Home and neighbourhood environment: association with children's physical activity and obesity-related dietary behaviour

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KEY MESSAGES

1. For children aged 8 to 12 years old, their parents still have an important influence on their obesity-related behaviour, ie physical activity and dietary habits.
2. Encouraging parents to be physically active and children to take part in outdoor play may help promote an active lifestyle and prevent obesity.
3. A neighbourhood with better aesthetic characteristics and easy access to parks may help children maintain a healthy body weight.

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Introduction

It is generally agreed that the environment rather than biology has fuelled the obesity epidemic over the past few decades. Today, children are thought to be less physically active and to consume more energy-dense foods than previous generations. This applies to many countries.

Fostering behavioural changes is challenging because there are multiple factors in the obesogenic environment that support an unhealthy lifestyle and obesity-related behaviour. The multitude of environmental influences has been well conceptualised in the social-ecological theory. Specifically for children, this theory highlights the influences of the multilevel (individual, family, school, community, sociodemographic, and physical environmental) factors. Hong Kong has a mixed culture and physical environment that may have a profound impact on health-related behaviour, although the magnitude of these influences remains unknown. More research based on the social ecological model is needed to clarify the complex nature of multiple factors that shape and influence physical activity (PA) and obesity-inducing dietary behaviour of Chinese children in Hong Kong. Furthermore, objective measures of both PA and the physical environment are warranted in future research. The purposes of this study were to examine the associations of home and the neighbourhood environment with body weight status and obesity-related behaviour among school children in Hong Kong.

Methods

Participants and procedure

This study was approved by the Research Ethics Committee of The Chinese University of Hong Kong. This cross-sectional study examined an existing cohort of children who were recruited in 2009 for the Understanding Children's Activity and Nutrition study. A total of 1265 children (54% boys) aged 8 to 12 years in grades 3 to 5 from 24 primary schools during the school year 2011-12 were examined. Anthropometric data of the children (body weight and height) were collected during physical education (PE) classes or school recess by the investigators. Meanwhile, an initialised Actigraph accelerometer and a parental-reported questionnaire (assessing PA, dietary habits and multiple correlates) were distributed to the children. Parents were instructed to complete the questionnaire at home and to return the forms to the contact teacher within one to two weeks.

Physical activity and dietary behaviours

The children were instructed to wear an ActiGraph accelerometer, which was attached to an elasticised belt worn at hip-level for 7 consecutive days. The accelerometer was only removed during swimming, showering, or sleeping. A 1-minute epoch was selected to record activity patterns. Data from children who recorded at least 10 hours per day for a minimum 3 days were considered to be valid. ActiGraph data were expressed as minutes spent at

different intensities of PA based on the age-specific cut-off counts.[1] Moderate-to-vigorous PA (MVPA) was defined as ≥3 METs. In order to minimise the effects of actual wearing time on the absolute minutes, the percentage MVPA was calculated and used in regression analyses. For all children, including those whose parents did not permit them to wear an ActiGraph, a validated questionnaire[2] was used to assess their PA. Four obesity-related dietary behaviours (high-fat foods, fruit/vegetables, snacks, and soft drink intake) of the children were reported by parents. The questions were adapted from similar measures used among Chinese and Australian youths.

Correlates of variables

Parents reported their occupation, educational attainment, and marital status as well as that of their partner (where applicable), and the number of sibling children in the same residence. Measures of perceived home and neighbourhood environment were reported by parents, including social network, safety, physical environment, availability of sports facilities and local destinations. The residential address of each child was geocoded into a pair of (X,Y) coordinates for plotting on a base map of Hong Kong. These cases were weighted by population arranged in 200m x 200m grid cells for subsequent cluster analysis using the SaTScan software. Proximal neighbourhood was defined as being within an 800 m crow-fly radius of each participant's residential address. Sixteen statistically significant clusters of cases with varying circle sizes and relative risks were identified by the spatial scan statistics. The clusters were then assessed using an environment audit tool (open public recreation spaces, presence and density of food outlets, and pedestrian infrastructure). Geographic Information System (GIS) data were assembled and managed; the variables included road density and street intersection density, nearest distance to parks and recreational facilities.

Statistics

Descriptive statistics were calculated to describe the average daily time spent in MVPA and body mass index (BMI). Independent *t*-tests were used to compare gender differences. Considering that children living within clusters were more likely to be similar, generalised linear mixed models were used to examine the associations of home and neighbourhood environment with PA, dietary behaviour, and BMI. Clusters were included as the random effects. In the first step, the fixed effects were sociodemographic confounders (age, gender, parental education attainment, marital status, and number of siblings). The individual variable was entered into separate models to predict MVPA, dietary behaviour, or BMI, adjusting for sociodemographic confounders. Variables significantly related to the outcomes were then added simultaneously into the final model. Because the units of GIS-determined variables varied widely, standardised scores were generated and used for the models.

