calculate summary values for the 400 m neighbourhood zones for dwelling density as the data available conformed to different boundaries.

3.4. Statistical Analysis

3.4.1. Data Screening and Reduction. Prior to analysis the data were checked for normality (Shapiro-Wilk and $\pm 2 \times$ SE skewness normality tests) and screened for outliers (values greater than $3 \times$ IQR removed). Data were transformed where necessary and possible (square root, natural log), and eleven environment variables were removed from the analysis on the grounds of there being (i) no data, (ii) duplication, or (iii) very low variability. Coach stop, Pool, and Zebra crossing were removed as they did not occur in any of the 400 m neighbourhood zones (i.e., the proportion of segments with these features was 0% for all participants). On the grounds of duplication between audit and GIS data, the street audit Bus stop variable was removed (GIS data preferred as they required less manipulation prior to analysis). Variables with a very low or high prevalence were removed, defined as those variables with >80% of the values for each participant/neighbourhood zone being equal to either 0% or 100% (Golf course, Bike locker, Underpass, and Path continuity). Proportion variables with a maximum value for all neighbourhood zones ≤2.5% were also removed (Bike rack, Paths area (%), and Train station). A total of 58 variables remained for the factor analysis (46 street audit variables and 12 GIS dataset variables).

3.4.2. Factor Analysis. Principal axis factoring (PAF) was used for data reduction as some variables could not be transformed to a near normal distribution, and this approach is considered to be most appropriate for data with severe departures from normality [43]. The analysis was run with an eigenvalue of 1 and varimax rotation (SPSS v.18). After the initial run, the *Wild nature views* variable was removed because it was entirely correlated with *Nature views* (*Nature views* preferred on the basis that it would encompass *Wild nature views*). Individual variable sampling adequacy was tested using the Kaiser Meyer Olkin (KMO) criterion, leading to the removal of further 15 variables from the analysis, all with a KMO value <0.45. These were *Land uses (no. of)*, *Government buildings (mean no. of)*, *Hedge height*, *Bridge overpass*, *Road narrowing*, *Derelict land*, *Sports track*, *Parking on street amount*, *Verge maintenance*, *Tactile paving*, *Cycle lane*, *Crossing with lights*, *Path obstructions*, *Water views*, and *Commercial views*. On rerunning the analysis on the remaining dataset of 42 variables, all variables passed an individual sampling criterion of 0.5 (considered to be appropriate for a dataset of this size), and the overall sampling adequacy for all variables was very good (KMO = 0.707). The determinant of the correlation matrix was within limits, and Bartlett's test of sphericity was highly significant ($P < 0.001$), indicating that the analysis was appropriate for the dataset. Variables with loadings <0.5 were removed from the analysis (*Urban views*, *Street lights*, *Driveway crossovers,* and *Transport stops*), as for a sample size of $n = 76$ only loadings greater than about 0.5 are statistically significant (and thus account for variance in the dataset). Rerunning the analysis on the remaining 38 variable dataset produced a 9 factor solution with meaningful groupings. Factor 9 was removed from the analysis on the basis of an eigenvalue <1 and it consisting of only one variable loading at less than <0.5 (*Recreation facilities-mean no. of*). The final ratio of participants to variables was 2:1, making the analysis on the low side of acceptable based on sample size. Communalities were high however (0.642–0.983; mean = 0.841, SD = 0.09), and for most factors a number of variables loaded strongly (>0.5), indicating a reasonably strong dataset for factor analysis [44]. Factor scores were saved as Anderson-Rubin scores and prior to the regression analyses were checked for normality and outliers (data were transformed and outliers removed as described above).

3.4.3. Multiple Linear Regression Analyses. A hierarchical blocked regression was used (SPSS v.18, "Enter" method), with demographic variables entered in block 1, and the 8 environment factors in block 2. Demographic variables included were age, gender, income (annual household), and SIMD rank. The analysis was carried out for (i) step counts at baseline at each of the 3 monitoring periods post-intervention (3 months, 6 months, and 12 months); (ii) the change in step counts relative to baseline for each monitoring period post-intervention. Final models were checked for multicollinearity (variance inflation factor < 10).

4. Results

Step counts at baseline and at each stage of the study post-intervention are shown in Figure 3. Step count followed an approximately normal distribution at 6 months and 12 months but were not normally distributed at baseline and 3 months. The median step counts at baseline was 6544 (IQR = 4396), which lies towards the upper end of the "low active" target group for participants [30, 45, 46]. After the intervention, median step counts increased by 46% (3 months) and then remained at approximately the same level above the baseline throughout the study (as noted above, see [31, 35]). Median step counts post-intervention were 9588 steps, 9221 steps, and 10085 steps, for 3 months, 6 months, and 12 months, respectively. The maximum level of activity for an individual over the length of the study was recorded at 3 months post-intervention (23589 steps), and the minimum was recorded at baseline (1346 steps).

The relative change in step counts from baseline at each monitoring period is shown in Figure 4 (data followed an approximately log-normal distribution). The average relative change was largest at 3 months post-intervention (median = 46.1%), and smallest at 12 months post-intervention (median = 33.2%), as might be expected given the passing of time from the start of the study. The largest relative change observed in an individual was 330%, at 3 months. At each stage of monitoring, there were some participants whose

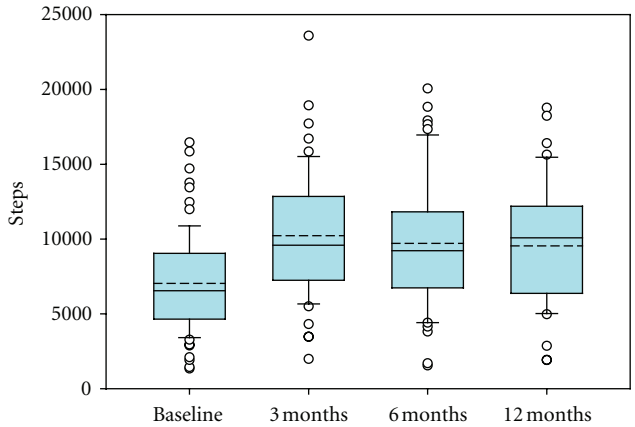

Figure 3: Step counts at each stage of the study. Whiskers are 10th and 90th percentiles and the dashed line is the mean.

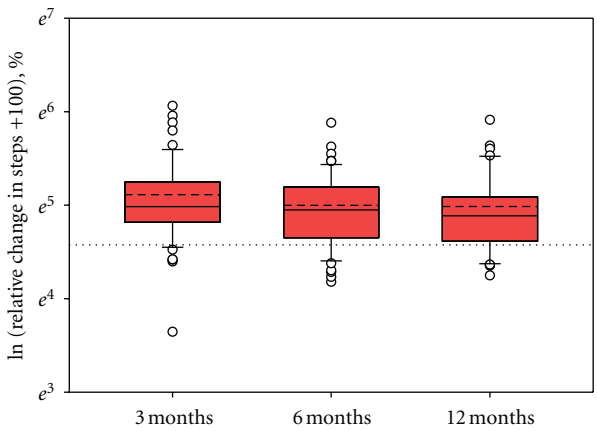

Figure 4: The relative change in steps from baseline at each stage of the study (NB: axis is natural log, with a constant of 100 added to all step counts). Whiskers are 10th and 90th percentiles and the dashed line is the mean. The dotted line at $e^{4.6}$ represents 0% change.

activity levels fell below their baseline levels: the largest drop below baseline values was a decrease of 62%, for one participant at 3 months post-intervention.

Table 2 shows the rotated factor matrix produced from the factor analysis. Only correlations >0.5 and those factors which were retained for the multiple regression analyses are shown. The total amount of variance explained by the 8 remaining factors was 80.7%. Factors were named, and the proportion of variance explained by each is, as follows: (1) *Green space and recreation facilities* (13.8%); (2) *Commercial and residential land use mix* (13.0%); (3) *Dangerous and busy roads* (12.6%); (4) *Pathway features other than safety* (12.3%); (5) *Pathway safety features* (9.7%); (6) *Roads and bus stops* (7.7%); (7) *Indoor fitness facilities and traffic calming features* (7.2%); (8) *Traffic signals and pedestrian signage* (4.2%).

The results of the multiple linear regression analyses for step counts are shown Table 3. For the change in step counts relative to baseline, none of the demographic variables included or any of the environment factors were significant ($P < 0.05$) predictors at any time period, and thus results are not reported. However, the *Indoor fitness facilities and traffic calming features* factor was borderline significant at 6 months, ($P = 0.063$, $\beta = .27$). For the step counts analyses, none of the demographic variables were significant predictors, but gender was borderline significant ($P = 0.058$) at 3 months post-intervention. SIMD rank was also close to significance at 3 months ($P = 0.096$), and income was close to significance at 12 months ($P = 0.097$). At each stage of the study, one or more environment factors were significant predictors. The total amount of variance which could be explained by the environment factors varied over the length of the study, ranging from 6% ($P < 0.05$) at baseline to a maximum of 34% at 6 months ($P = 0.001$, dropping to 28% when adjusted for a population study). Different factors were found to be significant at each time period, with the exception of at baseline and at 3 months, when results were consistent. At baseline and at 3 months, the *Dangerous and busy roads* factor was the only significant predictor ($P < 0.05$) and was inversely related to step counts. The total amount of variance accounted for by this factor at baseline and at 3 months was 6% and 8%, respectively ($P < 0.05$). At 6 months, four of the environment factors were significant predictors and together these accounted for 34% of the variability in step counts ($P = 0.001$). The *Commercial and residential land use mix* factor was the most important and was positively associated with step counts ($\beta = .40$). The remaining three factors were of approximately equal importance, with the *Dangerous and busy roads* and *Traffic signals and pedestrian signage* factors inversely related to step counts ($\beta = -.31$ and $-.30$, resp.), and the *Indoor fitness facilities and traffic calming features* factor was positively related to step counts ($\beta = .27$). At 12 months, the *Green space and recreation facilities* factor was a significant predictor ($P < 0.05$), and this was an inverse relationship ($\beta = -.34$). The *Commercial and residential land use* factor showed a borderline significant ($P = 0.05$) association with step counts, and this was a positive association, as found at 6 months. Together, the two factors accounted for 19% of the variance in step counts ($P < 0.05$).

5. Discussion

5.1. Characteristics of the Environment Associated with Walking. Over the course of the study different aspects of the environment were found to be influencing walking levels at different times, but in all cases the direction of associations were consistent over time (Table 3). The five environment factors that were found to be significant predictors of step counts were *Dangerous and busy roads* (inversely related), *Commercial and residential land use mix* (positively related), *Indoor fitness facilities and traffic calming features* (positively related), *Traffic signals and pedestrian signage* (inversely related), and *Parks and recreation facilities* (inversely related). The pathway features factors (factors 4 and 5) and the *Roads and bus stops* factor (factor 6) were not significant predictors.

The inverse association between step counts and the *Dangerous and busy roads* factor, which was a significant

Table 2: Rotated factor matrix for environment variables ($n = 38$), based on Principle Axis Factoring and a varimax rotation (with Kaiser normalisation). Only retained factors and loadings > 0.5 are shown. GIS variables (i.e. those not derived from street audit data) are shown in italic, and variables which are weighted averages are indicated with an asterisk.

Physical environment variable	Factor loadings							
	1	2	3	4	5	6	7	8
	Green space and recreation facilities	Commercial and residential land use mix	Dangerous and busy roads	Pathway features other than safety	Pathway safety features	Roads and bus stops	Indoor fitness facilities and traffic calming features	Traffic signals and pedestrian signage
Park	.924							
Recreation facility: other[a]	.899							
Playground	.652							
Dwellings per hectare	.631		.511					
Paths and roadside area (%)	.629							
Recreation facilities (mean no. of)	.608						.550	
Nature views	.532							
Land use mix index[b]		.924						
Green space area (%)		−.877						
Parking provision*		.693						
Commercial area (%)		.644			−.501			
Hedge % coverage*		−.606		−.514				
Cul de sac or perm. street closing[c]		.540						
Path: none		.531						
Bus stops (no. of)		−.511				.506		
Accidents: injury (no. of)			.900					
Accidents: inj. to pedestrians (no. of)			.869					
Accidents: non-injury (no. of)			.791					
Garden maintenance*			.675					
Junctions: three-legged (no. of)	.504		.541					
Pedestrian signage			−.536					.510
Dog fouling*			−.534					
Path material type*				.865				
Path material natural				.860				
Sports/playing field or tennis crt.				.693				
Hill views				−.646				
Road names visible				.601			.528	
Street closing w. walking access thr.				.519				
Path well lit					.847			
Raised kerb					.797			
Path distance from kerb*	.517				.591			
Domestic area (%)					.580			
Median refuge						.919		
Car lanes (mean no. of)						.798		
Fitness facility: indoor							.881	
Speed humps					.567		.643	
Kerb extension							.553	
Traffic signals								.710
Percent of variance	**13.8**	**13.0**	**12.6**	**12.3**	**9.7**	**7.7**	**7.2**	**4.4**
Total variance explained = 80.7%								

[a]Recreation facility other than an indoor fitness facility, park, playground, pool, golf course, sports/playing field, sports track, or tennis court.
[b]After Frank et al. [21].
[c]At either end of the street segment.

Table 3: Multiple linear regression analysis predicting step counts at baseline and at each monitoring period postintervention.

	Baseline[2]			3 months[2]			6 months			12 months		
	b	SE b	β	b	SE b	β	b	SE b	β	b	SE b	β
Step 1												
Age[1]												
Gender												
Income (annual household)												
SIMD rank												
Step 2												
Green space and recreation facilities (*Fac. 1*)[1]										−12667.3	5411.4	−.34*
Commercial and residential land use mix (*Fac. 2*)							1896.3	582.7	.40*	1259.5	622.4	.30†
Dangerous and busy roads (*Fac. 3*)[1]	−23.7	11.2	−.25*	−28.0	13.7	−.28*	−6376.0	2574.6	−.31*			
Pathway features other than safety (*Fac. 4*)[1]												
Pathway safety features (*Fac. 5*)												
Roads and bus stops (*Fac. 6*)												
Indoor fitness fac. and traffic calming feat. (*Fac. 7*)[2]							5576.3	2512.4	.27*			
Traffic signals and pedestrian signage (*Fac. 8*)							−1295.7	531.7	−.30*			
Constant	44.3	18.0		55.1	22.1		−12709.5	6992.2		39003.28	12478.1	
R^2 Step 1 (adj. R^2)												
ΔR^2 Step 2 (adj. R^2)												
Model / Step 2 R^2(adj. R^2)		0.06 (0.05)*			0.08 (0.06)*			0.343 (0.283)**			0.19 (0.15)*	
Model P		0.038			0.046			0.001			0.018	

[1] Natural log transform; [2] Square root transform

*<0.05. **<0.01.

† Borderline significant, $P = 0.05$.

predictor at baseline, and at 3 months and 6 months post-intervention (all $P < 0.05$), shows that walking levels were lower in neighbourhoods with a higher density of traffic, and this was despite higher levels of garden maintenance generally also being present in these neighbourhoods (Table 3). Previous studies have shown the impact of traffic density on walking to be mixed, due to its association with street network permeability and access to amenities. For example, Giles-Corti and Donovan [47] found a positive association between walking for transport and perceiving traffic to be present and heavy, but Cao et al. [48] found that perceiving traffic to be present and heavy seemed to discourage both transport and recreation walking, and Duncan et al. [11] found that physical activity was more likely where traffic is not perceived to be a problem. In addition to concerns for safety, poorer air quality and higher noise levels associated with heavy traffic may also discourage walking in neighbourhoods with a higher density of traffic and busy roads [49]. The inverse association found for the *Traffic signals and pedestrian signage* factor, which was a significant predictor of step counts at 6 months, probably also reflects an aversion to busy roads, as a greater incidence of both of these features can generally be associated with a higher density road network.

The positive relationship observed between step counts and the *Commercial and residential land use mix* factor, which was a significant predictor of step counts at 6 months ($P < 0.05$) and 12 months ($P = 0.05$) post-intervention (Table 3), is in concordance with the observations of a positive association between walking and land use mix and a high density of shops/amenities consistently reported in the literature [9, 10, 13]. A positive relationship was also observed between step counts and the *Indoor fitness facilities and traffic calming features* factor, which was found to be a significant predictor at 6 months post-intervention (Table 3). Access to recreation and sports facilities have generally been found to be positively associated with increased physical activity [9, 10, 13], as would be expected, especially as these types of centres often provide additional facilities that can act as walking destinations, for example, cafes. Inverse associations have been noted by others, however, for example, Giles-Corti and Donovan [50] found that members of recreation and sports clubs were only half as likely to achieve recommended walking levels than those who were not club members. Traffic safety measures have been found to be positively associated with physical activity (e.g., [11]), as would be expected due to the decreased risk of road accidents and a more attractive environment for walking associated with lower driving speeds. Further, Morrison et al. [51] found the introduction of traffic calming measures to have a positive impact on physical activity levels of a Glasgow community, based on observations of pedestrian activity made before and after the changes were made. A corresponding significant improvement in physical health was also noted (measured using the SF-36 instrument).

