IJOEM
International Journal of Occupational and Environmental Medicine

Original Article

To review this article online, scan this QR code with your Smartphone

The Association between Green Space and the Prevalence of Overweight/ Obesity among Primary School Children

Shraddha Manandhar, Thunwadee Tachapattaworakul Suksaroj, Cheerawit Rattanapan

Abstract

Background: Childhood overweight and obesity is a major health problem in many low- and middle-income countries such as Nepal. There is evidence indicating a significant association between health and access to green space.

Objective: To estimate the prevalence of childhood overweight and obesity, and to identify its association with green space among primary school children in Kathmandu metropolitan city, Nepal.

Methods: A cross-sectional study was conducted on 440 (195 male and 245 female) students studying in selected primary schools of Kathmandu metropolitan city. Mothers/caretakers of the participating children were also studied.

Results: Of the 440 children, 13.2% were overweight; 6.8% were obese. 4 of 16 studied variables that had significant associations with overweight/obesity in bivariate analyses, were found independent predictors of overweight/obesity after being adjusted for confounders. They included mode of transportation to school (aOR 2.08, 95% CI 1.12 to 3.88), consumption of sugary snack (aOR 2.57, 95% CI 1.12 to 5.91) and salty/savory snack (aOR 4.13, 95% CI 1.71 to 9.96), and the distance of a green space from child's residence (aOR 27.46, 95% CI 6.10 to 123.54).

Conclusion: One-fifth of the children in urban schools were found to be overweight or obese. The distance to a green space was identified as the most significant factor influencing childhood overweight/obesity.

Keywords: Overweight; Obesity; Green space; Child; Chronic disease; Nepal; Health

ASEAN Institute for Health Development, Mahidol University, Thailand

Introduction

Round the globe, childhood obesity is considered one of the most serious public health challenges of the 21st century leading to a significant increase in the prevalence of chronic diseases.[1,2] The mechanisms that lead to overweight and obesity are multifaceted, being associated with lifestyle, genetics and environment.[3] Growing evidence identifies a robust and interactive association between children's physical environment and sedentary lifestyle.[4,5] Proximity and accessibility are

Correspondence to Cheerawit Rattanapan, Salaya, Phutthamonthon, Nakhonpathom, Thailand
Tel: +66-2441-9040-3 ext. 62
Fax: +66-2441-9014
E-mail: cheerawit.rat@mahidol.ac.th
Received: Aug 8, 2018
Accepted: Dec 29, 2018

Cite this article as: Manandhar S, Suksaroj TT, Rattanapan C. The association between green space and the prevalence of overweight/obesity among primary school children. *Int J Occup Environ Med* 2019;1:1-10. doi: 10.15171/ijoem.2019.1425

For more information on greenness and hypertension see http://www.theijoem.com/ijoem/index.php/ijoem/article/view/1073

seen as potential influencing factors affecting usage of green space.[6,7]

Although childhood overweight/obesity has once only considered a major problem in high-income countries[2], nowadays, it also represents a growing concern in low- and middle-income countries such as Nepal. This may be due to the ongoing transition in the nutrition habits in these countries. The general shift in Nepal towards urbanization has instigated new challenges in ensuring well-being, the consequences of which are often seen amongst the young, who face growing levels of lifestyle-related risk factors.[8] According to a study conducted in Kathmandu, Nepal, 0.3% of urban lands are open, 7% are covered by natural vegetation, and 51.5% are enclosed by buildings.[9]

The association between urban green space and overweight/obesity varies from report to report: some studies reported evidence of significant associations between health and access to green space or neighborhood characteristics,[10-12] some investigations revealed only a modest or even no relationship,[13,14] and some even found negative associations.[15,16]

Childhood is a crucial phase for the development of overweight and obesity because of psychological, biological, social, and environmental changes. Childhood overweight and obesity is prone to endure into adulthood.[17] Early identification of children at risk of being overweight or obese in comparatively diverse geographic and cultural situations renders the analysis of key determinants necessary for prevention.[8]

Research regarding the association between green space and overweight/obesity among Nepalese children has so far been limited. None of the existing research articles has explored the relationship between open space and overweight and obesity amongst children. This study was therefore conducted to determine the prevalence of childhood overweight/obesity and to examine the relationship between access to green space and the prevalence of overweight and obesity among primary school children in Kathmandu metropolitan city.