Results

A total of 1265 children and their parents were examined; 37.8% of boys and 24.7% of girls were

TABLE 1. General characteristics of the participants

Variable	Boys		Girls	
	No. of participants	Mean±SD	No. of participants	Mean±SD
Age (years)	642	9.6±1.0	547	9.7±1.0
Body mass index (kg/m^2)*	642	18.9±3.8	547	17.9±3.2
Parental educational attainment	589	4.5±1.5	495	4.6±1.5
No. of siblings*	585	0.8±0.7	497	0.9±0.8
ActiGraph-assessed moderate-to-vigorous physical activity (MVPA) [min/day]*	369	106.1±39.1	297	86.5±32.4
Questionnaire-assessed MVPA (min/day)	569	95.5±116.5	502	104.4±115.9
Soft drink intake per day	515	0.2±0.3	440	0.2±0.2
High-fat food intake per day	515	0.3±0.4	440	0.3±0.4
Snack intake per day*	515	0.8±0.8	440	1.0±0.9
		% of participants		% of participants
Actigraph-assessed %MVPA*	369	14.3±5.1	297	11.4±4.0
Sufficient consumption of fruit (≥2 servings per day)*	515	21.0	440	26.4
Sufficient consumption of vegetables (≥3 servings per day)*	515	21.5	440	24.2

* Gender difference

classified as overweight or obese according to the age- and gender-specific criteria for childhood obesity (Table 1).[3] Parental questionnaires were obtained from 1130 (89%) children. There were no differences in basic characteristics between children who wore the accelerometer and those who did not. Among 694 children who agreed to wear the accelerometer, 297 girls and 369 boys provided valid data. Boys accumulated more minutes of accelerometer-determined MVPA than girls although there was no gender difference in parent-reported MVPA. More girls than boys had sufficient consumption of vegetables (≥3 servings per day) and fruit (≥2 servings per day). Snack intake was more obvious in girls than boys.

After controlling for age, gender, highest parental education attainment, marital status, and number of siblings, three variables were associated with objectively assessed %MVPA: parental role modelling of PA, preference for play outdoors, and attractive natural sights in the neighbourhood (Table 2). In predicting questionnaire-determined MVPA, parental role modelling of PA and social network were positively associated with parental reported minutes of a child's MVPA. Children whose parents reported a lower preference for play outdoors were less likely to participate in MVPA.

Significant variables were only found for the three dietary behaviours: vegetable consumption, soft drink and high-fat food intake (Table 2). After adjusting for the confounders, grocery diversity in the neighbourhood was negatively related to sufficient consumption of vegetables. In addition, children with parents who had more eating rules at home were less likely to consume soft drinks and high-fat foods.

The associations of the home and neighbourhood environment with obesity are shown in Table 3. Children living in a neighbourhood further away from a park and with fewer trees were more likely to be obese. Interactions were found between parental education attainment and these

TABLE 2. Associations of perceived and objectively assessed environment with moderate-to-vigorous physical activity (MVPA) and dietary behaviours*

Variable	Coefficient	SE	P value	95% CI
Actigraph-assessed MVPA (n=552)				
Gender (reference=boys)	-0.273*	0.040	0.000	-0.351, -0.194
Age	-0.166*	0.020	0.000	-0.204, -0.127
Parental role modelling for physical activity	0.046*	0.018	0.010	0.011, 0.082
Preference for outdoor play	-0.059*	0.023	0.012	-0.105, -0.013
Attractive natural sights	0.101*	0.042	0.018	0.018, 0.185
Questionnaire-determined MVPA (n=968)				
No. of siblings	-0.183*	0.056	0.001	-0.292, -0.073
Parental role modelling for physical activity	0.146*	0.039	0.000	0.069, 0.223
Social network	0.095*	0.029	0.001	0.038, 0.151
Availability of sports facilities	-0.016	0.035	0.641	-0.085, 0.053
Preference for outdoor play	-0.111*	0.045	0.014	-0.199, -0.023
Local destinations	0.021	0.014	0.150	-0.007, 0.049
Attractive buildings	0.082	0.046	0.074	-0.008, 0.173
Sufficient vegetable consumption (n=855)				
Parental education attainment (primary school or less vs tertiary level)	-0.790*	0.393	0.045	-1.564, -0.017
Marital status	-0.452*	0.226	0.047	-0.897, -0.007
Grocery diversity	-0.26*	0.118	0.028	-0.492, -0.028
Eating rules at home	0.168	0.110	0.129	-0.049, 0.384
Soft drink (n=855)				
Parental education attainment (primary school or less vs tertiary level)	0.311*	0.136	0.023	0.043, 0.579
Eating rules at home	-0.089*	0.042	0.034	-0.171, -0.007
High fat foods (n=855)				
Eating rules at home	-0.110*	0.049	0.025	-0.205, -0.014

* Generalised linear mixed models controlled for demographic factors (age, gender, marital status for parents, parental education attainment and number of sibling) and adjusted for neighbourhood clustering. Only significant factors in the bivariate model are included in the final model. For sociodemographic factors, only significant variables are shown.