The inverse relationship between walking levels and the *Green space and recreation facilities* factor at 12 months post-intervention ($P < 0.05$) is somewhat contrary to what would be expected given the generally positive association found between physical activity and recreation facilities, discussed above, and the large number of studies which have shown a positive association between physical activity levels and accessible, safe green spaces (e.g., [26–29]). Inverse associations between walking and green space have also been found elsewhere, however [10, 13]. Safety concerns, poor quality green space, and low perceived accessibility are factors which could account for this pattern [52–55], and several studies suggest that any association between residential proximity to green space and health is more strongly associated with mental than with physical health (e.g., [56, 57]). Given that all four parks in the study area sit adjacent to some of the most deprived areas in Scotland (an SIMD rank in the lowest two quintiles (0–40%), Figures 1 and 2), and that the majority (71%) of study participants were female, it seems plausible that the inverse association observed here could at least in part reflect safety concerns, as safety has been found to be more important for woman's physical activity levels than men (e.g., [58]). The quality of the parks and green spaces was not audited as part of this study and it may be that nearby green space considered of poor quality is a deterrent to use for walking, as suggested by other research [53]. Alternatively, it may be that low perceived accessibility is a barrier to use, rather than poor quality, for example, in a Glasgow study Macintyre et al. (2008) found that a park of good quality may not be visited by people from deprived areas for this reason. Sugiyama et al. [53] suggest that distance is not the only factor in the association between walking levels and neighbourhood green space, especially if the purpose of the visit is recreational walking, and that quality (attractiveness) and size of the park may override distance in importance. This study also suggested that nearer local parks may be visited more often, but used in a less active way, perhaps for mental relief and relaxation rather than physical activity. Thus, the inverse association with walking activity levels observed here could be an artefact of the neighbourhood scale used in this study (400 m radius). Residential density (*Dwellings per hectare)* was also a component of the *Green space and recreation facilities* factor (Table 3) and is, therefore, also inversely related to walking levels. Again, this is contrary to what would be expected based on previous studies [10, 13]. It is possible that this finding may reflect a tendency for the highest residential densities to be found in the most deprived areas, which are generally associated with lower levels of physical activity/walking.

The lack of any significant association between step counts and the *Pathway features other than safety*, *Pathway safety features*, and the *Roads and bus stops* factors suggests that these aspects of the physical environment were not important factors influencing walking levels during this study. This probably reflects the overall quite low level of variability in these features across the study area [40], and that neighbourhoods are generally supportive of walking in terms of these features.

5.2. Relative Importance of the Environment over Time. The amount of variability in walking levels which could

be accounted for by the environment factors varied over the course of the study, from a maximum of 34% at 6 months post-intervention, to a minimum of 6% at baseline (Table 3). The much larger total variance accounted for at 6 months compared to at baseline and 3 months (6% and 8%, resp.) suggests that the environment became a more important influence on walking levels as time passed, but it was not a major factor in the early stages of the study. This pattern is what might be expected given the context of this study, as at baseline walking levels were low (and thus exposure to the outdoor environment), and individual and social factors such as perception, motivation, self-efficacy and social support are known to be more important factors for behaviour change (e.g., [59–61], and therefore would be expected to account for more of the variability in walking activity during the initial stages of the study. Thus, these findings suggest that environmental factors are unlikely, on their own, to be influential in walking behaviour change but they may contribute to the maintenance of higher walking levels as time passes post-intervention. The lower amount of variance explained at 12 months post-intervention compared to at 6 months cannot be accounted for by a decline in walking levels/reduced exposure to the outdoor environment, as average step 26 counts were almost equal (Figure 3; 6 month mean = 9658 steps, SD = 4282; 12 month mean = 9677 steps, SD = 4001). This pattern would suggest that there was an increase in the relative importance of other factors which influence walking activity in the later stages of the study, such as motivation levels and changes in perception of the environment, or seasonal variations in walking activity related to changes in weather and day length may have caused this shift. The latter is not straightforward to analyse, however, due to a rolling recruitment programme with interventions starting on different dates over a 6 month period from August to December of 2006, and thus different seasonal effects for individuals at different stages in their personal programme of interventions. All we can conclude from the current analysis is that any identified influence of environment on walking levels is found despite any potential variability in effects of seasonality or weather.

5.3. Change in Walking Levels Relative to Baseline. That no significant relationship was found between the environment factors and the relative change in step counts suggests that the local physical neighbourhood environment was not a factor influencing the change in physical activity levels in this study, although (on the basis of the discussion above), it appears to have contributed to maintenance of post-intervention walking levels over time (Table 3). As discussed above, given the importance of psychological and social factors for behaviour change, (e.g., [54, 60, 61]), this might be expected; however, there are a number of limitations relating to participant characteristics and the data collected during this study which might also account for this outcome. Firstly, due to problems with recruiting from the more deprived areas and the inclusion of more affluent areas in the study (Figure 2), it is possible that there were fewer environmental constraints on walking than if all participants had been from highly deprived areas. Because of this, it is possible that there may not have been enough particularly unsupportive neighbourhoods present in the study to be able to capture an environmental influence. This is supported by findings from the qualitative analysis, namely, that participants generally felt that their neighbourhoods were supportive of walking [38]. Secondly, it is possible that the change in step counts from baseline were too small overall for an environment effect to be adequately detected. As baseline walking levels of study participants were in general towards the upper bound of being considered "low-active," this also seems plausible. Although some large relative increases in step counts were observed for certain individuals at each stage of the study (Figure 4), average (median) values were more modest, ranging from 33.2% at 12 months post-intervention to 46.1% at 3 months post-intervention.

5.4. Contributions of This Study and Further Work. As far as we are aware this study is the first to have examined the influence of the physical environment on walking levels in the context of a walking intervention. It is one of only a few studies to provide information on walking-physical environment relationships for a European city, and whilst many studies have investigated associations between walking activity and characteristics the built environment, relatively few have employed factor analysis data reduction methods to help identify relationships with underlying, or composite, environmental variables [62, 63]. Statistical data reduction techniques are useful and preferable as they introduce analytical rigor to the analysis and thereby improve the reliability and validity of research findings [64]. The environmental factors produced from our analysis map to expectations based on the literature to some extent; however, due to the challenges in producing reliable, independent audit scores for perceived safety and aesthetics in the urban context of our study, the absence of safety and aesthetics variables is notable. It can be conjectured that residents' self-report perceptions of safety and aesthetics will vary from those of independent auditors in any case, as other studies have shown [9], and that residents' perceptions of safety, in particular, are likely to be more meaningful.

The findings of this research also make a useful contribution to the knowledge base on walking activity and urban design and management. The results suggest that environmental factors contribute to the context in which healthy walking levels may be attained and maintained but that other individual and social factors may be the dominant influence, particularly in relation to interventions to increase walking, depending on time and circumstance. The evidence on the change in relative importance of the environment over time, after a pedometer-based intervention, suggests that certain aspects of the environment that are supportive of walking become increasingly important in the first year following such an intervention. The environmental factors that support walking, in the Glasgow context of this study, are a mix of different commercial and residential land uses, traffic calming measures, and the availability of indoor fitness facilities. Dangerous, busy roads and the need for traffic

lights are inhibitors of walking, as are certain parks and recreation facilities; it seems likely that poor quality green space and/or low perceived accessibility or safety of parks and recreation facilities are the reason for the negative association found here, but more research is needed to confirm this. Overall, the evidence points to aspects of the Glasgow environment whose modification might be expected to make a difference to walkability and, therefore, to walking levels.

This study has also demonstrated that the SWAT street audit is a potentially useful tool for characterising the neighbourhood environment, but it appears that not all of the features included are relevant for assessing variations in walkability between the different parts of the Glasgow context. This may be because of insufficient variation in some aspects of the environment under study, so that attributes that are supportive of walking (or inhibit it) are present in almost all cases, and, therefore, their significance has not been detected. The presence of roadside pavements (sidewalks), for example, is almost universal in Glasgow. It is important, therefore, to recognise that environmental attributes that have not been identified as significant in relation to variations in walking levels across particular locations may nonetheless be a vital contributor to the necessary conditions for a walkable environment. Such attributes may not be sufficient to enhance or inhibit healthy walking levels in the absence of other interventions, such as social support, but they may be necessary for those interventions to have an effect [14]. To understand these factors better, SWAT should now be tested with other longitudinal studies, ideally in other UK and other European cities, where a diversity of environment will help to tease out the environmental attributes that are important for different contexts. For any further studies conducted in Glasgow, it may be effective to limit future audits to those elements which were found to be significant in association with walking. However, the full audit tool is likely to be useful in a different urban environment, where the environmental characteristics might vary much more widely, and different elements be shown to be significant for variations in walking levels. Also, as with any audit tool, SWAT will be most useful in combination with GIS data for environmental characteristics that cannot be captured effectively using the audit tool. To add to our understanding of the Glasgow context, further analysis of the physical environment data in combination with subjective walking data from IPAQ, in particular information on actual walking routes and walking purpose, may be able to provide a deeper insight into the relationship between environment and walking levels during the WWW study.

6. Conclusions

This study has shown that certain characteristics of the physical environment of local Glasgow neighbourhoods appear to have influenced walking levels during a pedometer-based community intervention to increase walking, and that the relative influence of the environment varied over time. The environment was not an important factor influencing the change in walking levels; however, it appears to have contributed to the maintenance of post-intervention walking levels over time, for up to a year post-intervention. Factors such as land use mix, traffic levels, and traffic calming, and the quality and accessibility of recreational facilities and green space, have been identified as elements of the environment which contribute positively or negatively to walkability, and, therefore, are potential targets for better planning, design, and management. This study has also demonstrated that the SWAT street audit tool has good potential for characterising neighbourhood environments, and it should now be tested with other longitudinal studies, ideally in other UK and European cities.

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Research Article

Play Equipment, Physical Activity Opportunities, and Children's Activity Levels at Childcare

Jessica S. Gubbels,[1,2] Dave H. H. Van Kann,[1,3,4] and Maria W. J. Jansen[1,3,4]

[1] *Department of Health Promotion, Maastricht University, P.O. Box 616, 6200 MD Maastricht, The Netherlands*
[2] *NUTRIM, School for Nutrition, Toxicology and Metabolism, Maastricht University, P.O. Box 616, 6200 MD Maastricht, The Netherlands*
[3] *Academic Collaborative Centre of Public Health Limburg, South Limburg Regional Public Health Service, P.O. Box 2022, 6160 HA Geleen, The Netherlands*
[4] *CAPHRI, School of Public Health and Primary Care, Maastricht University, P.O. Box 616, 6200 MD Maastricht, The Netherlands*

Correspondence should be addressed to Maria W. J. Jansen, maria.jansen@ggdzl.nl

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This study investigated the association between physical activity facilities at childcare (e.g., play equipment) and physical activity of 2- and 3-year olds. Observations of physical activity intensity were performed among 175 children at 9 childcare centers in The Netherlands, using the OSRAC-P. The physical activity facilities were assessed for indoors and outdoors separately, using the EPAO instrument. Regular (single-level) multivariate and multilevel linear regression analyses examined the association of the facilities and child characteristics (age and sex) with children's activity levels. Various physical activity facilities were available in all childcare centers (e.g., balls). Riding toys and a small playing area were associated with lower indoor physical activity levels. Outdoor physical activity levels were positively associated with the availability of portable jumping equipment and the presence of a structured track on the playground. Portable slides, fixed swinging equipment, and sandboxes were negatively associated with outdoor activity levels. In addition, the 3-year old children were more active outdoors than the 2-year olds. In conclusion, not all physical activity facilities at childcare were indeed positively associated with children's activity levels. The current findings provide concrete leads for childcare providers regarding which factors they can improve in the physical environment to facilitate children's physical activity.

1. Introduction

Childhood overweight prevalence is increasing globally, with over 42 million children under 5 years already overweight [1]. Overweight children are at risk for various chronic diseases (e.g., cardiovascular diseases, diabetes) [2] and often remain overweight as adults [3]. The preschool age has specifically been indicated as the most critical growth period for future overweight development [4]. Modifiable determinants of childhood overweight include low level of physical activity [5]. These habits are formed at a young age and often maintained during later life [6, 7]. Targeting physical activity in early childhood is therefore essential to prevent overweight throughout life.

In Europe, over half of the toddlers attend some form of childcare or education facilities [8]. Moreover, various studies have shown an increased overweight risk in children attending childcare [9–11]. The childcare setting offers a potential opportunity for environmental interventions to promote physical activity among young children [12, 13]. Such interventions can only be systematically designed after the most important environmental determinants of physical activity have been identified [14].

A review of correlates of preschool children's physical activity level showed that the preschool a child attends is significantly associated with the child's total physical activity [15]. Several authors have called for additional research to identify the specific characteristics of preschools that explain variance in physical activity levels between preschools and childcare centers [16, 17]. However, previous studies mostly summarize or quantify the physical environment into one

measure for activity opportunities (e.g., using the Environment and Policy Assessment and Observation (EPAO) instrument or its subscales [18]) or overall quality of the facility (e.g., using the Early Childhood Environment Rating Scale (ECERS-R) [19]), examining the association between such general scores and activity levels [20–26]. Although it is very informative to see whether improving general childcare quality is associated with increased physical activity, it does not provide concrete leads for childcare organizations regarding which factors they can improve in the physical environment to facilitate children's physical activity. The few studies that have previously examined specific characteristics of the physical childcare environment have linked increased physical activity to colour markings at playgrounds [27], but evidence regarding other specific factors such as playground equipment is lacking. The current study therefore examined the association of several specific, separate, physical activity facilities in the physical childcare environment (e.g., play equipment), with the physical activity level of 2- and 3-year olds at childcare.

2. Methods

2.1. Design and Procedure. The design of the study is based on a study by Bower and colleagues [22]. All nine childcare centers of a large childcare coordinating organization in Maastricht, The Netherlands, were approached to participate in the study. The coordinating organization gave consent to conduct the study and all childcare centers agreed to participate. The childcare centers each catered care for an average of 92 (sd = 28) children, of which an estimated 12% (sd = 14%) were of non-Dutch origin. On average, there were 5 groups (sd = 1) and 20 staff members (sd = 6) per center. Parents were informed about the study in a letter and were able to refuse participation, although none of the parents did so.

Each childcare centre was visited three times in May and/or June of 2008: once for an interview with the center manager and a rating of the physical activity facilities and twice for direct observations of children's activity level. The observations were performed by two observers, both trained in using the instruments described below. Children were randomly selected for observations and observed simultaneously by both observers.

The physical activity level was observed by a momentary sampling procedure with observations lasting 15 seconds each. The 30 seconds following the observation period were used to record the observation. This procedure was repeated four times over a period of three minutes for each child. Each child was observed for two nonconsecutive blocks of four observations. In total, 10 children were observed per center per day, resulting in a total of 80 observations. This protocol was implemented on two days for each of the nine centers, during one morning and one afternoon, with at least one week between the two observation days. This resulted in 2880 single observations regarding 180 children (2 observers $\times$ 9 centers $\times$ 2 days/center $\times$ 10 children/day $\times$ 2 blocks/child $\times$ 4 observations/block).

2.2. Instruments and Coding

2.2.1. Physical Activity Levels. During the observations, physical activity level was assessed by means of a translated version of the Observational System for Recording Physical Activity in Children-Preschool Version (OSRAC-P [28]). In line with the OSRAC-P protocol, mean activity intensity during the observation periods (15 seconds) was assessed on a scale from 1 (sedentary) to 5 (highly active). Activity levels ≤ 2 were regarded as sedentary and activity levels ≥ 4 as moderate and vigorous physical activity (MVPA [22]).

2.2.2. Physical Activity Facilities. The physical childcare environment (i.e., physical activity facilities) was rated using translated items of the Environment and Policy Assessment and Observation Instrument (EPAO [18, 29]). The EPAO instrument assesses the accessibility of the physical environment, that is, the presence of physical activity facilities such as play equipment.

Subscales of the EPAO were used, for example, portable and fixed play equipment, and an additional subscale for total size of the playing area. These subscales were rated separately for indoors and outdoors. Portable equipment was rated by checking the availability of 9 types of equipment: balls, climbing structures (e.g., ladders), floor play equipment (e.g., tumbling mats), jumping equipment (e.g., jump ropes, hula hoops), push/pull toys (e.g., wagons), riding toys (e.g., tricycles, cars), slides, sand/water toys (e.g., buckets, scoops), and twirling equipment (e.g., ribbons, batons). Fixed equipment was rated in a similar manner for structured tracks (e.g., playground markings), merry-go-rounds, climbing structures (e.g., jungle gyms), see-saws, slides, tunnels, balancing surfaces (e.g., balance beams), sandboxes, and swinging equipment (e.g., swings, ropes). All play equipment was rated as either present (1) or not (0). Total playing area was rated on a scale from 0 (no playing area) to 10 (very large area).

2.2.3. Background Information. Background information regarding the childcare centers, such as the number of enrolled children, was recorded during interviews with the manager of each childcare center. In addition, child's sex and age were assessed by asking present staff after the observations were finished. Weather conditions and outdoor temperature were recorded per observation day.

2.3. Statistical Analyses. All analyses were performed using SPSS 17.0. In all analyses P values $<.05$ were considered statistically significant. For activity level, the mean of the scores of both observers was calculated. Cohen's kappa was used to determine the interrater reliability (IRR) of the two observers. This measure indicates the proportional agreement between two observers, corrected for chance agreement [30]. The IRR was .7 ($P < .001$) in the current study, indicating substantial agreement [31].

All analyses were performed separately for indoor and outdoor observations. Various background characteristics were explored using descriptive statistics. The distribution

of the physical activity facilities and the mean activity levels corresponding to the presence and absence of these facilities were explored. The significance of the differences between the activity levels with and without the facilities present were examined using t-tests. The association between total playing area and the physical activity level was examined using Pearson's correlations.

Next, we conducted backward regression analyses with the physical activity facilities and child characteristics (age and sex) as independent variables and the activity level as the outcome variable. Insignificant independent variables were stepwise deleted from the model in order of their significance, starting with the least significant variable. This procedure was repeated until all remaining independent variables were significant.

Stepwise multilevel linear model analyses with 3 levels (i.e., measurement level; child level; center level) were executed to examine the association between activity level and the physical activity facilities, while modeling the interdependence between observations within individuals and between individuals within childcare centers. In the starting model, random intercepts at the child and center level were included, as well as a first-order autoregressive (AR(1)) correlation structure for repeated measures. Furthermore, random slopes at the centre level were included for child sex and age. Insignificant random effects were backward removed from the model, starting with the least significant random effect. When all remaining random effects were significant, the fixed effects were examined. The fixed effects were then examined analogous to the regression analyses described above (i.e., through the backward procedure).

We performed both the multivariate analyses where we corrected for the multilevel structure of data, and those without correction of the data, because the multilevel analyses might unintentionally overcorrect for the dependence between repeated measures within one subject in case an activity lasted longer than the duration of a single observation period (i.e., 45 seconds). This might especially be the case for various sedentary activities, such as playing in the sandbox.