TAKE-HOME MESSAGE

- Childhood obesity is one of the most important public health challenges causing serious chronic diseases in adulthood.
- The prevalence of overweight/obesity increases with child's age.
- Childhood overweight and obesity were significantly associated with the distance between the child's residence and a green space.
- Expansion of green space areas may prevent childhood overweight and obesity at early ages.

Materials and Methods

An analytical cross-sectional study was conducted from March 15 to April 30, 2018 on a group of primary school children and their mother or caretaker. Those primary school children of Kathmandu metropolitan city whose guardians, preferably their mothers, were available were included. The minimum sample size was determined using the Taro Yamane statistical formula. Taking into account the presence of the guardian during the study period, the sample size was increased by 10% to reach a total of 440 primary school children and their mothers or caretakers. The probability proportionate sampling (PPS) method was used to select 22 primary schools. Simple random sampling was then used to select 20 students from each school. The body mass index (BMI) of each child was calculated. The mother/caretaker was then answered a number of questions through a

face-to-face interview.

Instruments

A structured data collection sheet was used in the study. The sheet was divided into four parts—physical attributes of the green space, *ie*, access to green space, use of green space, distance to green space from child's residence, and activities involved in green space; demographic characteristics; socio-economic characteristics; and behavioral characteristics, *ie*, mode of transportation the children used to go to school, hours of watching television, and consumption of unhealthy snacks. The unhealthy snacks included sugary snacks (cakes, doughnuts, biscuits, cookies, and ice-cream), salty/savory snacks (chips, salty biscuits, crackers, and noodles), and sugar sweetened beverages (packaged fruit juices, flavored water, flavored milk, and soft drinks). If a green space existed near the child's residence, we considered it "accessible;" otherwise it was considered "inaccessible." Use of green area was defined based on how often the child visited the green area for any activities, and was coded as "often" (4–5 times/week) and "seldom" (2–3 times/week). A seca scale and a stadiometer were used to measure weight and height of the children, respectively. A global positioning system (GPS) was used to ascertain the distance between the child's residence and the open space.

Ethics

The protocol of this study was approved by the Committee for Research Ethics, IPSR-Institutional Review Board of Mahidol University (COA. No. 2018/02-032). Approval from the District Education Office was also received prior to data collection. Furthermore, permission from school administration was taken. Written informed consent was obtained from the mothers/caretakers of the studied children.

Statistical Analysis

IBM SPSS® for Windows® ver 20 was used for data analysis. χ^2 test was used to compare categorical variables. Logistic regression analysis was used to adjust for confounding variables. Independent variables with a $p<0.25$ in bivariate analysis were included in the logistic regression. World Health Organization (WHO) Anthro-Plus software was used to calculate the children BMI for age.

Results

The studied mothers/caregivers had a mean age of 35.1 (SD 5.1) years. More than half (59.1%) of the mothers/caregivers aged between 31 and 40 years; most of them (85.7%) were educated. Half of the mothers/caregivers were employed; most (79.5%) of the mothers had at least two children at the time of interview. The majority (69.5%) of the respondents were living in a joint/extended family rather than a nuclear family (39.5%). The respondents were almost equally distributed in terms of wealth—54.8% had high-income and 45.2% had low-income. The majority (64.8%) of the respondents belonged to the advantaged group, while almost one-third (35.2%) of the respondents belonged to the disadvantaged group (Table 1).

Child-Related Factors

The studied children had a mean age of 8.5 (SD 1.5) years. More than half of the children aged between 6 and 9 years (Table 2). The majority (69.5%) of the children use active transportation to go to school. Most (87.3%) of the children watched television—one-third of them did so for more than two hours per day. More than half (68.6%) of the children consumed unhealthy snacks. Most (70.9%) of them consumed a sugary snack within 24 hours prior to the interview (Table 2).

