The Importance of the Food and Physical Activity Environments

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Abstract

There is increasing interest in identifying characteristics of neighborhood environments (physical, social, economical) that might favor unhealthy dietary and physical activity patterns leading to excess weight at population level. Measurement of characteristics of the physical environment in relation to food and physical activity has greatly improved in recent years. Methods based on assessment of perceptions by residents of their neighborhood or on objective assessment of the actual built environment (such as provided by Geographic Information Systems tools) would benefit to be combined. A number of recent systematic reviews have updated our knowledge on relationships of food and physical activity environments with relevant behaviors and obesity. Available evidence appears to show more consistent evidence of association between built environment characteristics related to physical activity ('walkability' indices, land use mix, variety of transports. . .) with physical activity behavior than with weight status. In contrast, built environment characteristics related to food habits (accessibility to different types of food outlets, availability of healthy foods. . .) would be more consistently associated with weight status than with eating behavior. The need for data from different countries and cultures is emphasized, as much as the importance of transdisciplinary research efforts for translation of these findings into our living environment.

Introduction

The development of socioecological models of health behaviors in the last two decades [1] has promoted environmental factors as key players in our thinking about obesity prevention and treatment [2]. For example, integrated maps about
obesity development emphasize the potential role of ‘activity environment’ alongside ‘individual activity’ as major clusters of interest in systems thinking on obesity [3]. There is therefore increasing interest in identifying the characteristics of neighborhood or local environments (physical, social, economical) that might favor unhealthy dietary and physical activity patterns leading to excess weight and obesity at the population level.

Our focus in this paper will be on the potential influence of the characteristics of the living environment (social, built), with a special emphasis on physical and infrastructural aspects. Dietary behavior may indeed be modified by spatial accessibility to food items through the patterns of implantation of various types of food outlets and services. Similarly, physical activity behavior may be influenced by access to recreational or sports facilities, green spaces or parks as well as transport infrastructures and land use [4]. Access has been recognized however as a complex construct that associates different dimensions such as availability (number, density of outlets), proximity (referring to distance and travel), diversity (referring to the types of services available) as much as affordability [5]. This applies to the concept of access in general but also to access to services related to eating or physical activity habits.

In the following text, we would like to briefly address some issues related to (1) the measurement of food and physical activity environments, (2) the current knowledge on the relations of attributes of the environment with behaviors and weight status, and (3) the possible implications for interventions and prevention.

**Assessment of Relevant Attributes of the Food and Physical Activity Environments**

Measurement of characteristics of the physical environment potentially related to eating and physical activity habits has greatly improved in recent years. A number of methods are currently used, based either on assessment of the perceptions by individual residents of their neighborhood, or on an objective assessment of the actual environment [6, 7].

Objective measures mainly rely on preexisting inventory databases and business directories or, in some cases, on environmental audits, which consist of sending trained raters with checklists to document specific aspects of the physical environment. Among objective approaches, spatial analysis methods based on geographic information systems (GIS) have opened up a new era of research in the field of public health nutrition [8]. GIS are computer-based methods and tools which, via different information sources, enable organizing, managing and combining spatial and thematic data, and representing and analyzing results according to geographic location [9]. Using GIS tools, analyses can be carried out to model spatial interactions between different types of information.
In the framework of a research project ongoing in France – the ELIANE (Environmental LInks to physical Activity, Nutrition and hEalth, www.elianeproject.eu) study – we recently performed and published a systematic review of the literature to investigate which GIS methods had been used to define the food environment and what type of spatial measurements were generated [8]. In total, 29 papers were included in the review. The aim of these studies was either to compare food outlet spatial accessibility between different neighborhoods or to investigate relationships between characteristics of the spatial accessibility measures and individual food behavior. Two main approaches were identified. A first approach was focused on availability of facilities with the aim to quantify the number of food outlets using the buffer method, kernel density estimation or spatial clustering. The second approach was focused on proximity with the aim to assess the spatial accessibility to food outlets by measuring distances or travel times.

