HHS Public Access

Author manuscript

Pediatr Obes. Author manuscript; available in PMC 2016 October 01.

Published in final edited form as:

Pediatr Obes. 2016 October ; 11(5): e6–e8. doi:10.1111/ijpo.12058.

Pre-school obesity is inversely associated with vegetable intake, grocery stores and outdoor play

M. Kepper[1], **T.-S. Tseng**[1], **J. Volaufova**[2], **R. Scribner**[3], **H. Nuss**[1], and **M. Sothern**[1]

[1]Department of Behavioral & Community Health Sciences, School of Public Health, Louisiana State University Health Sciences Center, New Orleans, LA, USA

[2]Department of Biostatistics, School of Public Health, Louisiana State University Health Sciences Center, New Orleans, LA, USA

[3]Department of Epidemiology, School of Public Health, Louisiana State University Health Sciences Center, New Orleans, LA, USA

Summary

The study determined the association between body mass index (BMI) [B-Z] score and fruit and vegetable intake, frequency and ratio of fast food outlets and grocery stores in concentric areas around the child's residence, outdoor play and total crime index. Data from 78 Louisiana pre-school children were analyzed using Pearson's correlation and multiple regression analysis. Parental-reported fruit intake was linearly associated with increased number of grocery store counts in concentric areas around the child's residence ($P = 0.0406$, $P = 0.0281$). Vegetable intake was inversely ($P = 0.04$) and the ratio of fast food outlets to grocery stores in a 2-mile concentric area around the child's residence was positively ($P = 0.05$) associated to BMI z score after applying Best Model regression analysis ($F = 3.06$, $P = 0.0346$). Children residing in neighbourhoods with greater access to fast foods and lower access to fruits and vegetables may be at higher risk for developing obesity during pre-school years.

Keywords

Behaviour; environment; obesity; pre-school

Unfavourable environmental conditions such as access to fast food and convenience stores, poor access to beneficial infrastructure (e.g. playgrounds, sidewalks) and physical disorder (e.g. graffiti, blight) create barriers to healthy behaviours (fruit and vegetable intake and physical activity) and therefore may increase the risk for pre-school obesity (1–7). Neighbourhood crime may also be a significant environmental barrier to outdoor play due to negative safety perceptions (5,8–9). However, inconsistencies plague research assessing the impact of environmental conditions and individual behaviours on obesity risk in pre-school

Address for correspondence: Mrs. M Kepper, Department of Behavioral & Community Health Sciences, School of Public Health, Louisiana State University Health Sciences Center, 2020 Gravier St., Lions Bldg., 2nd Floor, New Orleans, LA 70112, USA. mmohle@lsuhsc.edu.

Conflict of Interest Statement

I, Maura Kepper, certify that all authors listed on this manuscript have no conflicts of interest to disclose.

children (10,11). Although expected, associations between obesity risk, healthy eating and physical activity behaviour and environmental conditions are not apparent in pre-schoolers.

We propose that pre-school obesity is negatively associated with fruit intake, vegetable intake, grocery stores and outdoor play, but positively associated with fast food outlets and crime density. Baseline data were extracted from a randomized controlled trial, Nutrition and Physical Activity Self-Assessment in Child Care Centers, in 13 treatment and 13 waiting list control centres located in Southeast Louisiana. Using a cluster, stratified sampling method, children aged 2–5 years were invited to participate, but excluded if chronic medical conditions or a life-threatening disease, which would interfere with study measurements, was present; or if parents were unwilling or unable to communicate with staff or provide informed consent.

The total baseline study sample included 400 children at 26 day care centres. Overall, 35% responded to a validated food frequency questionnaire (12) and 34% responded to the outdoor playtime checklist. Response rates significantly differed by race ($P < 0.001$). Among non-white participants, 26% responded to the nutrition questionnaire, compared to 54% among white participants. Furthermore, 26% of non-white compared to 52% of white participants responded to the outdoor playtime questionnaire. Participants with height and weight data, a valid address and completed nutrition and outdoor playtime questionnaires were included ($n = 78$ from 17 day care centres). Characteristics of this sample ($n = 78$) did not differ from the total study sample ($n = 400$).

Trained interventionists collected height and weight with standard anthropometric procedures. Body mass index (BMI) z score, the primary outcome variable, was then calculated (13). A surrogate measure of the servings of children's fruit and vegetable intake as perceived by parents or guardians was obtained because of the participants' young age. A total of 14 fruits and 18 vegetables were included in the questionnaire (Table 1). Answers to all fruit and vegetable survey questions were summed to determine the average number of perceived servings consumed per week. Fast food and grocery stores, defined using the North American Industry Classification System code, were obtained from INFO USA (14). After geocoding, three buffers (1, 2 and 4 miles) were created using Geographic Information Systems (GIS) software by ESRI (Redlands, CA) to calculate fast food outlets and grocery store counts in varying distances from each child's home address.

Parents or guardians completed the outdoor playtime checklist (15). Responses were averaged to determine the number of minutes each child played outdoors near his/her home residence per week. CrimeRisk, a block group and higher level geographic database, was used to assess a range of serious crimes against both persons and property including personal crime, murder, rape, robbery, assault and property crimes (sample range: 11–397.8). In GIS software, the geocoded residence of each child was linked to crime risk data within the corresponding census tract.

Partial correlation coefficients (adjusted for race and sex) and Best Model procedures selected from regression analysis determined the association between BMI z score and fruit

and vegetable intake, fast food and grocery store counts, the ratio of grocery stores to fast food, outdoor play and crime risk.