Table 1: Socio-demographic and economic characteristics of respondents (n=440)

Characteristics	n (%)	Overweight/Obesity	Crude OR (95% CI)
Age group (yrs)			
21–30	108 (24.5)	18 (16.7)	1
31–40	260 (59.1)	57 (21.9)	1.40 (0.78 to 2.52)
41–50	72 (16.4)	13 (18.1)	1.10 (0.50 to 2.41)
Mother's education			
Uneducated	63 (14.3)	9 (14.3)	1
Educated	377 (85.7)	79 (21.0)	1.59 (0.75 to 3.36)
Mother's occupation			
Employed	223 (50.7)	34 (15.2)	1
Unemployed	217 (49.3)	54 (24.9)	1.84 (1.14 to 2.96)
Mother parity			
≤2 children	350 (79.5)	77 (22.0)	2.02 (1.02 to 3.99)
>2 children	90 (20.5)	11 (12.2)	1
Caste/Ethnicity*			
Advantaged	285 (64.8)	25 (16.1)	1
Disadvantaged	155 (35.2)	63 (22.1)	1.47 (0.88 to 2.46)
Type of family			
Nuclear	266 (39.6)	41 (15.4)	2.06 (1.27 to .270)
Joint/Extended	174 (60.5)	47 (27.0)	1
Wealth status			
High-income	241 (54.8)	60 (24.9)	2.02 (1.23 to 3.32)
Low-income	199 (45.2)	28 (14.1)	1

*Ethnicities of children were categorized into an advantaged (including advantaged Janajatis and the upper caste) and relatively disadvantaged groups (including Dalits, disadvantaged Janajatis, disadvantaged non-Dalit Terai people and religious minorities).

Prevalence of Childhood Overweight/ Obesity

Overweight and obesity in children were assessed based on their BMI for age using the WHO growth reference (BMI for age for 5–19 years). Out of 440 studied children, 58 (13.2%, 95% CI 10.0% to 16.4%) were overweight and 30 (6.8%, 95% CI 4.5% to 9.2%) were obese, yielding a total prevalence of childhood overweigh/obesity of 88 (20.0%, 95% CI 16.3% to 23.8%).

Physical Attributes of the Green Space

Green space was referred to public and private parks with green vegetation. The majority (67.0%) of the children did not reside near parks (Table 3). The mean distance of

Table 2: Child-related factors (n=440)

Characteristics	n (%)	Overweight/Obesity	Crude OR (95% CI)
Age group (yrs)			
6–9	306 (69.5)	68 (22.2)	1.62 (0.94 to 2.81)
10–13	134 (30.5)	20 (14.9)	1
Sex			
Male	195 (44.3)	46 (23.6)	1.49 (0.93 to 2.38)
Female	245 (55.7)	42 (17.1)	1
Transportation to go to school			
Passive	134 (30.5)	42 (31.3)	2.58 (1.59 to 4.17)
Active	306 (69.5)	46 (15.0)	1
Watching television			
Yes	384 (87.3)	84 (21.9)	3.64 (1.28 to 10.35)
No	56 (12.7)	4 (7.1)	1
Average time spent watching television (n=384)			
<2 hrs	246 (64.1)	58 (16.9)	3.64 (1.28 to 10.35)
≥2 hrs	138 (35.9)	26 (63.4)	1
Consumption of sugary snacks			
Yes	312(70.9)	76 (24.4)	3.11 (1.62 to 5.95)
No	128 (29.1)	12 (9.4)	1
Consumption of salty/savory snacks			
Yes	196 (44.5)	58 (29.6)	2.99 (1.83 to 4.89)
No	244 (55.5)	30 (12.3)	1
Consumption of sugary beverage			
Yes	133 (30.2)	46 (31.6)	2.62 (1.61 to 4.23)
No	307 (69.8)	42 (15.0)	1
Amount of sugary snack consumption			
Once a day or less	128 (29.1)	52 (15.7)	1
Twice a day or more	204 (46.4)	36 (33.3)	2.69 (1.63 to 4.42)
Amount of salty/savory consumption			
Once a day or less	245 (55.7)	75 (18.8)	1
Twice a day or more	155 (35.2)	13 (32.5)	2.08 (1.02 to 4.23)
Amount of sugary beverage consumption			
Once a day or less	307 (69.8)	73 (18.0)	1
Twice a day or more	98 (22.3)	15 (42.9)	3.41 (1.66 to 6.97)