3. Results

Five children were not present during the observations, leading to a total of 175 children that were each observed eight times. This resulted in 1400 observations per observer (i.e., 2800 single observations). Data regarding 18 observation periods were missing because these children were absent during one or more of the eight observation periods (e.g., because parents had already picked them up), which left 1382 observation periods for analyses. Eighty-nine (50.9%) of the observed children were male. The mean age was 2.6 years, with 75 two-year olds (42.9%) and 100 three-year olds (57.1%). The mean outdoor temperature during the observations was 20.4°C (range: 14°C–26°C). Most of the time the weather was sunny with clear skies (37.7%); least prevalent weather type was rain (11.4%).

3.1. Physical Activity Level. The mean activity intensity level during indoor observations was 2.36 (on a scale from 1 to 5). Only 5.5% of the indoor physical activity observations were classified as MVPA (moderate and vigorous physical activity; activity level ≥ 4), whereas 59.4% were classified as sedentary behavior (activity level ≤ 2). Outdoors, the mean activity level was 2.82, with 21.3% being MVPA, and 31.2% being sedentary.

3.2. Physical Activity Facilities. Table 1 provides an overview of the physical activity facilities in the 9 childcare centers. Indoors, all childcare centers provided balls and floor play equipment, and most (89%) also had portable and fixed climbing structures such as ladders and jungle gyms available. None of the centers had an indoor structured track, merry-go-round, tunnel, sandbox, or swinging equipment. The mean size of the indoor playing area was rated 6.11 (sd = 2.21) on a scale from 1 (no playing area) to 10 (very large playing area).

In line with indoors, all childcare centers also provided balls outdoors. In addition, all centers had push or pull toys and riding toys available outdoors, as well as sand or water toys and balancing surfaces. Most centers (89%) also provided fixed climbing structures, fixed slides, and a sandbox outdoors. None of the observed childcare centers had a merry-go-round or twirling equipment available outdoors. The size of the outdoor playground was rated with an average of 6.22 (sd = 3.07).

3.3. Associations between Facilities and Physical Activity Level

3.3.1. Indoor Facilities and Activity Level. Table 1 shows the mean activity levels corresponding to the indoor facilities being either present or not. Children were significantly more active indoors if jumping equipment, push or pull toys, portable slides, fixed slides or balancing surfaces were available indoors. They were significantly less active if sand or water toys were available indoors. The size of the indoor playing area was significantly positively correlated with children's activity levels (correlation coefficient $r = .17$, $P < .001$).

Table 2 shows the adjusted associations of the background factors and indoor physical activity facilities with indoor activity levels, with and without correction for the multilevel structure of the data (i.e., regression analyses and multilevel analyses, resp.). Both analyses show that riding toys are negatively associated with children's indoor activity levels, while the size of the playing area is positively associated with the activity levels.

3.3.2. Outdoor Facilities and Activity Level. The mean activity levels of the children in the childcare centers where the various outdoor facilities were either present or not are presented in Table 1. The children were significantly more active in case floor play equipment, jumping equipment, a structured track, fixed climbing structures, fixed slides, tunnels, or a sandbox were available outdoors. None of the outdoor physical activity facilities was associated with

Table 1: Physical activity facilities at childcare centers ($N = 9$) and corresponding activity levels children ($N = 175$).

Equipment		Indoor (Obs. = 710)				Outdoor (Obs. = 689)			
		Not present		Present		Not present		Present	
		Frequency	Mean activity level (sd)[a]	Frequency	Mean activity level (sd)[a]	Frequency	Mean activity level (sd)[a]	Frequency	Mean activity level (sd)[a]
Portable	Balls	0	—	9	2.36 (.61)	0	—	9	2.82 (.72)
	Climbing structures	1	2.36 (.68)	8	2.36 (.60)	7	2.80 (.74)	2	2.87 (.64)
	Floor play equipment	0	—	9	2.36 (.61)	7	2.79 (.72)	2	2.96 (.69)*
	Jumping equipment	4	2.26 (.49)	5	2.40 (.85)**	4	2.71 (.71)	5	2.93 (.71)**
	Push/pull toys	6	2.29 (.55)	3	2.44 (.66)**	0	—	9	2.82 (.72)
	Riding toys	7	2.39 (.63)	2	2.30 (.57)	0	—	9	2.82 (.72)
	Slides	8	2.29 (.55)	1	2.70 (.76)**	6	2.80 (.71)	3	2.89 (.76)
	Sand/water toys	4	2.45 (.67)	5	2.29 (.55)**	0	—	9	2.82 (.72)
	Twirling equipment	4	2.32 (.59)	5	2.38 (.62)	9	2.82 (.72)	0	—
Fixed	Structured track	9	2.36 (.61)	0	—	3	2.71 (.71)	6	2.93 (.71)**
	Merry-go-round	9	2.36 (.61)	0	—	9	2.82 (.72)	0	—
	Climbing structures	1	2.29 (.40)	8	2.36 (.62)	1	2.67 (.69)	8	2.86 (.72)**
	See-saw	8	2.36 (.62)	1	2.34 (.51)	5	2.79 (.72)	4	2.87 (.72)
	Slides	8	2.29 (.55)	1	2.70 (.76)**	1	2.67 (.69)	8	2.86 (.72)**
	Tunnels	9	2.36 (.61)	0	—	5	2.76 (.70)	4	2.94 (.74)**
	Balancing surfaces	2	2.18 (.49)	7	2.38 (.63)**	0	—	9	2.82 (.72)
	Sandbox	9	2.36 (.61)	0	—	1	2.67 (.69)	8	2.86 (.72)**
	Swinging equipment	9	2.36 (.61)	0	—	6	2.84 (.73)	3	2.78 (.70)

Obs.: number of observations.
*$P < .05$, **$P < .01$.
[a]Activity level assessed on a scale from 1 to 5. Significance levels of t-tests comparing the activity levels in centers with the equipment being present or not.

Table 2: Backward regression analyses and multilevel analyses of the association between the indoor childcare physical activity facilities and children's physical activity levels (number of observations = 710).

	Regression analysis[a]		Multilevel analysis[a,b]	
	Regression coefficient (B)	*P* value	Regression coefficient (B)	*P* value
Portable riding toys 0 = not present, 1 = present	−.32	<.001	−.31	<.001
Size playground 0 (very small)–10 (very large)	.10	<.001	.10	<.001

[a] Variables excluded from the analyses because they were present in either all or none of the childcare centers: portable equipment: ball equipment and floor play equipment; fixed equipment: structured track, merry-go-round, tunnels, sandbox, and swinging equipment. Variables excluded from the final model because they were nonsignificant: portable equipment: climbing structures, jumping equipment, push/pull toys, slides, sand/water toys, and twirling equipment; fixed equipment: climbing structures, see-saw, slides, and balancing surfaces; background variables: sex, age.
[b] Final model comprises a first-order autoregressive (AR1) correlation for repeated measures within children. Other random effects were not included in the final model.

a lower activity level in the bivariate analyses. The size of the outdoor playground was significantly positively correlated with children's activity level ($r = .13$, $P =< .001$).

Table 3 shows the adjusted associations of the background factors and outdoor physical activity facilities with outdoor activity levels, with and without correction for the multilevel structure of the data. The analyses without correction for the multilevel structure of the data (the regression analyses) show that older children were significantly more active outdoors than younger children. Furthermore, portable jumping equipment and having a structured track showed a positive association with outdoor activity levels. Portable slides, sandboxes, and swinging equipment outdoors were negatively associated with children's activity level. However, in the multilevel analyses, only the presence of a structured track was still positively associated with children's activity levels.

4. Discussion

The current study examined the association between the availability of various physical activity facilities at the childcare center and 2- and 3-year olds' physical activity levels. In general, children's activity levels were comparable to those found in an earlier study applying the same protocol in US childcare centers (mean overall activity level 2.55 [22], compared to 2.59 in the current study). With regard to the associations with physical activity facilities, the study showed different results for indoor and outdoor observations.

Indoors, children were more active when more space was available for playing. This is in line with a previous study by Cardon and colleagues [32], who found that the number of children per square meter was inversely correlated with activity levels, although this study regarded outdoor activity. We failed to find such an inverse association between the size of the playing area and activity levels outdoors. This could perhaps be attributed to the fact that Cardon et al. [32] took the number of children present also into account, which we did not. Also qualitative studies among childcare workers often mention space limitations as an important barrier for sufficient physical activity (e.g., [33, 34]).

In line with what could be expected from previous studies, which summarized the facilities assessed in the current study into one measure for activity opportunities and found a positive association between those activity opportunities and activity levels [21, 22], several outdoor physical activity facilities were positively associated with children's activity levels. Children were significantly more active when jumping equipment was present, as well as when a fixed track was marked on the playground. The latter is in line with an experimental study that showed that multicolor playground markings can increase children's activity levels, even in the long run [27].

However, there were also several play facilities that were found to be inversely associated with children's activity levels. Indoors the availability of riding toys seemed to decrease children's activity levels, and outdoors portable slides, sandboxes, and swinging equipment were associated with lower activity levels. With regard to the riding toys, this could probably be explained by space limitations and regulations indoors. The limited space restrains them from going very fast [33]. In addition, many childcare centers have safety policies or rules that limit vigorous physical activity such as running or riding very fast on a bike [33–36]. This results in the children merely sitting on a riding toy. Children in sandboxes are most of the time sitting, squatting, or standing, which explains the inverse association between sandboxes and activity level. With regard to slides and swings, we believe the negative association might stem from the fact that only one child can use these facilities at a time, and the other children are standing still, waiting for their turn. Moreover, once the child is using these equipments, he or she is again mainly sitting still. Many facilities that seem activity promoting at first glance thus appear to have the opposite effect on children's physical activity.

The negative associations found between various facilities and children's activity levels make the use of "activity opportunity" sum scores such as the EPAO score [18] (of which we used the separate components in the current study) at least questionable: not all supposed activity promoting facilities seem to actually be activity-promoting. However, the differences between the bivariate analyses and the multivariate analyses demonstrate that one can also not take only one or a few of the facilities into account when looking at the influence of the physical childcare environment on children's activity levels. The sandbox is a good example of this. In the

Table 3: Backward regression analyses and multilevel analyses of the association between the outdoor childcare physical activity facilities and children's physical activity levels (number of observations = 689).

	Regression analysis[a,b]		Multilevel analysis[a,c]	
	Regression coefficient (B)	*P* value	Regression coefficient (B)	*P* value
Age in years	.13	.019	—	—
Portable jumping equipment 0 = not present, 1 = present	.36	<.001	—	—
Portable slides 0 = not present, 1 = present	−.55	<.001	—	—
Fixed structured track 0 = not present, 1 = present	.53	<.001	.23	.003
Fixed sandbox 0 = not present, 1 = present	−.49	.002	—	—
Fixed swinging equipment 0 = not present, 1 = present	−.41	.001	—	—

[a] Variables excluded from the analyses because they were present in either all or none of the childcare centers: portable equipment: ball equipment, push/pull toys and riding toys, and sand/water toys, twirling equipment; fixed equipment: merry-go-round, balancing surfaces.
[b] Variables excluded from the final model because they were nonsignificant: portable equipment: climbing structures, floor play equipment; fixed equipment: climbing structures, see-saw, slides, and tunnels; background variables: sex.
[c] Final model comprises a first-order autoregressive (AR1) correlation for repeated measures within children. Other random effects were not included in the final model. Variables excluded from the final model because they were non-significant: portable equipment: climbing structures, floor play equipment, jumping equipment, and slides; fixed equipment: climbing structures, see-saw, slides, tunnels, sandbox, and swinging equipment; background variables: sex, age.

bivariate analyses, the presence of a sandbox at a childcare center was positively correlated with the activity levels of the children at that childcare center. However, the multivariate analyses showed a negative association between both. In practice, childcare centers that have a sandbox probably also have many other facilities available that do increase children's activity levels, because they have a larger budget for play facilities for instance, and it is actually a confounding effect that explains the positive bivariate association between the sandbox and activity levels. Indeed, secondary chi-square tests showed that the childcare centers that had a sandbox also significantly ($P < .001$) more often had various other physical activity facilities available, including jumping equipment and a structured track at the playground, which were both found to be positively associated with outdoor activity levels. In conclusion, studies examining influences of the physical childcare environment on children's activity level could probably best include a wide range of facilities, for instance, based on existing observation instruments such as the EPAO instrument [18], but refrain from summarizing these facilities into one measure for activity opportunities or childcare quality [20–26].

We found that the variability of the physical childcare environments was quite limited. Several facilities were provided in either all childcare centers (i.e., balls indoor and outdoor, indoor floor play equipment and outdoor push or pull toys, riding toys, sand or water toys and balancing surfaces) or in none of the centers (i.e., indoor structured track, merry-go-round, tunnels, sandboxes, and swinging equipment and outdoor merry-go-round or twirling equipment) in the current study. In case of the facilities that were present in none of the centers, this partly has to do with cultural differences between The Netherlands (in which the present study was conducted) and the USA (in which the EPAO instrument was developed [18]). Merry-go-rounds, for instance, are not common on playgrounds in The Netherlands. But the limited variability might also be partially due to the fact that all centers in our sample were part of the same coordinating organization, and adhere to central guidelines and policies of that organization. In that respect it would be interesting to repeat the current study in a broader sample of childcare centers. This does not solve the problem completely however, as part of the limited variability is probably not only a problem within our sample but in childcare centers in general. All childcare centers probably provide balls, for example. Experimental studies would be needed to further examine the influence of the different facilities on children's activity levels.

A strong point of the current study is that the environment and physical activity intensity were directly observed and that it did not rely on less valid measures such as self-report. Furthermore, all observations were performed by 2 observers and interobserver reliability indicated substantial agreement [31]. However, although we based the choice for the length of the observation period (15 seconds) on the design of an earlier study using the same instruments [22], a longer or shorter observation period could also have been chosen, which would possibly have influenced the findings. Another point of consideration is whether the total observed time is representative for a child's activity during a whole day at childcare. However, observations were performed in each childcare centre during both a morning and an afternoon, which covers a regular day at childcare in The Netherlands (9:00 AM–5:00 PM). Finally, children's behavior could have been influenced by other variables that were not taken into account in this study. For instance, various social environmental factors such as prompts by peers and staff have been previously linked to children's physical activity

level (e.g., [21]) but were not taken into account in the current study.

5. Conclusions

Childcare organizations can use the findings of the current study to optimize the physical environment to promote children's physical activity. Not all childcare play facilities that were expected to be physical activity promoting were actually associated with increased activity levels in children. For promoting physical activity, childcare centers should try to optimize indoor space for playing, create outdoor play ground markings, and provide jumping equipment. The use of riding toys should probably be avoided in restricted spaces. Finally, the use of various larger facilities such as slides, swings, and sandboxes should be further examined, since they possibly limit children's activity levels. These findings need further testing, specifically using experimental research designs.

With regard to future research into environmental influences on physical activity at childcare, the current study showed that physical activity facilities are probably better not summarized into general quality measures. It is, however, important to map the physical environment as completely as possible. Existing instruments (e.g., [18, 19]) are very useful for this purpose, although some cultural adaptations might be necessary, depending on the country in which the research is conducted.

6. Future Directions

The current study examined the influence of physical activity facilities on children's activity levels at childcare. Many other studies have previously examined the association between the childcare environment and children's activity levels, applying many different research designs and various focuses [16, 20–26, 32, 37–40]. However, these studies have in common that they mostly have a narrow, one-sided view on these environmental influences. This view mostly incorporates a physical activity stimulating environment as a whole, without further specifying contributes of individual environmental characteristics. Ecological models integrate environmental influences with individual influences and influences from other settings (e.g., the home environment) [41, 42], giving an overview of the broader picture in which the child's behavior takes place. We feel that also in the case of childcare, future studies should not only examine the direct influences of the childcare environment, but also the interactive influences of the childcare environment with children's characteristics (e.g., sex, temperament) and the home environment.

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Research Article

Interventions to Promote an Integrated Approach to Public Health Problems: An Application to Childhood Obesity

Anna-Marie Hendriks,[1,2,3] Jessica S. Gubbels,[3,4] Nanne K. De Vries,[1,2,3,4] Jaap C. Seidell,[5] Stef P. J. Kremers,[3,4] and Maria W. J. Jansen[1,2,3]

[1] *Academic Collaborative Centre for Public Health Limburg, Regional Public Health Service, P.O. Box 2022, 6160 HA Geleen, The Netherlands*
[2] *CAPHRI School of Public Health and Primary Care, Maastricht University, P.O. Box 616, 6200 MD Maastricht, The Netherlands*
[3] *Department of Health Promotion, Faculty of Health, Medicine and Life Sciences, Maastricht University, P.O. Box 616, 6200 MD Maastricht, The Netherlands*
[4] *NUTRIM School for Nutrition, Toxicology and Metabolism, Maastricht University, P.O. Box 616, 6200 MD Maastricht, The Netherlands*
[5] *Department of Health Sciences and the EMGO Institute for Health and Care Research, Faculty of Earth and Life Sciences, VU University Amsterdam, De Boelelaan 1085, 1081 HV Amsterdam, The Netherlands*

Correspondence should be addressed to Anna-Marie Hendriks, anna-marie.hendriks@maastrichtuniversity.nl

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Experts stress the need to bring the childhood obesity epidemic under control by means of an integrated approach. The implementation of such an approach requires the development of integrated enabling policies on public health by local governments. A prerequisite for developing such integrated public health policies is intersectoral collaboration. Since the development of integrated policies is still in its early stages, this study aimed to answer the following research question: "*What interventions can promote intersectoral collaboration and the development of integrated health policies for the prevention of childhood obesity?*" Data were collected through a literature search and observations of and interviews with stakeholders. Based on a theoretical framework, we categorized potential interventions that could optimize an integrated approach regarding children's physical activity and diet. The intervention categories included education, persuasion, incentivization, coercion, training, restriction, environmental restructuring, modeling, and enablement.