Based on this literature review [8], it was concluded that only some among many GIS methods available had been used, while other GIS methods combining availability and proximity, such as spatial interaction models, had not yet been applied to this field. As recently discussed by Salze et al. [10], spatial interaction models allow to compute access to facilities (such as food outlets or sports equipments) according to an inverse function of the distance from the resident home or work address (gravity-based models). Using such models makes it possible to overcome the limitations of the most frequently used indices such as the count of opportunities within a given neighborhood. Another way forward is to extend these models in order to take into account both home and work-based accessibility for a commuting population. This seems to be relevant to study the influence of environmental factors on eating habits in general, including food purchase and consumption.

Another conclusion from this methodological review on GIS measures of the food environment was that future research would benefit from a combination of GIS methods with survey approaches to describe both built and social environmental characteristics as important determinants of individual food and physical activity behaviors [8]. In particular, access to food outlets and physical activity resources may be limited by the subject’s perception of the environment in one’s neighborhood [11]. Therefore, the availability of healthy foods and physical activity opportunities as reported by residents (perception) and their availability as measured by GIS application (density) provide complementary information for characterizing the local food and physical activity environment. To better understand how features of the environment related to eating and physical activity behaviors are perceived, techniques such as asking residents to draw themselves maps of their neighborhood may help define their living space as seen by the subjects themselves. Information obtained by such (mental) maps can then be linked with physical activity measurements (e.g. accelerometers [12]) and/or GIS data. This field of research combining objective and subjective assessment seems particularly promising.
Recent systematic reviews have updated the status of knowledge regarding relationships of food and physical activity environments with relevant behaviors and obesity [13–15]. For the food environment, in the review by Giskes et al. [13] focused on obesogenic dietary intakes in adults (≥18 years), 28 original studies (from 2005 to 2008) were reviewed. Number of participants ranged from 22 to 1,000. Most studies originated from the US (n = 16), followed by Australia (n = 6), Japan (n = 2), the UK (n = 2), The Netherlands (n = 1), and New Zealand (n = 1). All but one were cross-sectional studies. Interestingly, among a total of 18 accessibility factors assessed, 16 were objective measures. An important finding emerging from this review is that current literature in adults appears to show more consistent evidence of associations between environmental factors and weight status than between environmental factors and obesity-related dietary intakes. Greater accessibility to supermarkets and lower access to takeaway outlets were found associated with lower BMI or prevalence of overweight/obesity. No consistent association was found between fruit and vegetable consumption and access to supermarkets or takeaway outlets, or availability/shelf space of fruits and vegetables. In contrast, area-level socioeconomic status was more consistently associated with healthier dietary behaviors. In children, based on objective measures of environmental factors, available evidence suggests that weight status is positively related to spatial accessibility to convenience stores, but findings with other food retail outlets and restaurants appear mixed [14].

For the physical activity environment, Ding and Gebel [15] performed a review of reviews on associations between built environment characteristics, physical activity behavior and obesity based on reviews published between 1990 and 2011. Among 37 reviews included for examination of their key characteristics, a vast majority (n = 27) dealt with physical activity and only a few with obesity (n = 5) or both physical activity and obesity (n = 5). Most reviews focused on youth (n = 12), and only 5 targeted adults and 2 senior residents. Very few reviews considered specific populations such as African-Americans, low socioeconomic or rural residents (n = 1 each) pointing to the need for more data in these groups.

Another recent review also emphasizes the fact that fewer studies have assessed associations of physical environment attributes with weight status than with physical activity [16]. In this latter review by Durand et al. [16], 5–10 times more studies assessed relations with walking behavior compared to BMI/weight status for environmental characteristics such as ‘walkability’ (composite indices usually including residential density, street connectivity and land use mix), mixed land use, variety of transports available, or density of built space. Moreover, if 30 to about 60% of associations between built environment characteristics were found in the expected direction with walking behavior, this
The proportion was reduced to only 10–20% for associations with BMI. Positive associations between accessibility to green space and both physical activity and weight status are also increasingly being reported [17]. Finally, in older adults, current literature appears inconsistent on the relation between walkability indices and physical activity [18].