Table 3: Physical attributes of green space (n=163)

Characteristics	n (%)	Overweight/Obesity	Crude OR (95% CI)
Availability of a park			
No	277 (63.0)	72 (26.0)	3.22 (1.80 to 5.77)
Yes	163 (37.0)	16 (9.8)	1
Accessibility to a park			
No access	285 (64.8)	73 (26.0)	3.21 (1.77 to 5.82)
Easy access	155 (25.2)	15 (9.8)	1
Use of a green space			
Often	79 (48.5)	2 (2.5)	1
Seldom	84 (51.5)	14 (16.7)	7.70 (1.69 to 35.08)
Hours spent at green space			
<1 hour	104 (63.8)	14 (13.5)	4.43 (0.97 to 20.23)
≥1 hour	59 (36.2)	2 (3.4)	1
Distance to green space			
≤1 km	149 (91.4)	6 (4.0)	1
>1 km	14 (8.6)	10 (71.4)	59.58 (14.4 to 246.0)
Level of physical activity*			
>7 hrs/wk	76 (46.6)	15 (19.7)	21.14 (2.72 to 64.38)
≤7 hrs/wk	87 (53.4)	1 (1.1)	1

*Based on the cut-off recommended by WHO for 5–17-year-old children

the children's residence to a park was 1.1 (SD 0.2) km. Only one-third (35.2%) of the children had easy access to a nearby park. Most (91.4%) of the children lived less than a kilometer from a green space. Half of the children had ≥7 hours per week physical activity, achieving the level recommended by the WHO for health benefits (Table 3).

Factors Associated with Childhood Overweight/Obesity

All independent variables with a p value <0.25 in bivariate analyses (distance to green space; level of physical activity; use of green space; access to a park; availability of a park; amount of consumption of sweetened beverage and sugary snack; consumption of sweetened beverages, salty/savory snack, and sugary snack; average number of hours spent watching television; watching television; use of transportation to go to school; wealth status; type of family; mother parity; mother occupation; mother education; sex, and age group) were included in the logistic regression analysis. Four variables were found to be independent predictors of childhood overweight/obesity (Table 4). Mode of transportation to go to school (aOR 2.24, 95% CI 1.21 to 4.13), consumption of sugary snack (aOR 2.57, 95% CI 1.12 to 5.91), consumption of salty/savory snack (aOR 4.13, 95% CI 1.71

Table 4: Independent predictors of childhood overweight/obesity

Characteristics	Crude OR (95% CI)	Adj OR (95% CI)
Mother's education		
Educated	1.59 (0.75 to 3.36)	0.46 (0.17 to 1.23)
Uneducated	1	1
Mother's occupation		
Employed	1.84 (1.14 to 2.96)	1.27 (0.73 to 2.20)
Unemployed	1	1
Mother parity		
≤2 children	2.02 (1.02 to 3.99)	1.70 (0.75 to 3.84)
>2 children	1	1
Type of family		
Joint/Extended	2.06 (1.27 to 3.27)	10.63 (0.36 to 1.10)
Nuclear	1	1
Wealth status		
Low-income	2.43 (1.50 to 3.94)	1.36 (0.70 to 2.61)
High-income	1	1
Age group (yrs)		
6–9	1.62 (0.94 to 2.81)	1.12 (0.56 to 2.22)
10–13	1	1
Sex		
Male	1.49 (0.93 to 2.38)	1.49 (0.84 to 2.63)
Female	1	1
Transportation to go to school		
Active	2.58 (1.59 to 4.17)	2.24 (1.21 to 4.13)
Passive	1	1
Watching television		
Yes	3.64 (1.28 to 10.35)	0.38 (0.12 to 1.22)
No	1	1
Consumption of sugary snack		
No	3.11 (1.63 to 5.95)	2.57 (1.12 to 5.91)
Yes	1	1