1. Introduction

Childhood obesity is currently considered an epidemic; prevalence rates have doubled over the last three decades. Globally, approximately 170 million children (<18 years) are estimated to be overweight or obese [1, 2], and 42 million of them are estimated to be under de age of five [3]. This rapid development has focused much attention on the problem [1–5], especially since childhood and adolescent overweight and obesity are associated with lower subjective as well as objective health [6–22], often track into adulthood [23], and consequently cause huge rises in health care costs, affecting economic growth [24–26].

With regard to subjective health, studies among children and adolescents from 11 European countries show that overweight or obese children and adolescents have poorer scores on the dimensions of physical well-being, self-perception, social acceptance, and bullying, compared to normal weight children and adolescents [6, 8]. Another study showed that severely obese children and adolescents experience a quality of life similar to that of children and adolescents with cancer [7]. Obese children and adolescents are also more likely to seek treatment for depression [9], are more likely to be stigmatized and discriminated against [10, 11], and are more likely to have disturbed eating patterns than normal weight children and adolescents [12]. With regard to objective

health, children and adolescents with overweight and obesity are more likely to suffer from metabolic syndrome (hyperinsulinemia, poor glucose tolerance, dyslipidemias, and high blood pressure) [14, 15], as well as from type-2 diabetes [16], atherosclerosis [17–19], asthma [20], nonalcoholic fatty liver disease (a chronic liver disease that may result in liver cancer) [21, 22, 27], and sleep-associated breathing disorders [28, 29]. Moreover, since childhood overweight and obesity often track into adulthood [23], the health consequences related to overweight and obesity frequently persist and culminate later in life. Obese adults are discriminated against in the context of employment, education, and healthcare; they are evaluated more negatively, and negative characteristics are attributed to them [10]. With regard to objective health, overweight and obesity in adults are associated with an increased risk of type-2 diabetes [30], cardiovascular diseases [31, 32], myocardial infarction [33], and several forms of cancer [34].

In view of these consequences and the related costs, many experts have stressed the need for governments to take action [25, 26]. Since it is recognized that health, and specifically obesity, is not only influenced by determinants within the health domain, but also by those outside this domain [2, 34, 35], experts stress the need to develop integrated solutions for this so-called "wicked problem" [36–39]. Such integrated approaches need to be developed and implemented by networks of local governments, public and private stakeholders, and health promoters [5, 39, 40].

Recent health data from New York [41] and Massachusetts [42] give rise to expectations for the efficacy of an integrated approach to childhood obesity. Experiences in France [43] and Cuba (during the so-called "Special Period") [44] also suggest that integrated approaches are effective. Commitment to integrated approaches is formalized in so-called "Health in All Policies" (HiAP) [45], defined as *"policies in which the most relevant sectors within and outside the health domain collaborate on the aspect of health, in which the common goal is to promote or protect health"* [46]. The development of such policies requires close collaboration with other policy sectors in the early phases of development. This is referred to as "intersectoral collaboration" [46]. For most governments, intersectoral collaboration is something new, as each policy sector has so far tended to work on the basis of its own logic and without regard for the impact on other areas of society [47].

In recent years, the Dutch national government has stressed the importance of developing an integrated approach for the prevention of overweight in children [48], and, in some Dutch regions, the regional Public Health Service (PHS) has implemented training courses to stimulate intersectoral collaboration in developing such an integrated approach for local governments. Although this training course has improved knowledge among local government officials about intersectoral collaboration, outcomes in terms of actual collaboration and integrated health policies with regard to overweight prevention have been disappointing [49]. Some causes of the slow development of integrated approaches for the prevention of childhood obesity are the lack of hard scientific evidence about the effectiveness of integrated approaches [49, 50], a lack of awareness of the childhood obesity problem in sectors outside the health domain [35], heads of departments not being sufficiently involved in the development of intersectoral health policies [51], civil servants lacking the competencies to develop such policies [49], and process management being insufficiently implemented [51–53]. Additionally, some experts argue that the political climate is ambiguous; governments do not seem eager to implement restrictive or legislative policy measures since this would mean they have to confront powerful lobbies by private companies (e.g., [54–56]).

To overcome these barriers, experts stress the need for a paradigm shift in society's current way of thinking about the childhood obesity epidemic [57, 58]; childhood obesity should be regarded as a public health problem instead of an individual health problem [58]. Three factors might explain why such a paradigm shift has not yet occurred. First, the problem is not yet taken seriously outside the health sector [25, 35, 56–58]. Second, the widespread long-term effect of obesity prevention is not yet widely acknowledged, compared to the limited success of individual-based treatment [1, 59]. Third, the potential role of the physical or built environment (e.g., lack of green spaces or playgrounds) [2, 50, 59, 60] and the social environment (e.g., parenting style) (e.g., [61]) in preventing childhood overweight and obesity is not yet fully recognized [2, 59]. Thus, compared to people's individual responsibility, society and governments are not yet held, or do not yet feel, responsible for providing healthy-weight-promoting environments (also referred to as leptogenic environments) [26, 56–58, 62]. In fact, however, the effect of such environments in determining behavior is even more decisive when it comes to repetitive and automatic behaviors such as diet and physical activity [62–64]; environments that offer immediate rather than long-term benefits for healthy diet and physical activity options can be expected to result in improvements in population health [65–68]. This approach to influencing behavior is also called "nudging" [66]. Examples of nudges are designing stairs with prompts that encourage people to use them, or making fruit freely available in schools during lunch breaks. The implementation of nudges is attracting interest from governments (e.g., [48, 50, 67]) since it seems to fit in with the trend among them to be reticent about interfering in private lives of citizens [56]. Local governments can implement nudges for individuals directly by changing the physical environment, but can also indirectly stimulate organizations in their municipality to implement nudges by developing policies (e.g., by subsidizing organizations that market healthy food products for children).

In theory, the best way to design and implement environments that promote physical activity and healthy diets is by means of integrated approaches. Integrated health policies formalize such approaches, and not only enable sectors within the health domain, but also local stakeholders outside this domain to change their environment and implement health promoting nudges. Local governmental policy sectors should collaborate in order to develop such policies.

To examine which interventions might be effective in supporting local governments in the development of

integrated health policies, we aimed to answer the following research question: "*What interventions can promote intersectoral collaboration and the development of integrated health policies for the prevention of childhood obesity?*"

2. Background

In order to provide some background information to the reflections presented in this paper, we first describe the theoretical framework used in this study and the Dutch local policy-making system.

2.1. Theoretical Framework. We reflected on possible intervention strategies using the theoretical framework developed by Michie et al. [69] (Figure 1). We adopted this framework since it provides a clear structure for categorizing intervention functions and linking them to an analysis of the behavior of actors within the policy process. Since we aimed to explore what possible interventions might be effective, rather than finding "the best" intervention, the framework by Michie et al. [69] could help us answer our research question. The framework was originally developed for the assessment of interventions intended for the traditional target population of health promoting interventions, such as intermediaries (the people who deliver the intervention) or the ultimate target group (the children), but in this study the framework was applied to behaviors of policy makers, who are the enablers of such interventions. Intersectoral collaboration was originally developed to predict the behavior of the target population. In the original framework, intersectoral collaboration might therefore be placed in the outer circle of "policies" (e.g., as a guideline or regulation) [69]. We interpreted intersectoral collaboration as a target behavior of policy makers and therefore regard it as a behavioral goal although we recognize this interpretation might be confusing.

The framework is based on the argument that behavior is determined by the following three resources: motivation, capability, and opportunity. If one of these resources is lacking or insufficiently present, behavior change interventions might be needed to increase the likelihood of achieving a particular behavioral goal. Policies can hinder or enable the implementation of certain interventions. Intervention strategies might include education, persuasion, incentives, coercion, training, restriction, modeling, and enablement [69]. These strategies can be used to stimulate intersectoral collaboration, which should ultimately lead to integrated health policies for the prevention of overweight in children.

2.2. The Dutch Local Policy-Making System. Within Dutch municipal governments, three levels of actors are involved in developing integrated health policies: actors at the strategic level (the relevant alderman, the mayor, and the municipal council), the tactical level (heads of municipal departments), and the operational level (the administrative system, consisting of civil servants) [53, 70].

At the strategic level, the local political system consists of a mayor, who is not elected by local citizens but appointed by the national government, and a coalition of local politicians and aldermen who are elected every four years. This implies that the ruling political coalition can change the direction of the local policies every four years. At the tactical level, the heads of the departments manage the work processes within the administrative system. At the operational level, officials from the health department work together with the PHS to develop the public health policies [71].

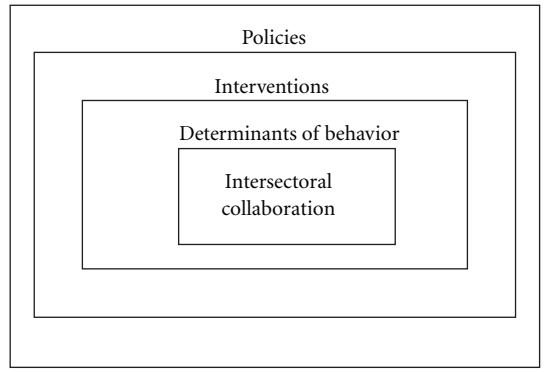

Figure 1: The behavior change wheel, adapted from Michie et al. [69].

The PHS is formally an extension of the health department of the municipal government, which means that the PHS staff belongs to the local government's administrative system. The degree to which the PHS is involved in policy making depends on the needs of the municipal government. Governments with larger health departments are more likely to have the capacity to draw up policy documents themselves, so their need for assistance from the PHS is usually less, while smaller municipalities often lack the capacity to develop these policies and thus delegate tasks to the PHS [71].

Avoiding administrative fragmentation and developing intersectoral policies requires vertical collaboration between each local government level as well as horizontal collaboration within these levels [45, 70]. Vertical collaboration refers to the collaboration between the relevant aldermen, the heads of municipal departments, and civil servants within one policy sector. Horizontal collaboration refers to the collaboration between the policy sectors at each level [47, 49, 53].

Since governmental agencies have a typically hierarchical organization structure, the decision to develop a new policy usually comes from one of three centralized sources at the strategic level within the municipal government: new national legislation that forces the municipal government to develop a new policy, a request from the municipal council for a new policy, or a decision on the part of the local aldermen that it is important to develop a policy [70–72].

If the initiative stems from actors at the strategic level, the "College of Mayor and Aldermen" all have to agree that it is in the interest of their municipality to prioritize a particular problem and develop policies for it. If they agree, a policy proposal is prepared by staff at the municipal Department of Public Health and PHS staff, who explore how the problem can be solved. Since multifaceted problems like the childhood obesity epidemic cannot be solved by

a single sector, collaboration with other policy sectors is important at this stage [71]. In practice, however, such collaboration is hardly ever established [49].

After the (intersectoral) policy proposal has been approved by the heads of municipal departments, collectively known as the management team (MT), the College of Mayor and Aldermen receives it for a final review. When they approve the proposal, it is presented to the municipal council. The council has the final decision to accept or reject the policy proposal; they have to be convinced of the importance of investing scarce resources in a particular approach to a particular problem. If the proposal is unclear, councilors can ask the relevant alderman to explain it. The alderman may be supported in this task by civil servants of the municipal government and the PHS, who can be asked to give a presentation or work out the policy proposal in more detail [70, 71].

Since the municipal council members are democratically elected, it is important for them to examine whether the interests of the citizens are served by the policy proposal. Since council members are elected every four years, policies that result in actions that are visible to citizens within a four-year timeframe are important for council members who want to be reelected [70, 71].

3. Methods

Data were gathered on the basis of a framework approach [73] derived from Michie et al. [69] (Figure 1). Interviews with stakeholders, observations at meetings of the regional PHS, and reading the relevant literature were conducted iteratively. The first author went to the participants' offices to conduct the interviews and attended meetings at the PHS. The researcher was able to attend all meetings at the PHS through her job at the Academic Collaborative Centre. Since we wanted to evaluate whether the framework could be applied in a local government environment, we held interviews with participants from the three levels within the municipal government, and other important stakeholders who were familiar with the local government's situation. The interviews were recorded and had an open character. Two questions were pertinent to all interviews: "*How does political commitment for the prevention of overweight in children come about?*" and "*How does intersectoral collaboration for the prevention of overweight in children come about?*" When interesting comments were made on a particular intervention, the researcher probed the participant for more details.

The analysis involved evaluating the interviews by listening carefully to the recordings. This analysis led to the selection of relevant parts of the interviews in order to search for common concepts, and specifically for comments on interventions. The interviews were interpreted further by analyzing these relevant parts of the written transcripts of the interviews. Quotes from the interviews are used to reflect on potential interventions presented below.

Twenty interviews were held with actors at the strategic, tactical and operational levels within Dutch local governments, supplemented with personal observations at meetings of the PHS of the South Limburg region in 2011. At the strategic level, five persons were interviewed: one mayor and four aldermen and one former national politician (who had previously been an alderman). At the tactical level, one secretary of the Board of the PHS, one head of a PHS department, and one head of a municipal department were interviewed. At the operational level, 10 civil servants from the local government were interviewed, as well as two project leaders of a program that supports municipal governments throughout The Netherlands. Observations were made at 20 meetings within the PHS. In addition, the literature on intervention strategies for intersectoral collaboration was reviewed.

Our review started by exploring the basic literature recommended by experts within the field, looking for important concepts and other relevant literature. This "snowballing" search method yielded a range of important studies. Google Scholar was used to support the retrieval of the papers thus identified. When current articles could not be found through Google Scholar, we continued our search using other databases such as PubMed. In this way, additional studies and theoretical frameworks were explored. Based on the articles, thus, identified, we searched again in a range of data bases. We applied minimal exclusion criteria during our search. Some of the key concepts we looked for, but without exclusively limiting our search to them, were intersectoral collaboration, cross-sectoral collaboration, intersectoral action for health, bridging intersectoral gaps for health, interventions/tools/strategies for inter-/cross-/multi-sectoral collaboration, local governments, collaborative governance, and politics of intersectoral collaboration. This approach was expected to yield a good impression of the interventions discussed in this paper. This implies that our literature review was not exhaustive, which we considered acceptable since the aim of this study was to provide a panoramic view of possible intervention strategies, rather than a narrow literature review on specific interventions.

Furthermore, since we did not find enough literature on interventions that is specifically related to the promotion of intersectoral working methods for childhood obesity prevention within the municipal government, we also drew on literature from other scientific disciplines, such as organizational and political sciences. Finally, intervention strategies were discussed with stakeholders.

4. Results

This section presents the reflections based on the literature, interviews, and observations on nine possible interventions strategies to promote intersectoral collaboration and the development of an integrated approach for the prevention of childhood obesity within municipal governments.

4.1. Education. Education implies increasing knowledge or understanding [69]. Creating awareness through education is especially important for problems such as obesity, for which norms among the public are slowly deteriorating, and which are therefore difficult to detect. Comparing the current norms with ideal norms, or the norms in other countries or groups (e.g., high versus low socioeconomic status groups),

might increase awareness and the likelihood that the problem of childhood obesity is put on the political agenda. One mayor said

> *This is an important role for education. . . .Health is something citizens do not see.* (Mayor)

Apart from increasing awareness, education might also be used to change the frame that dominates the discourse on a topic, since "nothing is a risk itself until it is judged to be a risk" [74], which is especially relevant for wicked problems for which the problem definition depends on ideas for solving it [36]. Actors at the strategic level might not regard themselves as being responsible for preventing childhood obesity, just as they neglected responsibility for tobacco prevention for years [75]. Education might serve as a way to point out the gains from investing in childhood obesity prevention; if a financially oriented alderman understands that prevention of childhood obesity will lead to higher work productivity later in life, he or she might become interested in investing in prevention. Ultimately, this results in cocreation by aldermen in different policy sectors. One alderman reported how education had changed his view on ways to solve the childhood obesity problem.

> *Six years ago, in our previous term of office, the college of mayor and aldermen once attended a talk by a professor, who confronted us with the statement that we have created an obesogenic society. Everything is based on comfort; nobody wants to ascend a flight of stairs these days. . . .When you enter a public building, if you look for a lift you'll spot it immediately, but if you're looking for the stairs, it takes forever, and you'll find it tucked away in some obscure corner. . . .You always first have to go through a phase of raising awareness before the College takes up the issue. . . .It touches on so many aspects (mentions all the relevant aldermen). . . .So you see it's like a fan, it fans out to include the whole College. If you really want to promote health policy, it's not so much like a bundle, but more like a skewer that cuts across all policy domains.* (Alderman responsible for public health)

However, although awareness of a particular problem might seem the most logical step toward recognizing it, actors at the strategic level often do not base their problem definition on objective analysis, but rather use it as a strategic activity to gain support for their point of view [74]. Merely educating actors at the strategic level by presenting epidemiological data can, therefore, not be expected to result in agenda setting for childhood obesity. Tailored information adapted to the portfolio of the relevant aldermen is more likely to result in effective education. However, presenting epidemiological data can boost agenda setting for those who are still unaware of the existence of the problem.

Policy sectors are not always aware of the way their policies influence health; education might increase awareness among all policy sectors, including those not involved in health [35]. An official of a municipal environmental department commented.

> *There's not a great deal of knowledge about health among the local authorities. There isn't the knowledge. It's certainly not a bad idea to involve the Public Health Service. The Service could be involved from the very early stages of development. We might invite them over. Other departments are willing to do that.* (Municipal environmental department official)

Evaluating the effects of previous policies is another way to increase awareness. However, previous attempts to create such awareness by introducing policy instruments like the Health Impact Assessment [76] have shown that awareness is not always sufficient to obtain commitment from other policy sectors.

4.2. Persuasion. Persuasion means that communication is used to elicit or enhance positive or negative feelings, or stimulate action [69]. Providing strategic information is intended to persuade, rather than to educate [77]. For example, informing aldermen about the possibilities for the development of the currently popular "public-private partnerships" as a way to implement policies is expected to stimulate political commitment for the prevention of overweight in children.

By whom people are persuaded depends on the social networks in which they operate [78]. Among policy actors, such networks are referred to as "policy networks" [79]. To integrate political values and beliefs, actors in the political arena need to possess political arguments and negotiation skills.