Altogether, available evidence more consistently shows an association between built environment characteristics related to physical activity with physical activity behavior than with weight status, whereas built environment characteristics related to food habits would be more consistently associated with weight status than with eating behavior (table 1). The importance of combining perceived and objectively determined aspects of the environment has again been recently emphasized. Gebel et al. [19] observed that residents who perceived neighborhoods to be less walkable than objectively determined (through GIS) were less active, more obese and more likely to decrease physical activity and to gain weight over time than those with a more accurate environmental perception.

### Implications for Intervention Strategies and Future Research

Significant advances have been made in recent years regarding the theories and methods used to study the food and physical activity environments. However, we have to acknowledge that major challenges are ahead to better understand the complex pathways through which attributes of the built environment may impact weight status, in conjunction with neighborhood and individual socio-economic characteristics.

In terms of measurement, defining the size of the neighborhood in which the relation between environment and behavior operates remains a methodological issue, as much as ways to combine refined objective spatial measures (such as GPS) with assessment of how residents perceive their environment. The combination of data from multiple sources and obtained with different types of sensors will require the development of new data platforms for integration and analysis. Designing and implementing longitudinal studies are on the list of priorities,

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as much as evaluation of ‘natural experiments’ such as re-location studies or opportunistic evaluations (including cost-benefit) of environmental interventions [20]. Wider use of refined analytical methodologies, including multilevel modeling, will be needed in attempts to identify causal relationships.

Regarding generalizability, it is likely that the effects of environment factors differ greatly across countries, cultures and climate. Since most studies were performed in the US, the UK or Australia, there is clearly a need for data from other regions and settings. Finally, to integrate findings about the physical activity and food landscape in a global picture including the social and policy environments appears very much in line with the current thinking on the prevention of non-communicable diseases [21]. The translation of findings from such transdisciplinary research will not be possible without the input from all potential stakeholders, to assist in creating environments that are more conducive to regular physical activity, healthy eating and maintenance of a healthy bodyweight.

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References

Discussion

Dr. Drewnowski: I was very interested to see the major differences in urban form between Berlin, Shanghai and New York. Context can be very important, and what we see in Seattle may not apply to Shanghai or to Paris. We need to do this kind of transdisciplinary transcontinental research to figure out which features of the food environment are common and which are unique to specific cities. It’s an interesting question.

Dr. Oppert: Right, but you have to convince the funders.

Dr. Finegood: It seems that all this work on the causal mechanisms of obesity is not going to get us very far because it’s not terribly transferable from one place to another. Shouldn’t we get more focused on solution-oriented research which isn’t worried about the causes of the problem but is more focused on what solutions are going to work in Shanghai versus New York versus another place? Your argument about causality – I would say forget it and move on.

Dr. Oppert: Yes, of course we emphasize cultural specificity; however, we can anticipate that some associations will be transferable from one place to the other, or at least this is what we are trying to do with Dr. Drewnowski, comparing shopping in Paris with Seattle supermarkets.
Dr. Drewnowski: In Paris, people live about 400 meters away from the nearest supermarket. In Seattle, shops are farther away. There will be huge differences in distance, and of course Parisians will walk to shops as opposed to drive and will shop much more often. But there will still be communalities in how people access food sources; that's what is interesting to us.

Dr. Barclay: Is it possible to obtain data from supermarkets about what is in the shopping basket and the cost? With what they call fidelity cards, they have a very good record of what people buy.

Dr. Drewnowski: We haven't done a project in collaboration with supermarket chains, but we have collected study participants’ grocery store receipts for at least 2 weeks, if not 4 weeks, to confirm what foods they bought. This was to validate self-reports of what people ate and how much they paid.

Dr. Finegood: There is a huge data base on what people purchase, but academic researchers don’t usually have an access to it because it’s expensive. Yes, supermarket chains have tons of data that would be very useful, but it’s hard to access.

Dr. Drewnowski: The data are available from consumer market research companies such as the NPD group.

Dr. Finegood: For how much?

Dr. Drewnowski: For free if they are interested in research. But the point is that health researchers need to go to commercial data sets and start looking at commercial suppliers. The problem is that with national surveys, the number of people in any one location will be small. For example, I would expect the number of Seattle residents in any national database to be under 100. However, we are interested in data that can be geocoded where the data set is national. Is there anything like this in Europe, there are a number of consumer research suppliers?