Continued

Table 4: Independent predictors of childhood overweight/obesity

Characteristics	Crude OR (95% CI)	Adj OR (95% CI)
Consumption salty/savory snack		
No	2.99 (1.84 to 4.89)	4.13 (1.71 to 9.96)
Yes	1	1
Consumption of sugary beverage		
No	2.62 (1.62 to 4.24)	1.47 (0.65 to 3.29)
Yes	1	1
Accessibility to a park		
No access	3.21 (1.77 to 5.82)	0.58 (0.03 to 8.86)
Easy access	1	1
Use of a green space		
Seldom	7.70 (1.69 to 35.08)	3.11 (0.49 to 19.63)
Often	1	1
Level of physical activity		
>7 hrs/wk	21.14 (2.72 to 64.38)	5.22 (0.54 to 49.78)
≤7 hrs/wk	1	1
Distance to green space		
≤1 km	1	1
>1 km	59.58 (14.40 to 246.00)	27.46 (6.10 to 123.54)

to 9.96), and distance between the child's residence and green space (aOR 27.46, 95% CI 6.10 to 123.54).

Discussion

The prevalence of childhood overweight/obesity was found to be 20% (23.6% in boys and 17.1% in girls), similar to what was reported in Pakistan.[18] The prevalence, however, was higher than that recorded in a school-based cross-sectional study conducted in Biratnagar, Nepal.[19] In the present study, a higher prevalence of 22.2% was observed in the younger age group (6–9 years) compared with the older children. In contrast, research conducted in Massachusetts and Norway has suggested that the prevalence of overweight/obesity increases with child's age.[12,15] This might be attributed to the culture of people in Nepal, as younger children are not allowed to go out alone; they mostly spend their time indoor. The prevalence of childhood overweight/obesity was higher in boys (23.6%) than girls (17.1%). Previous literature about reasons for a higher observed prevalence of overweight/obesity in boys showed that they are more likely to be engaged in technologies and activities such as watching television or using computers than girls are, and thus more prone

to become overweight or obese.[20]

We found that the risk of overweight/obesity in those children who used passive transportation (bus, van, motorbike) to go to school was twice that of those using active transportation. Numerous theories have attempted to explain the association between watching television and overweight or obesity. First, for many, television has replaced physical activity that ultimately leads to reduced total energy expenditure.[21] Nowadays, children consume more unhealthy snack foods (*eg*, sweets, salty/savory and fast foods).[22] We found no association between childhood overweight/obesity and average consumption of unhealthy snack foods, after adjustment for covariates. However, consumption of sugary snack (aOR 2.57) and salty/savory foods (aOR 4.13) constituted a significant predictor of childhood overweight/obesity.

A significant association (aOR 27.46) was observed between the distance to green space and childhood overweight/obesity—children whose residence was >1 km away from green space were at higher risk of overweight/obesity. No association was found between the level of physical activity in green space and childhood overweight/obesity, although it did play a substantial role in affecting children's body weight. This might be attributed to numerous factors influencing the level of physical activity, including the nature of activity and individual involvement. A cross-sectional study of individual health survey responses from the New Zealand Health Survey showed similar results—greener environments encourage higher levels of physical activity.[23] Use of green space also had a significant effect on children's BMI. The present study suggested that children who seldom use green space were 3.11 times more likely to become overweight or obese. These findings were consistent with the results of a study of Norwegian adolescents that demonstrated how the use of nature does not comprise a mediating variable for childhood overweight/obesity.[12]

In conclusion, the prevalence of childhood overweight/obesity in Nepal was high. Childhood overweight/obesity was associated with the distance of the child's residence and a green space. Expansion of green space areas may prevent childhood overweight/obesity at early ages.

Conflicts of Interest: None declared.

Financial Support: None.