> *You have to convince people and show them. . .why we think this is important (referring to the integrated approach to the problem of childhood obesity).* (Alderman responsible for public health and spatial planning)

Since actors in the political arena have different interests than those at the operational level, promoting intersectoral collaboration among civil servants requires a different set of interests to be combined. This means that it is important to know how to adapt to the rationality of others. If, for example, the PHS cannot adapt to the mindset of politicians, certain health problems will not be put on the political agenda. The municipal council members and aldermen are elected every four years by individual votes and need to distinguish themselves in some way to be reelected; they need success stories based on individual health gains. The ability of the PHS to demonstrate individual progress, illustrated by narratives, is therefore expected to be more persuasive to politicians than the way the PHS currently tries to persuade them (by presenting epidemiological data). PHSs have recently recognized the following:

> *On the other hand (i.e., apart from the civil servants and the Board) you're also dealing with*

> *politics. When it came to the really crucial aspects we made sure we were present at all committee meetings, all council meetings, to explain and illustrate. So in that sense we're really investing efforts in those people. . . .Which is often difficult, in politics it's not always the factual arguments that count. You can produce a 500-page book full of factual arguments, but that doesn't mean anything to them, it gets you nowhere. You have to be able to use the kind of arguments that count for them, and you have to know which ones they are.* (PHS official)

Frames that dominate a discourse can be used to justify investing resources into intersectoral collaboration for the prevention of childhood obesity rather than in others problems. This is why reframing is such an important ability for actors in the policy context [80]. It implies that just as much effort should be invested in the presentation of data as in the data itself; information for politicians should be simple and sensible, while civil servants (the operational level) need more in-depth information about the causes and solutions. The politicians' task is to make the complexity of real-world problems understandable, while actors at the operational level should find out exactly what a problem entails and how it can be solved.

> *So you have to look for those arguments that interest them. . .and that has nothing whatsoever to do with the actual health-related arguments. . .If you see these people (i.e., politicians and administrative officials) often. . .so that you know what they're interested in (then you know what arguments to use).* (PHS official)

The difference between reframing and argumentation lies in the associative feelings that frames can elicit. For example, politicians sometimes claim that dietary intake and physical activity behaviors should not be controlled by government, but are the responsibility of individual citizens. Such claims are hard to counter with rational arguments since they refer to ethical rather than rational issues [81]. Additionally, heuristic arguments are more important than the quality of the argument if people have a low personal involvement with the topic at hand [82]. Hence, it is important to know how to reframe the debate [80].

4.3. Incentives. Incentivization means creating expectations of rewards [69], as in marketing [68].

> *So personal affinity is something that, I think, if you want a political commitment, that's what you have to look for. It means too little is being invested in. . .In my view, in the roots of the rulers. (Social marketing aimed at politicians) Very much so. . .That's marketing. . .Cola. . .Those guys are always studying what 12-year-old kids like. That's all they ever do all day. . .It's that simple.* (Former politician and alderman)

The lack of incentives and the presence of disincentives for intersectoral collaboration within the governmental system might explain the slow development of such collaboration. A political system could also incorporate a reward system that more directly incentivizes civil servants who work across sectors, for example, by giving bonuses, or that works indirectly through creating a supportive culture.

> *I think the head of a department can do a lot about this. As head of department, you can concentrate on guarding your own department's interests, and everyone will keep doing their own things, but you could also adopt a more open and positive attitude. And you can challenge your staff a bit more. You can focus on your own domain, but there are also interfaces with other domains, so you should also spend some time on that. You shouldn't just stick to your own little territory.* (Head of municipal department)

What works as an incentive for a person depends on their values [83], so it is crucial to have a thorough understanding of the actors for whom an incentive is being developed. For example, if a municipal council member wants to be reelected (the incentive), what matters to them are votes, and this person will invest in policy topics that attract votes: a way to provide incentives. One alderman said

> *Most council members are not terribly interested in health policy. It just not sexy, to use that word. It's not cool. What they're interested in is housing, spatial planning. That's what they like. Because that's what citizens ask them about. They talk about the pavement being new, or grass not being mown in time, or a tree not being pruned in time. Those are the things they notice. But health policy, that's something citizens don't see. . .So it's really visibility that. . .What is it, what are the consequences, what's in it for me. That's the first question any council members asks. . .And they are politicians, right? They're politicians. They want to score with the electorate. . .They want to be reelected in four years' time, or now even in three years. Be reelected to the council. And what are citizens interested in? That tree and that pavement. Not in not being fat or such things.* (Alderman responsible for public health and spatial planning)

Another alderman said that he had been reelected because the municipal government had invested in the prevention of childhood obesity; he had made his efforts visible by attracting media attention, which improved the town's image.

> *(What you need is) a kind of motto you can link to your town. "(Town's name), a Healthy City". That's sounds good, right? That's where you want to live, that's where you want to work, that's where you want to spend your leisure time.* (Alderman responsible for public health)

Investments in childhood obesity prevention are expected not to diffuse quickly within municipalities because the relative advantage of investing in childhood obesity prevention is still an abstract concept to most politicians, and visible results in terms of body mass index are only observed in the long term, beyond the four-year timeframe of most politicians [70]. Thus there is a need for increased effort by the PHSs to highlight relative advantages and make health progress more visible [84].

4.4. Coercion. Coercion means the use of punishment in the form of penalties or disincentives [69]. One civil servant suggested that managers could coerce civil servants if they refused to collaborate with colleagues from other policy sectors, resulting in health policies that failed to become integrated.

> *We sign our proposal. ...Then the head of the department initials it, then the secretary initials it. ...If along the way nobody looks at integration, or, in the end that's where the drive should come from. ...so go back to the drawing board. ...That will be uncomfortable at first, but it forces people to think.* (Civil servant at municipal health department)

However, the expectation of coercion might also have adverse effects. Since the governmental system rewards civil servants who work without failures, most civil servants engage in risk-avoiding behaviors [85], which may suppress creativity [86]; if heads of departments express skepticism about each innovation, such as initiating intersectoral collaboration, civil servants will be unlikely to initiate it (they will experience this as a disincentive). Additionally, if innovations (e.g., new rules for working methods) are forced upon civil servants, they might be perceived as a threat, making the manager's efforts result in oral agreements which will never be implemented. A lack of congruence between the values of the managers or the organization and those of the employees might develop into what is known as a "façade of conformity" in the latter. In order to survive or succeed within the organization, employees might act as if they embrace the organization's values whereas they do not act upon them [87]. Therefore, rules are expected to be better enforced by "carrots" (promises of rewards to compliers) than by "sticks" (threats of punishment to noncompliers) [68].

4.5. Training. Training is intended to increase skills [69]. A recent evaluation of a training course for civil servants that was intended to increase their skills for intersectoral collaboration showed that although the course was effective in terms of increasing knowledge about integrated health policies, it did not result in more intersectoral collaboration and integrated approaches to childhood obesity in terms of concrete actions. This was attributed to the fact that the civil servants and alderman were often replaced after they had attended the course, or the civil servants involved did not have sufficient time to put the acquired skills into practice. Another cause of this poor outcome of the training could be that the skills were not "hands-on" enough and got stuck at the level of knowledge, making it look more like education. This lack of opportunity eliminated the effect of the training [49]. One alderman responsible for public health commented as follows

> *Well, I think...there are enough training institutes that regard an integrated approach as their mission and that can help you. We've seen that at the PHS. To me, that was a real eye-opener. I mean, I'm not involved in health care myself, but I thought it was very, it was an eye-opener. And I think that if people get this eye-opener and then perhaps they themselves can, err, training the trainer or whatever it's called. Training the trainer? Yes, training the trainer. You could introduce that sport of thing too. But I think it's often a matter of the penny having to drop. You have to see the advantages. The gains. ...You have a particular objective, for instance regarding health, like achieving a healthy weight, and you then see that you, well, you tend to think mostly about diets and dieticians and that sort of thing. But as soon as you take a broader view, a whole new world opens up.* (Alderman responsible for public health)

Training to improve policy makers' adaptive skills is especially important in the case of childhood obesity prevention since the solutions to this "wicked" public health problem [36–38] may depend on the problem and opportunities to implement solutions in the local situation. For example, defining which stakeholders should be involved in the effort to empower parents to stimulate their children to become physically active and eat healthy food requires the municipal government or PHS to investigate which organizations are active in the environment of the individual children or their parents. This knowledge may not be available beforehand but should be proactively sought. After the stakeholders have been identified, each stakeholder should be stimulated to collaborate. This requires strategic modes of operation, which means adapting to their interests. Many experts have therefore emphasized the importance of the skill to increase the capability of leaders to persuade stakeholders (e.g., [57]). A former politician stated

> *You have to convince your colleagues. Hundreds of books have been written about how to do that. You just have to master those techniques. You can read about these things. All those things have to be...It's not a matter of being right. I was convinced I was right for eight years. It's a matter of convincing others you're right.* (Former politician and alderman)

4.6. Restriction. Restrictions, which may be imposed for instance by laws and regulations, are rules that define which behaviors are not allowed [69]. For example, local governments are not allowed not to allocate resources for public health issues; the Dutch public health law obliges local

governments to take care of public health and develop a health policy document every four years [72]. One alderman said that this stimulated his involvement in childhood obesity prevention. Some rules are defined at national level, to prevent citizens from being subjected to a different set of policies in each municipality.

> *So this municipal autonomy is sometimes a good thing as it's close to the citizens. Those municipal officials quickly realize what's going on and can take tailored measures. But the disadvantage is that you might end up with a patchwork of different measures in different municipalities.* (Mayor)

In The Netherlands, adherence to such rules is monitored by the Health Inspectorate. They concluded that, in recent years, devolvement of tasks to local governments (which started three policy cycles ago) has yielded disappointing results [88]. So although local governments do produce health policy documents, their quality is not always sufficient.

The national government also imposes rules on civil servants and managers within the municipal government; the municipal management team (MT) is formally charged with checking whether the health policies developed by the civil servants are coordinated and integrated [51]. In everyday practice, however, the MT only checks if such rules are adhered to in terms of financial aspects. One alderman of public health referred to the following:

> *You can develop a procedure on paper, but as I just said, if it remains a piece of paper it won't work. So if you. . .Because you do of course need to have it, because we do have a procedure here and it does work. And there's the stamp of approval from the finance department. That works. And why does it work? Because we all know that if that stamp of approval isn't there then nobody in the College of Mayor and Aldermen is willing to say yes. Right? That's very black-and-white, but that's how it is. And that's how it should be here.* (Alderman responsible for public health)

4.7. Environmental Restructuring. Environmental restructuring means changing the social or physical context [69]. Social context refers to the political and public interests or the culture within an organization, while the physical context refers to the institutional design [89], the organizational structure [90], or the geographic proximity of colleagues from other policy domains. Both contexts are expected to be closely interconnected; some municipalities expect that changing the organizational structure will lead to a change in the organizational culture (e.g., [91]). For example, one municipal public health official commented that intersectoral collaboration with her colleagues from the spatial planning department was poor because they were located in another building. It is expected that when people are put together in the same space, they are naturally more inclined to discuss certain topics. Things like meetings increase physical proximity and therefore create social opportunities.

> *So first of all it's important that those officials around you that you have to depend on to achieve something, that they, that they can agree with the ideas you want to realize in the end. And what I then, I'm just speaking for myself now, what I usually do is that I sound out my fellow aldermen. I think that, well, you just raise the topic of overweight prevention. How can we deal with that? And then it's a matter of making sure you're prepared, that you've thought about ways to tackle the problem. By getting round the table with the parties involved, by organizing things in spatial planning and so on. I could name a few more.* (Alderman responsible for public health)

Political and public interests are similar to the concept of "policy stream" introduced by Kingdon [92], and the concept of "social-political context" proposed by Paulussen et al. [93]; it includes the national government and the laws and regulations it imposes, the organized political forces, civil servants at important positions, the network of organizations within the community, and other problems that prevail in the community and attract attention.

Institutional design refers to organizational structure; Mintzberg [90] distinguishes different types of structures to match different organizational purposes [94]. The theory of institutional design refers to these changes in an organization's structure as "organizational restructuring" [89]. Environmental restructuring includes changes outside the organization (e.g., the national culture or organizational climate), while organizational restructuring only refers to changes within the organization (e.g., the organizational structure). Both environments determine (indirectly) why innovations are adopted or rejected [84, 93]. For example, in some Dutch regions, the PHS has implemented a training course that aimed to increase the skills of civil servants to collaborate with other sectors. Although the civil servants adopted the new idea of working collaboratively, the organizational structure hampered the implementation of new working practices. Hence, the innovation was not implemented and did not continue after being adopted [49].

Future attempts to stimulate intersectoral collaboration may thus require organizational structures to be changed at the same time. Examples of such attempts by governments are the implementation of E-government systems [95, 96], intersectoral work teams, and matrix structures [90]. Matrix structures organize work based on a project or theme (e.g., the environments in which people live) rather than a subject (e.g., spatial planning). One municipal public health official commented as follows.

> *People within our department and the other departments are not engaged in public health. However, we expect that the new department structure (referring to the new matrix structure being developed for the municipal government) will change many things.* (Public health official)

4.8. Modeling. Modeling means providing an example that people can and want to copy [69]. Modeling an intended

behavior change is based on classical learning theories, in which a person develops associations through observation. Bandura's [97] Social Learning Theory argues that a person becomes motivated if certain behaviors and the consequences of those behaviors are observed in a role model who is "walking the walk." Such a model can be a person, an organization or a concept, as long as it is an example that includes an association between a cause and an effect.

A person can only be a role model if the observer can identify with him or her, or is in a similar situation. For example, after a politician has retired, he or she might still be interested in working in the political field, but in a different role, working as a role model or entrepreneur for childhood obesity prevention might be a way to stimulate others in the same situation to copy their entrepreneurship. Examples of such role models for national and local governments include First Lady Michelle Obama in the United States [5], and former politician Paul Rosenmöller in The Netherlands [98].

Organizational practices can also be used as examples to stimulate other organizations to adopt the same practices [93]. Some organizations, for example, stimulate their employees to engage in exercising, and such policies can be copied by other organizations (e.g., [99]). If a large part of the organizational network adopts a certain innovation, it increases the likelihood that others will also adopt [93].

Examples make abstract concepts, like intersectoral collaboration, more concrete and motivating.

> *Yes of course you have to make it concrete. Otherwise it won't work. You just have to tackle a specific case and say, listen, this works. That's what I found, at the PHS at the time, that's what I thought was very good. They used this example. . . I think it's that one, with the high-rise building with those lifts and the stairs. . . . Yes, I found that. . . As soon as you hear something like that you think, wow, yeah. Anybody could have thought of that, but nobody did.* (Alderman responsible for public health and spatial planning)

Previous research found that heads of municipal government departments reported intersectoral collaboration to be difficult to achieve because there were no concrete examples [51]. PHSs could, therefore, assist municipal authorities by providing such examples, like the program called "Youth on a Healthy Weight" (which is known in Dutch by the acronym JOGG). JOGG gathers examples and disseminates them, in a planned and systematic campaign, among their network of local governments [98].

Additionally, social interests may change through modeling; if citizens observe that children's health is improving in another but similar municipality, the municipal council might become motivated to copy the measures taken in the other municipality:

> *But at another municipality they're doing a lot more, or doing less about overweight. What effect do you think that has on our citizens? The citizens see that Oud-Beijerland, our neighboring municipality, they're doing this and that about overweight. . . . And citizens see this and they talk to the council members and say why aren't we doing something like that? So then the council members at a certain point start to say, they're doing this and that in Oud-Beijerland, and we're doing nothing. Don't we have this problem here, mister alderman? . . . It's just because they see it happening elsewhere.* (Alderman responsible for public health and spatial planning)

4.9. Enablement. Enablement means increasing opportunities for removing or dealing with barriers, not including training, education, or environmental restructuring [69]. Barriers to intersectoral collaboration at the strategic level might be removed by having two domains combined in one alderman's portfolio.

> *So public health and spatial planning currently happen to be the responsibility of the same alderman. . . . And that means I can't make the link between spatial planning (and childhood obesity prevention). . . . But then it is mine, that's where you get integration.* (Alderman responsible for public health and spatial planning)

A frequently mentioned barrier to implementing integrated health policies is the lack of time to manage the process. Process managers in public health often have too little time to complete tasks, or they may not be replaced if they become ill or change jobs. This barrier might be explained by the lack of involvement among heads of departments [51]. This lack of leadership at the tactical level makes the organizational culture less supportive [100], which might be a barrier to the development of integrated health policies.

> *You can make your own integrated little plan (at the operational level), but it should also be targeted at (the tactical level).* (Municipal public health official)

However, if civil servants, despite the support of their managers, do not know how to develop such policies, they could overcome this barrier by consulting experts. And, in the absence of the boundary-spanning skills of a project coordinator, an external project coordinator with such skills might be appointed. One official at a non-health-related department identified the fact that external advice is always not offered free of charge by the PHS as a barrier to involving the PHS in their policy development.

> *For some reason, the PHS is not consulted. . . It's only when you ask a very specific question. . . that there are some agreements (between the municipality and the PHS) on what's included in the standard package of what the PHS is involved in within the municipality, but if it's not specific (when the question is not included in the standard package) we have to pay for it. . .* (Municipal environment official)

Inflexible agreements might, therefore, represent a barrier to non-health-oriented policy sectors consulting PHSs. More

flexible agreements, enabling municipal authorities to ask for health advice free of charge, might increase the involvement of the PHSs in developing non-health-related policies. Easy access to advice seems especially important to improve the collaboration with the nonhealth sectors since it often happens that a health recommendation clashes with the interest of nonhealth sectors. For example, if a spatial planning official is advised to reverse his plans in such a way that the city centre becomes less car friendly, he might expect at least some resistance from car owners. If he is also forced to pay for such advice, his motivation to ask for it is likely to decrease.

