Childhood Obesity and Physical Activity-Friendly School Environments

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Objective Childhood obesity may be related to school environment, but previous studies often focused on food environment only. This study aimed to examine the relationship between school physical activity environment and childhood obesity.

Study design This is a cross-sectional study with multilevel data collected on school physical activity environment using teacher questionnaires, students' growth, and obesity status from electronic health records, and neighborhood socioeconomic status from census data.

Results This study included 208 280 students (6-18 years of age) from 438 schools (45% of Hong Kong). Prevalence of obesity was 5.0%. After controlling for socioeconomic status and intraschool correlation, robust Poisson regression revealed a reduced obesity risk associated with higher teachers' perceived physical activity benefits (risk ratio 0.96, 95% CI 0.94-0.99, $P = .02$), physical activity teaching experience (0.93, 0.91-0.96, $P < .001$), school campus size (0.93, 0.87-0.99, $P = .02$), physical activity ethos (0.91, 0.88-0.94, $P < .001$), number of physical activity programs (0.93, 0.90-0.96, $P < .001$), and physical activity facilities (0.87, 0.84-0.90, $P < .001$). Students in schools with at least 3 physical activity-friendly environmental factors (11.7%) had a much lower risk of obesity (0.68, 0.62-0.75, $P < .001$) than those without (23.7%).

Conclusions A physical activity-friendly school environment is associated with lower risk of obesity. School physical activity environment should be considered in future epidemiologic and intervention studies. *(J Pediatr 2017;191:110-6).*

In the past decade, childhood obesity has become more prevalent all over the globe, with 32% of children in the US and 20% in Hong Kong being overweight or obese.[1,2] This obesity epidemic is expected to continue, particularly in rapidly developing countries like China.[3]

The etiology of childhood obesity is complex and multifactorial, including both individual (eg, genetics, dietary intake, and physical activity) and environmental factors (eg, family food environment, school physical education program, and walkability in the community).[4-6]

Among different environments, schools are one of the most important for children and adolescents because they spend at least one-third of their waking time in schools.[7,8] Coincidentally, there has been evidence suggesting that schools were associated with a weight controlling effects. Specifically, students experienced much less weight gain during the academic year than in the summer holiday, possibly because of better nutrition (eg, balanced diets) and physical activity (eg, more opportunity to exercise) environment in school.[9] Nevertheless, such effect was highly variable between school, suggesting that school environments may play a key moderating role.[10]

Considerable evidence has shown the importance of school nutrition environment, but evidence on school physical activity environment has been relatively scarce. Even among the limited studies, mixed conclusions have often been found. For example, a large study in US found that more time spent in physical education (PE) and better participation in interschool sports were associated with less overweight students,[11] but another US study found a null effect of school exercise resources on students' body mass index.[10] One potential limitation of these 2 studies is that they only focused on 1 facet of physical activity environment (PE classes) but omitted other physical and social environment that may related to physical activity, such as school campus size and number of exercise programs provided. The aim of this study was to evaluate the association between childhood obesity and a comprehensive list of school physical activity environmental factors, as well as the cumulative effect of these factors.

GEE	Generalized estimating equation
PE	Physical education
SES	Socioeconomic status
SHS	Student Health Service, Hong Kong Department of Health