References

1. World Health Organization. Obesity: Preventing and Managing the Global Epidemic. Technical Report Series. **2000**. Geneva: WHO, 8942000.
2. De Onis M, Brown D, Blossner M, Borghi E. Levels and trends in child malnutrition. UNICEF-WHO-The World Bank joint child malnutrition estimates. **2012**.
3. Mistry SK, Puthussery S. Risk factors of overweight and obesity in childhood and adolescence in South Asian countries: a systematic review of the evidence. *Public Health* 2015;**129**:200-9.
4. Davison KK, Lawson CT. Do attributes in the physical environment influence children's physical activity? A review of the literature. *Int J Behav Nutr Phys Act* 2006;**3**:19.
5. Zask A, van Beurden E, Barnett L, *et al*. Active school playgrounds—myth or reality? Results of the "move it groove it" project. *Prev Med* 2001;**33**:402-8.
6. Cohen DA, Ashwood JS, Scott MM, *et al*. Public parks and physical activity among adolescent girls. *Pediatrics* 2006;**118**:e1381-e9.
7. Stevens RB, Brown BB. Walkable new urban LEED_ Neighborhood-Development (LEED-ND) community design and children's physical activity: selection, environmental, or catalyst effects? *Int J Behav Nutr Phys Act* 2011;**8**:139.
8. Piryani S, Baral KP, Pradhan B, *et al*. Overweight and its associated risk factors among urban school adolescents in Nepal: a cross-sectional study. *BMJ open* 2016;**6**:e010335.

9. Adhikari D. Kathmandu Vulnerable Climate', *New Spolight Magazine* 2011;5. Available from *https://www.spotlightnepal.com/2011/08/09/kathmandu-vulnerable-climate/* (Accessed July 25,2018).

10. Akpinar A. Urban green spaces for children: A cross-sectional study of associations with distance, physical activity, screen time, general health, and overweight. *Urban For Urban Green* 2017;**25**:66-73.

11. Bell JF, Wilson JS, Liu GC. Neighborhood greenness and 2-year changes in body mass index of children and youth. *Am J Prev Med* 2008;**35**:547-53.

12. Wilhelmsen CK, Skalleberg K, Raanaas RK, *et al*. Associations between green area in school neighbourhoods and overweight and obesity among Norwegian adolescents. *Preventive Medicine Reports* 2017;**7**:99-105.

13. Halonen JI, Kivimaki M, Pentti J, *et al*. Green and blue areas as predictors of overweight and obesity in an 8-year follow-up study. *Obesity* 2014;**22**:1910-7.

14. Picavet HSJ, Milder I, Kruize H, *et al*. Greener living environment healthier people?: Exploring green space, physical activity and health in the Doetinchem Cohort Study. *Prev Med* 2016;**89**:7-14.

15. Lachowycz K, Jones A. Greenspace and obesity: a systematic review of the evidence. Obes Rev 2011;**12**:e183-9.

16. Nielsen TS, Hansen KB. Do green areas affect health? Results from a Danish survey on the use of green areas and health indicators. *Health Place* 2007;**13**:839-50.

17. Koplan JP, Liverman CT, Kraak VI. *Preventing Childhood Obesity*. Washington DC, **2005**. Available from *www.nap.edu/read/11015/chapter/1* (Accessed July 25,2018).

18. Ahmed J, Laghari A, Naseer M, Mehraj V. Prevalence of and factors associated with obesity among Pakistani schoolchildren: a school-based, cross-sectional study. *East Mediterr Health J* 2013;**19**:242-7.

19. Sah VK, Giri A, Acharya R. Prevalence of overweight, obesity and its associated risk factors among school children aged 6-16 years of Biratnagar. *Journal of Nobel Medical College* 2016;**5**:22-5.

20. Kehler M, Atkinson M. *Boys' bodies: Speaking the unspoken*. Peter Lang, New York, **2010**.

21. Biddle SJ, Gorely T, Marshall SJ, *et al*. Physical activity and sedentary behaviours in youth: issues and controversies. *J R Soc Promot Health* 2004;**124**:29-33.

22. French SA, Story M, Jeffery RW. Environmental influences on eating and physical activity. *Annu Rev Public Health* 2001;**22**:309-35.

23. Richardson EA, Pearce J, Mitchell R, Kingham S. Role of physical activity in the relationship between urban green space and health. *Public Health* 2013;**127**:318-24.