5. Discussion

Without governments that promote healthy nudges or restrict unhealthy ones in existing environments, the childhood obesity epidemic is expected to be difficult to bring under control [65, 66]. Integrated health policies, which are developed through intersectoral collaboration, seem to be the ideal way to design and implement sustainable environments that stimulate physical activity and healthy diets. Integrated approaches not only enable sectors within the health domain but also local stakeholders outside the health domain to change their environment [45, 46]. This may stimulate the implementation of successful interventions to promote a healthy weight. Promoting this development should be based on reflections about various interventions to promote intersectoral collaboration and the development of integrated health policies. At each level within the municipal government, a different set of interventions is expected to be most relevant. Relevance of interventions is expected to be related to the actions that need to be performed by actors at each level; strategic level actors, for example, are responsible for the decision to adopt the idea and therefore need to be persuaded rather than trained. Based on these considerations, the relevance of the various interventions is discussed below, followed by a brief discussion on the methodology of the present study.

5.1. Interventions Aimed at the Strategic Level: "Impossible Only Means That You Haven't Found the Solution yet". Education, persuasion, and incentivization are probably most important interventions for actors at the strategic level; they need to be persuaded that investing in childhood obesity is urgent and receive incentives to overcome party-political and -organizational self-interests. Other strategies seem less important here since they tend to focus on capability and opportunity. These are more important at the lower levels in the municipal hierarchy. This is in line with Jansen's [53] views; strategies to increase collaboration between niches at the strategic level include brokering, sidestepping the formal system, lobbying, and agenda-setting. All these strategies can make use of persuasion and incentivization [68, 78]. Kingdon [92] also maintains that agenda setting for a new policy appears when a problem is recognized at a certain point in time (which can be achieved by increasing knowledge about the problem and by persuasion), when the way to solve the problem is accepted (which can be achieved through brokering) and when the political climate is favorable (which can be achieved by offering incentives to decision makers). However, before persuading an actor at the strategic level, they should be made more aware of the urgency of solving the problem [84]. Providing narratives that illustrate an individual's health progress is thought to be educational and persuasive to actors at the strategic level. After that, persuasion techniques are necessary to cross-boundaries or broker between the actors from the health and nonhealth sectors; they should solve the problem together. Using interpersonal channels is very important for such brokering. It makes persuasive communication more effective, which is especially important since the health and nonhealth policy sectors have a niche character [84]. Providing incentives for investing in childhood obesity prevention is, therefore, expected to compensate for the difficulty of the persuasion efforts and increase the relative advantages for those involved [84, 101]. Stakeholders, such as PHS staff, who are trying to influence the development of integrated health policies, should therefore have sufficient knowledge about what could constitute an incentive for the actors at the strategic level. Programs such as JOGG [98] seem to posses such knowledge: they proactively increase the visibility of aldermen's actions through media attention and use role models with whom actors at the strategic level can identify.

5.2. Interventions Aimed at the Tactical Level: "Mobilizing the Troops". Education, training, and modeling are expected to be especially important for actors at the tactical level; these actors need to be aware of the requirements for facilitating intersectoral collaboration (e.g., making it a priority and therefore allowing time to be spent on it) and be aware that childhood obesity is a problem that is best approached in an integrated way. Furthermore, actors at the tactical level need to know how to manage the process of intersectoral collaboration to produce integrated health policies. Improving specific process management skills with regard to intersectoral collaboration is regarded as useful in this respect [52, 53]. Managers from commercial organizations or successful heads of departments from other municipal governments can educate or train actors at the tactical level. In order to have the right influence or to be opinion leaders, they need to be similar to the actors they are educating or training, but possess more skills to perform process management. Furthermore, commercial organizations may have more know-how about tools which can support the task of process management to increase intersectoral collaboration (e.g., E-government systems) [95, 96]. Learning from commercial organizations' best practices involves the intervention functions of education, training, and modeling. Modeling is expected to be particularly relevant. However, it seems that learning from others' experience is often rejected by actors at the tactical level; municipal governments seem to be rather introverted organizations. Additionally, previous research has concluded that staffing or recruitment policy is an important strategy for actors at the tactical level [53]. This can be stimulated through education and training.

Heads of departments can recruit civil servants who are "team players"; recruiting individuals who are skilled and willing to collaborate will increase the likelihood that they will initiate and sustain collaboration, compared to civil servants who are incapable and unmotivated to collaborate. Besides focusing on hiring the right individuals, the tactical level also seems very important as regards developing the right organizational culture. Kotter [102], who is an expert on leading organizational change, emphasizes the need to create a change-friendly culture by creating a continuous sense of urgency to improve performance. Leaders within the organization should continuously reinforce alertness and curiosity, instead of greeting it with skepticism [86, 102].

5.3. Interventions Aimed at the Operational Level; "Don't Blame the Foot, If the Shoe Doesn't Fit". Training, environmental restructuring, and enablement seemed to be particularly important for actors at the operational level; they need to be competent to work across sectors, and at the same time they depend on actors at the tactical level to allocate scarce resources, such as time. Restructuring the organizational environment, for instance, by rearranging the workspace and creating a supportive organizational culture, is usually controlled by higher-level actors. Environmental changes can stimulate actors at the operational level to initiate and sustain collaboration [102]. This is line with Steenbakkers [49] and Jansen's [53] suggestions; operational level changes can only be sustained if they are supported by higher-level changes. Blaming individuals should therefore be avoided. Steenbakkers et al. [49] also suggest that training should focus on increasing civil servants' ability to adopt a problem-based approach and to formulate concrete long-term goals. Additionally, barriers that emerge during change processes can be overcome through a proactive and creative approach by civil servants. Instead of thinking along a straight line, divergent thinking skills can enhance their ability to come up with a wider range of solutions to overcome any barriers. Increasing the available time can be achieved through prioritizing but can also be achieved by consulting the regional PHS. Moreover, PHS staff can use the experience they have gained in previous training courses to prepare civil servants to overcome previously identified barriers [49, 51].

5.4. Limitations. A weakness of the present study is its methodology. We chose to derive arguments from the interviews rather than from a detailed examination of certain hypotheses or cases through systematic analysis. Although we are fully aware of this limitation, we adopted this approach since we aimed to explore the field inductively first. In our further studies, we will systematically collect and analyze such data, and we want to encourage other researchers to do the same.

6. Conclusion

Actors within municipal governments may or may not be motivated or able to develop integrated health policies for the prevention of childhood obesity, but they are nevertheless asked by outside stakeholders to do so. Awareness of a whole range of interventions can help such stakeholders to rethink ways of stimulating or assisting municipal authorities in addressing children's physical activity and dietary habits through policy development.

Regional PHS staff can be used to persuade and incentivize actors at the strategic level by showing them success stories based on individual health gains, or by making health progress more visible within a four-year timeframe (the time to reelection of council members and aldermen). Programs that incorporate a wide range of such interventions can be tailored to the needs of the actors involved. These needs may differ depending on the stage of knowledge about the innovation [84] (e.g., the need to be educated before being persuaded) or other conditions specific to the targeted actor (e.g., the rearrangement of their workspace).

Diffusing the development of integrated health policies is assumed to start with knowledge about the topic [84]. This knowledge should be available nowadays since the Ottawa Charter already mentioned the need for integrated health policies in 1986 [103], and several training courses to stimulate their development have been implemented among municipal governments in recent years (e.g., [49]). To take the diffusion of this innovative working method a step further, interventions should be implemented that can accelerate the decision to adopt and implement the integrated approach to childhood obesity prevention by municipal governments. Hence, programs that persuade and support municipal governments should be developed and disseminated. A good example is the Dutch JOGG program [98, 104].

Future studies should examine the behavior change techniques and procedures used in programs that incorporate interventions to stimulate the development of the integrated approach to childhood obesity prevention within local government. This knowledge can be used to survey the full range of intervention options available, and to select rational options from among them.

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Research Article

Measuring the Food Environment: A Systematic Technique for Characterizing Food Stores Using Display Counts

Cassandra Miller,[1] J. Nicholas Bodor,[2] and Donald Rose[2]

[1] *Healthy Communities Institute, 2054 University Avenue, 3rd Floor, Berkeley, CA 94704, USA*
[2] *School of Public Health and Tropical Medicine, Tulane University, 1440 Canal Street, Suite 2301, New Orleans, LA 70112, USA*

Correspondence should be addressed to Donald Rose, diego@tulane.edu

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Marketing research has documented the influence of in-store characteristics—such as the number and placement of display stands—on consumer purchases of a product. However, little information exists on this topic for key foods of interest to those studying the influence of environmental changes on dietary behavior. This study demonstrates a method for characterizing the food environment by measuring the number of separate displays of fruits, vegetables, and energy-dense snack foods (including chips, candies, and sodas) and their proximity to cash registers in different store types. Observations in New Orleans stores ($N = 172$) in 2007 and 2008 revealed significantly more displays of energy-dense snacks than of fruits and vegetables within all store types, especially supermarkets. Moreover, supermarkets had an average of 20 displays of energy-dense snacks within 1 meter of their cash registers, yet none of them had even a single display of fruits or vegetables near their cash registers. Measures of the number of separate display stands of key foods and their proximity to a cash register can be used by researchers to better characterize food stores and by policymakers to address improvements to the food environment.

1. Introduction

Over the past decade, there has been a large increase in research on the neighborhood food environment, with a number of studies documenting associations between the food environment and dietary intake or weight status [1–13]. These and other studies have led to recommendations by scientific panels and policy makers that promote improvements in neighborhood access as a strategy for dealing with the obesity epidemic. For example, the Institute of Medicine listed improving neighborhood access to healthy food as one of the key actions that local governments could take to address the child obesity epidemic [14], and the US President's budget for 2012 included funding for a fresh food financing initiative to improve food access in underserved areas [15].

Despite the tremendous growth, the field is still relatively new, and more research is needed on methods to better-characterize the food environment. One approach to studying it has focused on measures of access to retail food outlets, such as distance to the nearest supermarket [3, 16] or number of supermarkets within a defined area [1, 4, 6, 10]. A second line of research has focused on measures of food within the store. For example, in-store measurements of shelf space have been conducted to study the availability of different types of foods within stores [17], while other studies have looked at inventories of different types of foods or the pricing of foods [8, 18–28].

Marketing research has demonstrated that the in-store environment affects consumer purchasing decisions. It is well known, for example, that the amount of shelf space is an important determinant of sales [29]. Other studies have found that additional display stands influence purchasing behavior [29–32]. For example, in their classic study Wilkinson et al. [32] found that sales increased between 77 and 243% when a brand was displayed in a secondary location. Increasing the number of display stands of a product increases the likelihood that a consumer will encounter it in the store, and thus increases the probability of its purchase, particularly for impulse items. In marketing research that

investigated both consumer and in-store characteristics, Inman and coauthors [31] found that additional displays increase unplanned purchases by almost 40% over baseline estimates. The importance of gaining visual attention of the consumer has also been documented in point of purchase studies [33].

Despite the importance of the number of display stands for influencing consumer purchases, and the relative ease in which these data can be collected, very few studies have provided evidence on this variable for foods of particular interest to dietitians and nutritionists [34, 35]. In this study we demonstrate a method for characterizing the food environment by measuring the number of separate displays of various foods and their proximity to a cash register in different types of stores. Because of their documented importance to public health, we focus on fruits, vegetables, and energy-dense snack foods [36, 37].

2. Methods

A census of all food stores in the city of New Orleans was developed in the fall of 2007. We began with a commercial list of stores from InfoUSA, which we verified on the ground to assure that listed stores were still open and that new stores were included in the list. Stores were categorized into one of six types: supermarkets, midsize food stores, small food stores, convenience stores (including those attached to a gas station), drug stores, and general merchandise stores. The category of general merchandise stores included local discount retailers and chain discount "dollar" stores that sell a variety of consumer goods in addition to packaged foods. North American Industry Classification System (NAICS) codes and sales data from InfoUSA were used to categorize the stores. Stores with a "supermarket and other grocery store" NAICS code that had annual sales greater than $5 million dollars were classified as supermarkets. Stores with this same code and sales between $1 million and $5 million dollars were classified as midsize food stores, and those with less than $1 million annual sales were categorized as small food stores. Other store types did not rely on sales data for classification and were based directly on the NAICS codes. New stores found on the ground were classified into one of the six categories using information on store characteristics (e.g., number of registers, inventory sold). A 30% random sample of stores was chosen. Additional details regarding development of the store census and sampling have been described previously [38].

In-store observations were taken for 90 stores in 2007 and 113 stores in 2008, with 31 stores observed in both 2007 and 2008. A comparison of data for stores observed in both years did not reveal any significant differences, so these stores were randomly assigned measurements from one of the two years. A total of 172 unique stores were observed, forming the analytic sample for this paper.

Teams of two observers per store collected information on the number of separate displays for five broad categories of fruits and vegetables—fresh fruits, fresh vegetables, canned fruits, canned vegetables and frozen vegetables—and five types of energy-dense snack foods—salty snacks (such as chips and nuts), cookies and crackers, doughnuts and pastries, candies, and carbonated beverages. A continuous linear aisle, or a portion thereof, devoted to a given food category (e.g., fresh fruits), regardless of the number of vertical shelves, was counted as one display, as was a separate island devoted to a given food category. If items for the same food category appeared in two separate linear shelves (e.g., such as in a different aisle, or on opposite facing shelves within the same aisle) they were counted as two separate displays. Displays were counted only once, regardless of the number of specific foods within a given category (e.g., a display aisle of fresh apples, bananas, and/or other fruits was counted as a single display of fresh fruits) nor were they separated by brand (e.g., two or more brands of canned pineapples in a display aisle was counted as a single display). The same method was applied to all food categories, including energy-dense snacks, where brand and type within each snack category were not considered when counting displays. We did not limit our counting of a display to a minimum or maximum length. Observers also recorded whether each separate display was within one meter of a cash register. Interobserver reliability for our method was high with a Pearson correlation value of 0.997 for fruits and vegetables and a value of 0.968 for snacks. Paired t-tests showed no significant differences between the mean numbers of displays counted between observers. Supercenters, such as Wal-Mart, were excluded from the analysis, because of the inherent differences in supercenters from other retail food outlets. Additional details on the in-store protocol can be requested from the authors.

Analysis of variance (ANOVA) was used to assess overall differences ($P < 0.05$) in the number of displays by store type. The least significant difference (LSD) test was used post hoc to assess differences in the number of displays for pair-wise combinations of stores. Within a store type (e.g., supermarkets), a paired sample t-test was used to assess the difference between the total number of fruit and vegetable displays versus the total number of energy-dense snack food displays. For clarity of presentation, and because of its overriding policy interest, these aggregate food groups (i.e., all fruits and vegetables, all energy-dense snack foods) were used for statistical testing of differences. Data were analyzed using SPSS (version 16.0.1, 2007, SPSS Inc, Chicago, IL, USA). This study is exempt from institutional review as it did not involve human subjects.

3. Results

Of the 172 stores that were surveyed, 8 were supermarkets. The most frequently observed stores in the study were convenience stores ($n = 69$) and small stores ($n = 63$).

Almost all stores sold each of the 5 energy-dense snack foods, but the availability of fruits and vegetables differed markedly by store type. Fresh fruits and vegetables were available at all supermarkets and 80% of small stores, but only at 45% of convenience stores and 6% of drug stores (results not shown). Twenty-eight percent of convenience stores did not sell fruits or vegetables of any kind, that is, neither fresh, canned or frozen.

Table 1: Mean number of separate displays, by food group and store type, New Orleans, 2007-2008.

Food group	Supermarket (n = 8)		Midsized (n = 8)		Small store (n = 63)		Conven[1] (n = 69)		Drug store (n = 16)		Genl merch[2] (n = 8)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
All fruits and vegetables[3]	20.1[a]	9.9	9.1[b]	6.5	5.8[c]	3.9	2.7[d]	2.6	3.1[d]	2.7	5.1[cd]	4.4
Fresh fruits and vegetables	12.8	6.8	3.8	2.7	2.4	2.1	0.9	1.3	0.1	0.5	1.1	3.2
Fresh fruits	6.1	2.2	2.0	1.8	1.2	1.1	0.5	0.8	0.1	0.5	0.5	1.4
Fresh vegetables	6.6	4.9	1.8	1.0	1.2	1.2	0.4	0.8	0.0	0.0	0.6	1.8
Can/froz fruits and vegetables	7.4	3.9	5.4	4.2	3.4	2.3	1.8	1.6	2.9	2.4	4.0	2.6
Canned fruits	2.5	1.8	2.4	2.5	1.4	1.0	0.8	0.8	1.9	2.0	2.0	0.8
Canned vegetables	3.5	2.5	2.1	1.7	1.7	1.3	0.9	0.8	1.0	0.6	2.0	2.3
Frozen vegetables	1.4	0.5	0.9	0.4	0.4	0.6	0.1	0.3	0.0	0.0	0.0	0.0
All energy-dense snack foods[3]	79.8[a]	51.3	21.8[bc]	5.7	17.3[c]	6.1	16.8[c]	7.3	24.5[b]	10.7	29.3[b]	12.2
Candy	18.3	13.0	5.4	2.6	3.1	1.6	2.9	1.6	8.8	5.1	9.3	3.5
Salty snack foods	22.9	14.1	6.5	3.3	4.3	2.2	4.4	2.6	5.4	2.9	7.4	4.7
Cookies and crackers	14.4	11.0	3.3	2.1	3.2	1.5	2.9	1.7	4.4	2.4	5.0	1.9
Doughnuts and pastries	12.5	8.8	2.8	1.5	2.4	1.4	2.7	1.6	1.8	1.4	3.0	1.6
Carbonated beverages	11.8	8.1	3.9	1.7	4.3	2.0	3.9	2.0	4.2	1.6	4.6	2.4

[1,2] "Conven" refers to convenience stores, and "Genl merch" refers to general merchandise stores.

[3] Analysis of variance (ANOVA) was used to study the difference by store type in the total number of displays of fruits and vegetables. The overall ANOVA was significant ($P < 0.05$). The LSD test was used post hoc to test the difference between pairs of stores. Store types sharing a common superscript (e.g., convenience, drug, and general merchandise stores) were not significantly different from each other on number of displays of this food group. A separate ANOVA was done and found to be significant ($P < 0.05$) for differences in energy-dense snack foods by store type. Within each store type, paired sample t-tests showed significantly ($P < 0.05$) more energy-dense snack displays than fruit and vegetable displays.