Dr. Oppert: Yes, there are directories or databases where you can get some of these data. I would think that the firms would be interested in working together with researchers. One reason is that the market is evolving. For example, in France and in some parts of Europe it is not supermarkets but mini-markets that are getting back into town. I think that the companies would be really interested. We have good contacts with some of them.

Dr. Rolls: I have been at meetings in the UK where it has been made clear that supermarkets have information that is proprietary. Stores know a lot about how food choices are affected by price, labels, and positioning, but they are reluctant to share their data. Such data would be very useful to try to figure out how to change food choices.

Dr. Oppert: Designing an audit method to assess exactly what is in a shop is very complicated. In one of the large-scale EU projects that was performed in the last several years on prevention of obesity, a big part of the project was dedicated to this, and they found that it was really complicated to make a complete audit of store contents. So, I think that perhaps photos taken with a camera would provide more information than a store-by-store checklist of what products are being sold.

Dr. Klassen: Do you have data on the person that purchases the products? The person who shops may be different from the person who consumes the food. For example, in urban areas you might find more singles or students, which consequently may lead to a different purchase pattern in Paris than in rural areas.

Dr. Drewnowski: Dr. Oppert has those exact data for Paris. In Seattle, we looked to see who went to large warehouse stores, such as Costco, which can be farther away. It
was as you would think. People who went to Costco had large families and went there less often compared to the average Safeway shopper.

*Dr. Oppert:* Sometimes you have those details but you don’t know where the people go, so currently we have to admit it’s very difficult to have all the relevant questions in the same study.

*Dr. Warshaw:* I would imagine that even shopping patterns are different from Paris to Seattle or other US cities.

*Dr. Oppert:* What do you mean by shopping patterns?

*Dr. Warshaw:* Frequency, value purchase per time shopping, maybe that’s my perception in Paris.

*Dr. Drewnowski:* You are right, I think in Seattle the shopping pattern was to go by car once a week; in Paris that was clearly not the case, so yes, absolutely.

*Dr. Finegood:* I will just be a little bit more challenging here, and say that part of the reason why we think we need to work out the causality is that we believe we will find solutions in the causes of the problem. But in this big domain of the food and physical activity environment, the changes will need to be big. My impression is mostly anecdotal and I apologize for that, but the experiments that have been done to change the food environment and the physical activity environment haven’t worked out very well. I wonder whether you can comment on that. Proposed changes to the environment can be very expensive, but we haven’t seen the results that people were hoping for.

*Dr. Oppert:* I think there have been a few so-called natural experiments that have been performed especially in the UK, and these were not so positive. The results were really mixed; I mean having a new supermarket in a neighborhood may lead to changes in food purchasing behavior. But I think there are many new ongoing studies on this, especially physical activity. New projects are looking in great detail into changes in the physical environment and the effective impact on physical activity habits. I think there are new studies and new designs ongoing at the moment, so I would try to be positive.

*Dr. Lovejoy:* I think we do need to know causality, and I think the challenge, as Dr. Drewnowski pointed out earlier, is that we haven’t looked enough at it at a micro-level. We have been making assumptions about things like food deserts and how people shop and how people engage in physical activity based on macro-situations when there are so many exceptions. One common assumption is that easy access to green spaces in parks will be associated with more physical activity. But researchers found that in some places that is not true because green spaces in parks in the US anyway are sometimes used only for little league fields. So if your children are not playing in little league, they are not using the park and they are not engaging in any more physical activity. So that’s an example of a micro-level. You need to know that causal piece of it in that unique situation in order to be able to do an effective intervention.

*Dr. Oppert:* But this is why you have to complement the objective data with subjective data using interviews to assess the perceptions of residents about the environment they live in. The use of a place can be completely changed from its initial purpose, and this appears especially true for physical activity.

*Dr. Rosenbaum:* You have to distinguish between intervention and prevention. You can’t do prevention if you don’t understand causality. If I don’t know why people are getting fatter, I can’t do anything to prevent it.

*Dr. Oppert:* There are good guesses, however, which would not prevent us from action.