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Methods

This is a cross-sectional study conducted in the school year 2013-2014. Multilevel data were collected from the participating students, schools, and their corresponding communities. Teachers of all primary and secondary (grades 1-13) schools in Hong Kong were invited to participate in this study by postal mail. Data on school physical activity environment were provided by the participating teachers through a school and physical activity environment questionnaire adapted from a previous study.[12] Clarification and explanation regarding the study and the questionnaire were made through email and telephone. Based on the list of participating schools, the Hong Kong Student Health Service (SHS) provided all the participating students' demographic data and body height and weight records to the research team. Personal identifiers (eg, name and Hong Kong identity card number) were removed from the data-set but school registration number of each students were available through the internal records of SHS, which were used to matched student-level with school-level data. The SHS is a territory-wide health promotion and disease prevention service accessible to all school children in Hong Kong. Students enrolled in SHS will be given free appointments to attend the nearby SHS center, in which a series of health services (including health check-up and growth measurements) were conducted. Over 90% of school-aged students in Hong Kong participated in the SHS.[13] Data on socioeconomic status (SES) of the corresponding communities were extracted from the most recent Hong Kong Population Census database.[14] The school and student data-sets were matched using the school registration number (a publicly available school identifier that is also stored in the SHS database for all students) unique to each school and the school and community data-sets were matched through geomapping. Participating schools' addresses were retrieved from their school registration record from Hong Kong Education Bureau. These addresses were then coded into geographic coordinates and located on a predefined map linked with the census data using ArcGIS 10.0 (Esri Inc, Redlands, CA).

Students' height and weight were measured by trained registered nurses in 12 SHS centers using standard electronic weighing station with stadiometer (Model 763; Seca, Hamburg, Germany) to the nearest 1 mm and 0.1 kg, respectively, within 1 academic year. Obesity was defined using the International Obesity Task Force body mass index sex- and age-specific cut-off values.[15]

Questionnaires on school physical activity environment were completed by the PE teachers within the same academic year of the obesity measurement, and information on the schools' campus size was retrieved from the Hong Kong Education Bureau database.[16] The questionnaire was adapted from a PE teacher questionnaire used in a previous study.[12] The questionnaire was culturally adapted with the input of a local panel composed of pediatricians, school teachers and principals, researchers, and experts in sports science and was piloted among local PE teachers. The teachers who participated in the pilot testing perceived the questionnaire to be suitable to reflect school physical activity environment and relevant to the situation in Hong Kong.

The number of school physical activity programs (excluding PE classes, eg, after school football training, martial art classes) per academic year were reported directly by the teachers. Length and frequency of PE classes was not measured in this study because schools in Hong Kong follow the official curriculum guideline by the Hong Kong Education Bureau, and there is very little variation of duration and frequency of PE classes between different schools.[17] Common physical activity facilities (eg, basketball court and football field, swimming pool, gym room) were listed in the questionnaire and the heads of PE panels were asked to indicate how many of these facilities were available in their school. Teachers' attitude toward teaching physical activity and perceived benefit of physical activity was measured by 4 and 9 Likert-scale items, respectively. The attitude items covered questions on whether the teachers enjoy teaching physical activity with 1 being the least and 5 being the most enjoyable. The perceived benefit items asked the teacher to what extent the teachers agreed on the potential benefits of physical activity (eg, improved physical fitness and cognitive performance) with 1 being totally disagree and 5 being totally agree. School physical activity ethos and perceived barrier to promoting physical activity in school because of insufficient funding, manpower support, and parental support were also assessed by items on a Likert scale with 1 being totally disagree and 5 being totally agree. All the above social environment items achieved excellent internal consistency (Cronbach α 0.93).

SES was evaluated by a community SES composite score. The composite score was generated by principal component analysis using 4 sociodemographic statistics from the recent population census, namely median monthly household income, proportion of professional working population, proportion of postsecondary educated adults, and proportion of public rental housing.[18] The correlation matrix of these items was used in a principal component analysis model with varimax rotation. The first principal component (largest eigenvalue) was extracted as the SES composite score. This method has been shown valid to identify health disparity in overseas and local studies.[19,20]

Statistical Analyses

School environment variables specific to teachers (teaching experience, attitude, perceived benefits, and perception on school ethos, insufficient funding, manpower support, and parent support) were averaged within each domain. Multiple teachers' scores were averaged within each school. Variables specific to schools (school campus size, number of physical activity facilities, and number of physical activity programs) were taken from the head teacher of the PE panels. These 10 variables characterized the school physical activity environment for each school. These school-level factors were repeated for each of the participant within the school.

The association between students' obesity and their school physical activity environment was tested using multiple Poisson