Table 2: Mean number of displays within 1 m of a cash register, by food group and store type, New Orleans, 2007-2008.

Store type		All fruits and vegetables		All energy-dense snack foods	
	N	Mean	SD	Mean	SD
Supermarkets	8	0.0	0.0	19.9	17.0
Midsized stores	8	1.0	2.1	5.9	3.9
Small stores	63	0.3	0.5	2.8	2.8
Convenience stores	69	0.2	0.5	2.5	1.9
Drug stores	16	0.2	0.4	5.5	3.1
General merchandise stores	8	0.0	0.0	4.9	2.2

Supermarkets not only had the greatest number of separate displays of fruits and vegetables (mean = 20 ± 10) but also had a much greater number of separate displays of energy-dense snack foods (mean = 80 ± 51) (Table 1). Following supermarkets, midsize stores had the greatest number of separate displays of fruits and vegetables (mean = 9 ± 6) and general merchandise stores had the greatest number of separate displays of energy-dense snack foods (mean = 29 ± 12). Regardless of store type, all stores contained more displays of energy-dense snack foods than of fruits and vegetables.

Not one supermarket in the sample had a single display of any type of fruit or vegetable within a meter of their cash registers (Table 2). Although this was true for most stores in the sample, some midsized stores did have displays of fruits or vegetables that were close to cash registers (mean = 1.0 ± 2.1). In contrast to their stocking practices for fruits and vegetables, supermarkets had many displays of energy-dense snack foods within a meter of their cash registers (mean = 19.9 ± 17.0). Out of the ten food groups studied, the top three items displayed within 1 meter of a cash register for supermarkets were candy, salty snack foods, and carbonated beverages (results not shown). For all other store types the top three items close to registers were candy, salty snack foods, or doughnuts and pastries.

4. Discussion

This study has demonstrated a method for characterizing the in-store food environment by counting the number of separate displays of foods and determining their proximity to cash registers. Benchmark results on this information for different store types in a major American city are provided for food groups of importance to those working on obesity and urban food access.

Not surprisingly, supermarkets had more displays of fruits and vegetables than other store types, while drug stores or convenience stores had very few. The availability of these "healthful" foods is consistent with general impressions about supermarkets, as well as with a growing literature that has drawn associations between proximity to supermarkets and positive diet or weight status outcomes [1–4, 6, 7, 39, 40]. No direct comparisons on the number of displays of these foods can be made with previous research, since, to the best of our knowledge, no other studies exist on this topic.

But our results are consistent with previous in-store studies showing supermarkets with much greater shelf space of fruits and vegetables than other store types [17].

What is more striking about our results is the sizable number of displays of energy-dense snack foods in supermarkets, particularly the large number of displays of these foods within one meter of store cash registers. Industry research has widely supported that 70–83% of confectionery sales are impulse driven [41]. Recognizing this, most supermarkets and other retail outlets strategically place candy and other items near checkouts. Our findings are consistent with this strategy and with other research on this topic. An observational study of 24 supermarkets in Melbourne, Australia, found that foods displayed at supermarket checkouts were predominantly energy-dense confectionary items [34]. The Food Commission in the United Kingdom surveyed several London supermarkets in 2003 and found all but one of the supermarkets contained confectionery or other snack foods at the checkout [35]. Fruits and vegetables are not usually thought of as impulse items, but supermarkets could certainly experiment with placing snack-size produce—such as individual apples or bananas or prewashed packages of baby carrots—near check-out registers.

While the checkout-counter findings are not surprising, quantitative information about this situation can generate awareness about the problem, and also serve as baseline for measuring progress. To date, most of the policies and programs to address obesity through changes to the food environment have focused on bringing more supermarkets to an area, or on improving the offerings of small stores. For example, financing initiatives have been developed to bring supermarkets to low-income areas [42–47]. In some cases these initiatives can be used by existing small stores in underserved areas, so that they can improve infrastructure to carry more fruits and vegetables. There are also a number of examples of "corner store initiatives," that is, efforts to convince small store owners to carry healthier foods [12, 48, 49].

However, virtually no work is being done on limiting access to energy-dense snack foods in supermarkets. Given the narrow profit margins in the industry and the importance of stocking decisions to store profits, such work would certainly be an unlikely battle. One viable approach might be to focus on improving the quality of check-out stands, and other aspects of supermarkets, through a voluntary recognition program. Just as the LEED (Leadership in Energy and Environmental Design) designation has sought to encourage green building designs [50], so might a similar program seek to promote characteristics of healthy store designs [14]. Whatever the specific goal that public health nutrition advocates might seek, our study and others like it can provide baseline documentation for efforts to improve in-store aspects of the food environment.

This study is not without limitations. While it takes into account the number of separate displays, it does not consider other factors that might influence consumer purchasing, such as the size or location of separate displays or the prices of foods. Another limitation is the exclusion of whole grains, reduced-fat dairy products, and other important food groups from our study. Our goal here was to focus on a few key food groups that have been linked to obesity and that we could appropriately observe in a larger number of stores. This study was conducted at stores only within New Orleans, so the usual caveat about generalizability from a localized study applies here. Finally, although marketing research has indicated the importance of the number and location of displays, we have no evidence on the impacts of such variables on diet and health outcomes. Additional research is certainly needed in this regard.

5. Conclusions

As the field of environmental nutrition expands, more comprehensive assessments of neighborhood food environments are needed. This study demonstrates a useful and relatively simple method for characterizing the in-store environment of retail food outlets by counting the number of separate display stands and their proximity to cash registers for fruits, vegetables, and energy-dense snack foods. Although supermarkets are often thought of as contributing to the healthiness of the food environment, they have many more displays of energy-dense snacks than of fruits and vegetables, particularly at check-out counters. Further research is needed to corroborate these findings and to examine the relationship between in-store display variables and diet and health outcomes.

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Research Article

The Healthy School Canteen Programme: A Promising Intervention to Make the School Food Environment Healthier

Fréderike Mensink, Saskia Antoinette Schwinghammer, and Astrid Smeets

The Netherlands Nutrition Centre, P.O. Box 85700, 2508 CK The Hague, The Netherlands

Correspondence should be addressed to Fréderike Mensink, mensink@voedingscentrum.nl

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The environment can exert a strong influence on people's food decisions. In order to facilitate students to make more healthy food choices and to develop healthy eating habits, it is important that the school food environment is healthy. The Healthy School Canteen programme of The Netherlands Nutrition Centre is an intervention that helps schools to make their cafeteria's offering healthier. A descriptive study was conducted by an independent research agency to survey the perceptions, experiences, and opinions of users of the programme (school directors, parents, students, and health professionals). Results show that directors and students of participating schools perceive their cafeteria's offering to be healthier after implementing the programme than prior to implementation. Next, further important results of the study are highlighted and relations with other projects, caveats, and practical recommendations are discussed. It is concluded that the Healthy School Canteen programme is a promising intervention to change the school food environment but that further research is needed to ultimately establish its effectiveness. Also, it will be a challenge to motivate all schools to enroll in the programme in order to achieve the goal of the Dutch Government of all Dutch school cafeterias being healthy by 2015.

1. Introduction

With 14% of young people in The Netherlands being overweight [1], the prevalence of overweight continues to grow, and many teenagers have an unhealthy food pattern containing too much saturated fats, sugars, and a lack of dietary fibre [2]. The fact that children spend many hours at school each day, including lunchtime, causes the school environment to be an important out of home setting where children consume at least one main meal a day. Almost 90% of all secondary schools in The Netherlands have a school cafeteria and/or soft drink vending machines, and 80% have vending machines selling snacks and candy bars [3]. With one in three schools selling pizza and one in five selling deep-fried products, almost half of all schools selling candy bars and a lack of fresh fruit in 57% of the schools [3], there is still a lot to improve when it comes to offering healthy foods in the school cafeteria. In this paper, we will first elaborate on why it is important to offer healthy food in school cafeterias and then introduce the Healthy School Canteen programme, an intervention that is aimed at making the school food environment healthier. In the remainder of this paper, we will discuss a descriptive study that was conducted to assess perceptions and opinions of parties that (have) participate(d) in the programme.

The idea that environmental factors can be important in shaping human behaviour is not new. In the 1930s, Lewin already emphasizes in his field theory that both the person and the environment need to be taken into consideration when studying human behaviour [4]. Lewin, considered to be the founding father of social psychology, conventionalised human behaviour as a function of both the person and the environment. This idea became known as Lewin's equation: $B = f(P, E)$. From this heuristic, it follows that behaviour is the result of an interplay of one's personal characteristics and the situation (that contains both physical and social elements) in which the person operates. This perspective provides a useful starting point from which to consider

eating behaviour. Specifically, it could help to explain that good and strong intentions to eat healthily (person factors) are most of the time not enough to prevent people from making unhealthy food choices. Rather, temptations that lurk in one's direct environment such as the smell of hamburgers or seeing friends eating candy bars can be very powerful in shaping people's actual eating behaviour.

Although Lewin's equation was quite revolutionary in his days and sparked some debate among fellow scientists, his conceptualization is widely acknowledged nowadays. Also, in the domain of eating behaviour, there is ample evidence now that environmental cues can influence people's eating decisions, both consciously and unconsciously. For example, research has demonstrated that the way food is presented, portioned, and packaged in one's direct environment can affect the amount of food that one consumes. Specifically, larger serving portions and packages usually allure people to consume more food, which in turn leads to greater energy intake [5, 6]. In addition, the accessibility and presentation of foods can influence people's food choices in such a way that the more accessible or easy to reach certain types of food are, the more they are being consumed [7, 8].

Interestingly, the impact of the environment on people's food choices and eating behaviour is dependent on the way in which people make their food decisions. Specifically, decision-making and choice behaviour usually results from one of two distinct cognitive processes: reflective or impulsive processes [9, 10]. When decision-making is powered by the reflective system, people think carefully and rationally and they usually act upon their intentions. On the other hand, when people operate through the impulsive system, they act more automatically and spontaneously and are usually led by impulses. It is under these circumstances that environmental cues can strongly affect people's decisions and behaviour [9]. When we apply these insights to the current topic of eating behaviour, it is to be expected that the environment strongly influences such behaviour when people make food choices via the impulsive system (as opposed to the reflective system). Research on habits and information processing has demonstrated that when behaviour has become habitual and when people are not motivated or cognitively involved enough (or are too distracted) to engage in effortful reasoning and deliberation, their decision making will likely be powered by the impulsive system [11, 12]. More specifically, this implies that when people have well-developed eating habits and are not very much involved in their food choices (and as a result do not invest much time and effort in thinking about their choices), the environment is likely to determine their eating behaviour to a large extent.

A recent study indicates that most students do not consider their eating patterns important and making healthy food choices is not a top-of-mind issue for them [13]. Also, meals and foods are consumed during breaks, which are for most students social events in which they communicate and hang out with each other. These two facts imply that students, when they are at school deciding what to eat for lunch, will most probably not be motivated enough or too distracted to engage in deliberate decision making about their eating behaviour. Therefore, it is very likely that most students' choices about what to eat are largely based on decision making through the impulsive system. As a result, environmental cues, such as the mere presence of unhealthy food items, portion and packaging sizes, and tempting smells or displays of unhealthy food, will most probably have an impact on students' eating behaviour. In line with this, students themselves also indicate that they are influenced by the presence of unhealthy food in the school cafeteria. More specifically, they admit to be tempted when they see or smell palatable and unhealthy food [14]. For this reason, many Dutch students indicate that in their opinion schools should only sell healthy products [14]. Still, the majority of school cafeterias offer a large amount of unhealthy food products, and the school environment contributes in this way to the development of unhealthy eating patterns in young people.

At the same time, school cafeterias offer great potential to improve students' eating behaviour. When taken into consideration that most students tend to engage in impulsive decision making, when it comes to their food, this implies that environmental cues can also "nudge" them in the direction of more healthy choices. When cafeteria offerings would be predominantly healthy and healthy food would be made more attractive (e.g., appealing presentation, putting it on display), it is to be expected that this would increase healthy choices. And indeed, a study by TNO has demonstrated that this can be a fruitful and effective means of encouraging healthy eating behaviour in students: changing the offering of vending machines into low-calorie candy, snacks, and soft drinks, resulted in students choosing these healthy products more often [15]. As a result, they had a lower calorie intake than students of schools with vending machines in which products with a lot of sugar and fat prevailed.

Another reason why targeting students offers great potential to improve healthy eating habits is that eating habits that are formed early in life may persist into adulthood [16] and that, once an unhealthy habit has been established it is difficult to change [17]. Therefore, promoting and establishing healthy habits in young people is probably more effective and fruitful than trying to change unhealthy habits later in life. In addition, schools are increasingly indicated as key settings for interventions related to healthy eating. Health promotion in schools is worth the effort, because it can contribute to healthier behaviour in pupils, higher academic achievements, and a reduction in school drop-out levels [18]. At the same time, the school setting is an important context for health promotion because it reaches a large proportion of the population for many years [19]. It also offers a safe environment to practice new skills [20]. These skills have an effect on the possibility of young people to protect themselves against health risks and can positively affect their lifestyle into adulthood [20]. In sum, interventions aimed at changing students' eating behaviour in the school setting have a lot of potential.

Given the influence the environment can exert on students' food choices, it is crucial to create a healthy food environment in schools that facilitates students to choose healthy food products. In this way, students are enabled to develop healthy eating habits from which they can benefit the

rest of their lives. With this particular aim the Healthy School Canteen programme was developed. The Healthy School Canteen programme of The Netherlands Nutrition Centre is an environmental intervention designed to create a healthy food environment and promote healthy food choices in secondary schools and schools for vocational training in The Netherlands. This intervention entails a multicomponent strategy involving all parties: students, teachers, parents, school boards, canteen employees, Municipal Health Services, and caterers.

The programme consists of a four-step roadmap for school working groups, consisting of (1) an Inventory (what is the current state of affairs regarding cafeteria offerings, curriculum and policy?), (2) an Action Plan (setting goals and corresponding actions), (3) an Implementation Phase (implementing the action plan), and (4) an Evaluation (what has been achieved?). While completing these four steps, the school is guided towards a healthy school canteen in their own tempo. As health promoting interventions are more effective when they are structurally implemented in schools and the set up is comprehensive [18], the Healthy School Canteen programme not only motivates schools to change the offerings in the school cafeteria but also encourages them to embed knowledge of healthy nutrition in the curriculum and to develop healthy school food policies. Municipal Health Services play an important role in guiding schools through the process of change. As we have learned from experience, not every Municipal Health Service has enough time and manpower to support all schools in need of support in their region. To be able to support the schools in need, an important additional component of The Healthy School Canteen programme was created: the "Canteen Brigade." This brigade consists of dieticians employed by The Netherlands Nutrition Centre, who give tailored advice to schools and, if necessary, visit schools to provide tailored advice and support on site.

Since the pilot study in 2002, almost one third of all secondary schools in The Netherlands have worked with the programme [3]. In 2006-2007, 11% of all secondary schools participated; in 2010-2011, 29% indicated to have participated in the programme in the last four years [3], which is a substantial increase. To motivate schools to enroll in the programme, a Healthy School Canteen Stimulation Award competition has been organized biannually since 2006. This competition challenges schools to submit an action plan that describes the steps they will take to create a healthier food offering. After 6 months, a report must be handed in, in which the achieved goals are described. The school that has accomplished the most structural changes will win the award.

In 2010, a descriptive study among users of the programme was carried out by an independent research agency to survey the perceptions, experiences, and opinions of school directors, parents, students, and health professionals with the programme [21]. This study was undertaken to gain more insight on perceptions of users of the programme and to define factors that could help to improve the programme. In this descriptive study, the following issues were addressed: (1) perceptions of the school's cafeteria offerings, (2) the way in which the school's cafeteria was managed, (3) the role of the Municipal Health Service, (4) continuation of the programme, (5) additional value of the Stimulation Award competition, (6) parents' involvement in the cafeteria's offering, and (7) possible factors that stimulate nonparticipating schools to enroll in the programme. (The Canteen Brigade has been active since the end of 2009 and, for this reason, was not part of the research study. Schools for vocational training started participating in the programme from 2011 and, for this reason not part of the research study.). In the remainder of this paper, we will elaborate on this research and present and discuss the most important results.

2. Method

2.1. Recruitment and Procedure. Contacts of schools that participated in the Stimulation Award competition in 2006-2007, 2008-2009, and/or 2009-2010 were approached by e-mail to provide us with the e-mail address of their school director, student council, and parent council. A dataset with e-mail addresses of every Dutch secondary school was used to invite nonparticipating schools to participate in this study.

Subsequently, directors of participating schools (school directors of schools that (have) participate(d) in the Healthy School Canteen Stimulation Award competition at one point in time during the years 2006–2010) and nonparticipating schools and parents and students of participating schools, were invited to participate in the study and were sent links to online questionnaires. In total, four online questionnaires were sent out; one to school directors of participating schools, one to parent councils of participating schools, one to student councils of participating schools, and one to school directors of non-participating schools (respondents of participating schools only had to answer questions that were relevant to them; respondents of schools participating in the school year 2009-2010 for instance did not have to answer questions about continuation of the programme as they had just started). Questionnaires were sent to 153 directors of participating schools, 139 parent councils, 137 student councils, and 708 nonparticipating schools.

In addition, interviews were held with ten school directors of participating schools of the Stimulation Award competition in the school year 2006-2007 and 2008-2009, who were randomly selected and approached by telephone and e-mail with the request to participate (school directors of schools participating in the Stimulation Award competition at that specific time were not approached to participate, because questions about continuation of the programme would not be relevant yet). All interviews were conducted by an independent research agency. Finally, an expert meeting was held with 12 health promoters of involved Municipal Health Services to discuss their experiences supporting schools during the process of changing the offering of their school cafeteria by implementing the Healthy School Canteen programme. For this expert meeting, all contacts of 28 Municipal Health Services were invited by e-mail to participate. The expert meeting was conducted by an independent strategy development agency.