TABLE 3. Associations of home and neighbourhood environment with obesity*

Variables†	Coefficient	SE	P value	95% CI
Gender (reference=boys)	-0.806*	0.338	0.018	-1.471, -0.140
Preference for outdoor play	0.291	0.152	0.055	-0.007, 0.589
Nearest network distance to park*EDU=1	-0.063	0.355	0.859	-0.761, 0.635
Nearest network distance to park*EDU=2	0.863*	0.333	0.010	0.210, 1.517
Nearest network distance to park*EDU=3	0.039	0.631	0.950	-1.200, 1.279
Presence of trees	-0.345*	0.158	0.029	-0.655, -0.035

* Generalised linear mixed models controlled for demographic factors (age, gender, marital status for parents, parental education attainment and number of sibling) and adjusted for neighbourhood clustering (n=928). Only significant factors in the bivariate model are included in the final model. For socio-demographic factors, only significant variables are shown.

† EDU 1 denotes primary education or no formal education, EDU 2 secondary education, and EDU 3 tertiary education

two environmental variables. The influence of neighbourhood variables seemed to exist only for children with less educated parents.

Discussion

The current study examined a variety of features within the home and neighbourhood environment that might influence children's PA participation, dietary behaviour, and body weight status in Hong Kong. Several potentially modifiable factors were associated with the risk of being obese, being physically inactive, and adopting unhealthy dietary habits. The findings suggest that encouraging parents to be physically active and children to take part in outdoor play may help promote an active lifestyle and prevent obesity. In addition, neighbourhoods with better aesthetic characteristics and easy access to parks may help children maintain a healthy body weight.

Social factors in the home and neighbourhood environment have been extensively examined for children in western countries. Consistent with the literature, the current study found that parental role modelling of PA was an important factor of children's MVPA. In addition, children were more likely to be physically active if they preferred outdoor play. Although the existing studies of the relationship between time spent outdoors and PA in children have been mainly cross-sectional in design, the findings suggest that children tend to be more physically active if they spend more time outdoors.[4] Certain characteristics of the neighbourhood environment, eg aesthetics, may influence an individual's willingness to spend time outdoors and thus increase opportunities to be physically active. For adults, aesthetics-PA associations have been supported by a multi-site comparison study across 11 regions including Hong Kong.[5] It may also be important for children; children living in a neighbourhood with more attractive buildings or natural sights spent more time in PA.

If parents applied more rules to their child's eating behaviour, their children were less likely to adopt unhealthy eating habits (ie, a lower intake of soft drinks and high-fat foods). Regarding the influence of the built environment on healthy food consumption, diversity of food and grocery stores rather than prevalence of these stores was related to vegetable consumption. The food environment in Hong Kong may be distinctly different to that of western countries; only 1% of children's parents reported lack of a food or grocery stores within 800 meters of their home. On the contrary, diversity may reflect the variety of items available in these stores. Many of the choices may be energy-dense or processed foods that may compete with sales of more healthy foods due to taste preferences.

There is a growing body of literature to show the relationships between perceived and built environment features and PA or dietary behaviour of children. Nonetheless, few studies have investigated the impact of the environment on obesity. We found that the aesthetics of the neighbourhood environment (presence of trees) were related to a reduced risk of being obese. In addition, interaction effects were found for socio-economic characteristics with GIS-assessed accessibility of facilities. Specifically, the likelihood of being obese was positively associated with nearest distance to a park in the neighbourhood, but only in children with parents who had completed secondary education. Previous studies of spatial accessibility of sport facilities have seldom controlled for socio-economic status. In French children, low spatial accessibility of urban PA facilities led to an increased likelihood of being overweight in blue-collar-workers' children, but not in children from higher socio-economic status families.[6] It seems that for people living in an ultra-dense environment such as Hong Kong, a

pleasant neighbourhood is an important feature, especially for children from lower educated families.

Conclusion

Both the social and physical environment in the home and neighbourhood may be important factors for obesity-related behaviour of Chinese children in Hong Kong. Strategies that encourage parents to be more physically active and children to take part in outdoor play, and provide a pleasant neighbourhood with easy access to parks are warranted in future research for developing obesity intervention programmes.

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