2.2. Questionnaires

Directors. The online questionnaire for school directors of participating schools first assessed their perception of the school's cafeteria offerings. Specifically, the following questions were asked: "How was the ratio healthy/unhealthy offerings in the school cafeteria before start of the programme?" and "How is the ratio healthy/unhealthy offerings in the school cafeteria at this moment?". Answers were given on 5-point Likert-type scales (1 = *almost entirely unhealthy products*, 5 = *almost entirely healthy products*).

Subsequently, questions about the programme, the degree of external support and continuation of the programme, and the Stimulation Award competition were presented. Specifically, the following questions were asked

(i) "Who manages the school cafeteria?" with three response options; (1) internal management, (2) external management (professionally organized catering), or (3) otherwise, namely....

(ii) "Did your school receive support from the Municipal Health Service?" with two response options; "yes" or "no."

(iii) "How do you evaluate the support given by the Municipal Health Service?" Answers were given on 5-point Likert-type scales (1 = *quite insufficient*, 5 = *very good*).

(iv) "Which continuation activities did your school carry out?" with response options like "structural change in canteen offerings" and "development of a school food policy".

(v) "The Healthy School Canteen Stimulation Award competition motivated to enroll in the Healthy School Canteen programme." Answers were given on 5-point Likert-type scales (1 = *totally disagree*, 5 = *totally agree*).

Students. The online questionnaire for student councils of participating schools also first assessed their perception of the school's cafeteria offerings. The student councils were asked to represent the opinion of all students when answering the questions.

Specifically, the following questions were asked: "How was the ratio healthy/unhealthy offerings in the school cafeteria before start of the programme?" and "How is the ratio healthy/unhealthy offerings in the school cafeteria at this moment?". Answers were given on 5-point Likert-type scales (1 = *almost entirely unhealthy products*, 5 = *almost entirely healthy products*).

Subsequently, questions were asked about involvement and perception of the students regarding the programme. Specifically, the following question was asked: "Were students involved at the start of the programme?". There were three response options; (1) yes, (2) no, or (3) I do not know. In addition, students were asked to respond to the statement: "Our students acknowledge the importance of the Healthy School Canteen programme". Answers were given on 5-point Likert-type scales (1 = *totally disagree*, 5 = *totally agree*).

Parents. The online questionnaire for parent councils of participating schools explored involvement and perception of the parents regarding the programme. The parent councils were asked to represent the opinion of all parents when answering the questions.

Specifically, the following question was asked: "Were parents involved/informed at the start of the programme?". There were three response options; (1) yes, (2) no, or (3) I do not know. Also, the following statement was used: "Parents have a say in selection of school canteen offerings". There were three response options; (1) yes, (2) yes, but only through the parent council, or (3) no. Next, parents were asked to respond to the following statements: "Parents know what is offered in the school cafeteria" and "Parents have a say in the cafeteria's offering". There were three response options; (1) yes, (2) no, or (3) I do not know. Finally, parents were asked to respond to the statement: "Parents acknowledge the importance of the Healthy School Canteen programme." Answers were given on 5-point Likert-type scales (1 = *totally disagree*, 5 = *totally agree*).

Nonparticipating Schools. The online questionnaire for school directors of nonparticipating schools assessed their perceptions of the school's cafeteria offerings. Specifically, the following question was asked: "How is the ratio healthy/unhealthy offerings in the school cafeteria at this moment?" Answers were given on 5-point Likert-type scales (1 = *almost entirely unhealthy products*, 5 = *almost entirely healthy products*). Also, statements were used to determine which factors would motivate them to participate in the Healthy School Canteen programme. Specifically, directors were asked to respond to the following statements: "The required time investment has to be met for by the school" and "The required finances have to be met for by the school." Answers were given on 5-point Likert-type scales (1 = *totally disagree*, 5 = *totally agree*).

2.3. Interviews with Directors.

The interview design was based on the online questionnaire and consisted of in-depth and additional questions about the school director's participation, support during execution of the programme, continuation, Stimulation Award participation, and possible improvements of the programme.

2.4. Expert Meetings

Health Professionals. The aim of this meeting was to obtain more insight in their experiences, needs and the role Municipal Health Services play within the programme. Participants were asked to indicate which components of the programme should be continued, which components should be eliminated and with which components the programme should be enriched. More specifically, one of the statements that was used was "Municipal Health Services perceive the Stimulation Award competition to be an incentive for schools."

3. Results

3.1. Questionnaires. Response rates were as follows: 62,7% ($n = 96$) of school directors of participating schools filled in the questionnaire, 54% ($n = 75$) of the parent councils, 38,7% ($n = 53$) of the student councils, and 25,6% ($n = 181$) of nonparticipating schools. Of the 181 nonparticipating schools, 39 were eliminated from the study because they were already implementing the Healthy School Canteen programme ($n = 29$) or were interested in doing so ($n = 10$). Hundred and thirty-five schools were not motivated to enroll in the programme in the nearby future. These schools received the questionnaire. The most important findings will be discussed below.

Perceived Cafeteria Offering. Differences in mean scores of participants on the questions regarding the offering before and after implementing the programme (at this moment) were compared with paired t-tests. Differences in mean scores of school directors of participating and nonparticipating schools on the question regarding the offering "at this moment" (for participating schools, this was after implementing the programme) were compared with an independent t-test.

Analyses showed that both school directors and student councils perceived the offering before and after implementation to be significantly different. Specifically, directors perceived the cafeteria offering to have shifted from relatively more unhealthy products before start of the programme ($M = 2.17$) to more healthy products at the present moment ($M = 3.76$; M-change $= -1.60$; SD = 1.12), $t(83) = -13.05$, $P < 0.0001$. For students, a similar pattern emerged: they also perceived the cafeteria offering to have shifted from more unhealthy products before start of the programme ($M = 2.55$) to more healthy products at the present moment ($M = 3.80$; M-change $= -1.25$; SD = 1.62), $t(39) = -5.28$, $P < 0.0001$. In contrast, directors of nonparticipating schools perceived (at this moment) that the number of unhealthy and healthy products being offered at their cafeteria was equal ($M = 3.06$). Analyses showed there appears to be a significant difference in perceived offering "at this moment" between school directors of participating schools and school directors of nonparticipating schools (SD = 1.39), $t(217) = 4.68$, $P < 0.0001$.

Cafeteria Managing. 69% of schools indicated the school cafeteria had internal management, and 31% of schools indicated the school cafeteria had external management. In addition, there appeared to be a relationship between whether the cafeteria was catered by the school or an external party: 32,7% of schools with a cafeteria managed by the school itself against 12,0% of schools with an external caterer indicated to have an almost completely healthy offering in the school cafeteria (Spearman's $r = .26$, $P = 0.015$). Apparently, cafeterias that are managed by a professionally organised external caterer have a less healthy offering than cafeterias managed by the school.

Role of Municipal Health Service. 73% of participating schools indicated they were supported by a Municipal Health Service, and the majority are (very) content with this support: sufficient (32%), good (42%), and very good (17%). Only schools that started the programme during the school years 2006-2007 and/or 2008-2009 were questioned about continuation of the programme ($n = 48$).

Continuation of Programme. Three activities that have often been undertaken as continuation of the programme are structural changing the food on offer in the cafeteria (69,2%), making healthy eating a part of the regular curriculum (64,1%), and changing the school food policy (61,5%).

Additional Value Stimulation Award. A majority (75,3%) of directors of participating schools (completely) agreed that the Stimulation Award competition motivated to enroll in the healthy School Canteen programme.

Parents' Involvement with Programme and Cafeteria Offering. 59,2% of the students and 47,9% of the parents say they were involved at the start of the programme. Of the parents, 15,2% reported they had a say on what is being sold in the cafeteria, and almost half of the parents indicated they know what is being sold (48,3%).

Importance of Programme. 55,3% of the students and 80% of the parents (totally) agreed with the statement that the Healthy School Canteen programme is important.

Stimulating Factors for Nonparticipating Schools. Important factors for nonparticipating schools to start with the program are time and finances: 78,5% indicated enough time is (very) important, and 73,3% pointed to sufficient finances as being (very) important.

3.2. Interviews. All 10 interviewed school directors were positive about the Stimulation Award competition and find it a good initiative. The interviews also revealed that schools are in need of "role model schools" and experiences of other schools for inspiration. All 10 interviewed school directors indicated support of students, teachers, and parents was created and that support of the school director was sufficient. Seven school directors indicated the school was supported during the programme by the Municipal Health Service, and 5 school directors indicated they received support from The Netherlands Nutrition Centre. All ten interviewed school directors indicated healthy food had been included in the school food policy.

3.3. Expert Meetings. During the meeting with Municipal Health Services, 12 professionals were present. Below the most important insights are discussed.

Municipal Health Services feel that the Stimulation Award competition is a relevant part of the Healthy School Canteen programme, and according to them, the programme

is a good way to highlight the importance of healthy nutrition in secondary schools. However, they indicate that there should be more time to execute the programme when participating in the Stimulation Award competition, partly because they need enough time to recruit schools.

4. Discussion

It appears that schools participating in the Healthy School Canteen programme have been successful in creating improvements in their school cafeteria offerings due to implementing the programme, as they report to have healthier offerings compared to nonparticipating schools. Also, the Stimulation Award competition is seen as a motivator to enroll in the programme both by schools and Municipal Health Services. It is encouraging that both school management and students perceive that their cafeteria's offering has positively shifted into the direction of more healthy than unhealthy food products. A recent study on overweight prevention in secondary schools in The Netherlands in 2010-2011 supports this finding and states that, for a large number of schools, improvements in their cafeteria were realized (at least in part) by participating in the Healthy School Canteen programme [3]. The overall picture indicates that the school cafeteria offerings in The Netherlands have become healthier compared to 2006-2007. This is probably largely due to an increase in healthy products being offered and a decrease in unhealthy products [3].

The Healthy School Canteen programme and the present findings are also relevant in light of the overall aim of the Dutch government to realize healthy school canteens in all schools in The Netherlands by 2015. The present findings provide a first indication that the Healthy School Canteen programme could be a powerful contributor in achieving this goal. This goal was also adopted by the Dutch Covenant on Healthy Weight. This Covenant is a collaboration of a total of 27 actors from (national and local) governments, industry and civil society organizations, which are collectively committed to fight against the rising trend of overweight and obesity. The main goals of the Covenant are increasing awareness of health risks related to overweight and obesity and achieving an arrest in the evolution of overweight and obesity in children and adults. Within this Covenant a Manifest on Healthier Food in schools was realised in 2011 in which parties agree to work together towards schools where the food offered in the school cafeteria is healthy to a minimum of 75% according to the Dutch guidelines for healthy food.

4.1. Relations with Other Initiatives. Across Europe, many countries take action to positively change the school food environment. For example, English chef Jamie Oliver has striven to improve unhealthy diets and poor cooking habits in schools in the United Kingdom since 2005 when he launched his "Feed Me Better" campaign. Since 2006, junk food is banned in British schools, and new legal food-based standards for school food were brought in. Next to the UK, also Portugal has compulsory regulations on the provision of school lunches [22]. Several other European countries have also adopted measures concerning nutrition in schools. For instance, France has banned automatic vending machines and energy drinks in 2005 and 2008, respectively [22], and Spain has banned the sale in schools of food and drinks that have high amounts of saturated fat, trans fats, salt, or sugar in an effort to tackle a rising prevalence of overweight and obesity [23].

4.2. Practical Recommendations and Critical Remarks. Results indicate that support from a Municipal Health Service is highly appreciated. As mentioned before, Municipal Health Services do not always have enough time and manpower to assist all schools in need of support in their region. Therefore, it is to be recommended to keep the Canteen Brigade as an important component of the programme. The Brigade provides schools with tailored advice, so schools know where to start, which products are suitable for a healthy offering, and how to create a healthy school canteen. And indeed, the Brigade is increasingly being called upon by schools to help them change the cafeteria offerings. Another advantage of deploying a Brigade is that it reinforces the efforts of the Municipal Health Services, for example, by acting as interlocutor when talking with an extern caterer.

Another recommendation to ensure continuation of the programme that follows from the present findings is that schools should always be advised to include healthy nutrition in their school food policy. In addition, schools should strive for structural changes in the school cafeteria offerings and incorporate healthy eating in the regular curriculum. These factors should increase potential success. Also, schools can be informed about the "Healthy School Method" of the Centre for Healthy Living. This method promotes an integrated and structured approach to create a healthy school, including healthy cafeteria offerings.

A last recommendation concerns the Municipal Health services. To be better able to meet their need, it is advisable to allocate more time to them to recruit schools for the Stimulation Award competition.

Also, some critical remarks seem in place. First, it is noteworthy that, with respect to the near future, the atmosphere seems to be somewhat less favorable compared to five years ago. During the school year 2006-2007, 59% of the secondary schools expected to pay more attention to the issue of overweight in the near future, compared to 31% in 2011 [3]. In addition, a lower percentage of secondary schools (37% in 2011 compared to 46% during the school year 2006-2007) consider themselves to be coresponsible for the prevention of overweight among students [3]. Also worth mentioning is the fact that the offering of food and beverages appears to have become more healthy, but there was an increasing offer of pizza slices and sugary milk products [3]. This development could be a threat to achieving the goal of healthy school canteens in all Dutch schools in 2015.

In addition, some barriers concerning the content of the programme have to be tackled, as not all school directors report a shift from mostly unhealthy offerings

before the programme to mostly healthy offerings currently. Unfortunately, we do not have full insight in completion of the programme: schools who participated in the Stimulation Award competition were included in the study. This implies they started with the programme, but sometimes it takes several months or even years to completely change the food on offer in the school canteen. As a result, it was not known whether the schools had successfully implemented the programme. Also, intractability of practice might play a role in this matter. There can always be crucial factors in some schools that negatively impact the process. From experience, we know most of the time these factors are lack of time or lack of support from other important parties within the school. Therefore, more has to be done to involve other important parties like students and parents. As a first step, The Netherlands Nutrition Centre has started using inspirational examples of other schools to motivate schools to organize activities for students, for instance, giving them an active role in composing and preparing the cafeteria offerings. This might actually work as a double-edged sword, as these actively engaged students might be perceived as role models by other students hereby creating a positive social norm that could encourage other students to pay more attention to their eating behaviour. Another matter that has room for improvement is information about time and finances that are needed for implementing the programme. Specifically, directors of nonparticipating schools indicate that time and finances are factors that play a role in deciding whether to participate or not. More information needs to be given about these factors so that schools can make well-informed decisions. In order to meet this need, a factsheet will be composed that provides directors with the information they need.

Also, schools have to be stimulated to only remove and not add unhealthy products. The School Canteen Brigade of The Netherlands Nutrition Centre will play an important role in this, educating schools how to execute to programme effectively and how to compose a healthy offering. Moreover, in the present study, it was found that school directors of schools with a caterer managed by the school itself perceived their cafeterias to have a healthier offering than schools directors of schools with an external caterer. This is a finding that needs attention. The Manifest on Healthier Food can play an important role in changing this situation, by committing different parties—including external caterers—to achieve a minimum of 75% healthy products according to the Dutch guidelines for healthy food.

4.3. Venues for Future Research. At this point, we would like to stress that, in the present descriptive study, only user perceptions have been measured and no quantitative data of food supplies in the school canteens of participating and nonparticipating schools were measured. Moreover, the programme's effect on students' actual eating behaviour has not been measured in this study. Whether the programme will prove to be effective in changing students' eating behaviour has yet to be demonstrated. However, previous research has established that changing aspects in the food environment can indeed affect eating behaviour. For example, aforementioned research in The Netherlands by TNO has clearly demonstrated that making offerings healthier can change students' choices in a positive way and that changes in assortment can lead to changes in consumption [15]. In addition, evaluation research conducted in the US of a school-based intervention on replacing food items with low nutritional value with more healthy ones has demonstrated that this was an effective means of decreasing students' consumption of unhealthy food [24]. Moreover, there was no evidence for a so-called compensation effect: students did not engage in compensatory consumption of unhealthy food at home. Also, the present programme bears resemblance to theories about "nudging" that posit that people can be gently "pushed" toward healthier life choices by making minor adjustments in their environment or choice architecture [25]. The essence of the nudging approach is to elegantly use common decision heuristics that ordinarily steer people toward unhealthy decisions instead to nudge them in a healthier or more beneficial direction [26]. For example, research has shown that making unhealthy options less accessible helps people to choose healthier options [26]. Together, these two lines of research provide indirect evidence that the present approach of creating a healthier offering in school cafeterias could actually result in healthier food choices and eating behaviour. However, further research is necessary to determine whether such a positive effect actually occurs.

More research is also needed to get more insight in effects and barriers that might operate in each of the four different steps of the programme. The current research has not taken this into account. In addition, it might be interesting to examine whether there are differences between participating schools and nonparticipating schools in domains like health issues and neighbourhood socioeconomic status. Future research should give more insight in these differences as this might provide new starting points to recruiting and stimulate schools to enroll in the programme.

5. Conclusions

The environment can exert a strong influence on people's food decisions. In order to facilitate students to make more healthy food choices and to develop healthy eating habits, it is therefore important that the school food environment is healthy. The Healthy School Canteen programme is an intervention that helps schools to make their cafeteria's offering healthier. The present study shows that this intervention is promising, as directors and students of participating schools perceive their cafeteria's offering to be healthier after implementing the programme than prior to implementation, and participating schools perceive their cafeteria's offering to be healthier than nonparticipating schools.

It will be a challenge to motivate schools to enroll in the programme in order to achieve the goal of all school cafeterias in The Netherlands being healthy by 2015. While it is promising that one-third of schools are (or have been) participating in the programme, still two-thirds of schools

have not participated yet. And as a lower percentage of secondary schools consider themselves to be coresponsible for the prevention of overweight among their students, it may be necessary and fruitful to explore other ways to attain this goal. Possibly, we could take France and Spain as an example and use legislation to create healthy school cafeterias in every school in The Netherlands.

With the present obesity epidemic and the number of young people in The Netherlands being overweight continuing to grow, any measures that may help in facilitating healthy food choices deserve to be put into consideration. In light of the Dutch government's preference for stimulating individuals to make their own health decisions, interventions that are aimed at creating a healthier environment that enables and facilitates people to make healthy decisions are a particularly fruitful venue to be further explored.

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