Study participants averaged 2.94 years, and 49% were male (Table 2). The majority of the sample was white (54%). Mean BMI z score was 0.42 (SD ± 0.97). White children had the highest mean BMI z score (0.56 [SD ± 0.73]) compared to blacks (0.26 [SD ± 1.28]) and other (0.28 [SD ± 0.9]) races. The average number of fast food and grocery store counts increased in larger concentric areas. At 1 mile, the mean fast food count was 5.47 (SD ± 7.54), at 2 miles 18.99 (SD ± 18.22), and at 4 miles 53.74 (SD ± 43.81). The mean grocery store count at 1 mile was 2.58 (SD ± 3.07), at 2 miles 8.03 (SD ± 8.49), and at 4 miles 25.71 (SD ± 26.55). In all three concentric areas, approximately double the number of fast food outlets than grocery stores was observed. The mean crime index was 85.21 (SD ± 82.11) (Table 2).

Fruit intake was significantly correlated with grocery store counts. Increased grocery store availability within 2 and 4 miles was also significantly correlated with fruit intake ($P = 0.0406$, $P = 0.0281$). Significant results ($F = 3.06$, $P = 0.0346$ [table 3]) were found using a best-fit model regression analysis for BMI z score, which included vegetable intake (servings/week), the ratio of fast food outlets to grocery stores in a 2-mile concentric area around the child's residence and outdoor play (minutes/week). Individually, vegetable intake was significantly related to BMI z score ($P = 0.0472$), and the ratio of fast food outlets to grocery stores approached, but did not achieve statistical significance ($P = 0.0590$). Outdoor play was not significantly related to BMI z score ($P = 0.1130$) (Table 3). Relationships remained or achieved significance when gender and race were considered in the analysis of BMI z score and vegetable intake ($P = 0.0398$), and the ratio of fast food outlets to grocery stores ($P = 0.0487$) (Table 3). There was no correlation between BMI z score and crime risk.

These findings provide preliminary evidence that individual behaviours (fruit and vegetable intake, outdoor play) and environmental factors (fast food outlets, grocery stores) should be jointly targeted to reduce the risk of pre-school obesity. Other factors such as convenience stores, parental eating and physical activity behaviours, mode of transportation and independent measures of crime should also be considered (2,11). Prior studies have not considered fast food outlets and grocery stores simultaneously; nor have they assessed concentric areas individually and collectively (9–11). This was the first study to examine varying distances of fast food outlets, grocery stores and the ratio of fast food outlets to grocery stores around the child's residence. However, results are limited by surrogate measures for fruit and vegetable consumption and outdoor playtime. Limitations also include the use of outdoor playtime as a proxy for physical activity, and the omission of indoor activities or outdoor play at school. Small sample size and low response rates in non-white participants further limit study findings. Further research, which examines environmental conditions and individual behaviours concurrently, is needed to promote the implementation of effective policies to reduce obesity risk in pre-school children.

Acknowledgments

This research was supported by the School of Public Health, LSUHSC-New Orleans, Louisiana Department of Health and Hospitals; Office of Public Health, Maternal and Child Health Program, the LSUHSC Jim Finks

Endowed Chair in Health Promotion Research Fund, The Nutrition Obesity Research Center at Pennington Biomedical Research Center, NIDDK (CNRU) 1P30 DK072476, NIMHD 5U54MDO08176-02, NCMHD P20 MD00481701, NICHD 1R01HD41071-01A2, and 1R01HD49046-01.

References

1. Singh GK, Siahpush M, Kogan MD. Neighborhood socioeconomic conditions, built environments, and childhood obesity. Health Aff. 2010; 29:503–512.
2. Kumanyika S. Environmental influences on childhood obesity: ethnic and cultural influences in context. Physiol Behav. 2008; 94:61–70. [PubMed: 18158165]
3. Singh GK, Kogan MD, van Dyck PC, Siahpush M. Racial/ethnic, socioeconomic, and behavioral determinants of childhood and adolescent obesity in the United States: analyzing the independent and joint associations. Ann Epidemiol. 2008; 18:682–695. [PubMed: 18794009]
4. Singh GK, Kogan MD, Siahpush M, van Dyck PC. Independent and joint effects of socioeconomic, behavioral, and neighborhood characteristics on physical inactivity and activity levels among US children and adolescents. J Community Health. 2008; 33:206–216. [PubMed: 18373183]
5. Molnar BE, Gortmaker SL, Bull FC, Buka SL. Unsafe to play? Neighborhood disorder and lack of safety predict reduced physical activity among urban children and adolescents. Am J Health Promot. 2004; 18:378–386. [PubMed: 15163139]
6. Mellor J, Dolan C, Rapoport R. Child body mass index, obesity, and proximity to fast food restaurants. Int J Pediatr Obes. 2011; 6:60–68. [PubMed: 20429736]
7. Boone-Heinonen J, Gordon-Larsen P, Kiefe C, Shikany J, Lewis C, Popkin B. Fast food restaurants and food stores. Arch Intern Med. 2011; 171:1162–1170. [PubMed: 21747011]
8. Burdette HL, Whitaker RC. A national study of neighborhood safety, outdoor play, television viewing and obesity in preschool children. Pediatrics. 2005; 116:657–662. [PubMed: 16140705]
9. Gomez J, Johnson B, Selva M, Sallis J. Violent crime and outdoor physical activity among inner-city youth. Prev Med. 2004; 39:876–881. [PubMed: 15475019]
10. Rahman T, Cushing RA, Jackson RJ. Contributions of built environment to childhood obesity. Mt Sinai J Med. 2011; 78:49–57. [PubMed: 21259262]
11. Mushi-Brunt C, Haire-Joshu D, Elliott M, Brownson R. Fruit and vegetable intake and obesity in preadolescent children: the roles of neighborhood poverty and grocery store access. Am J Health Educ. 2007; 38:258–265.
12. Newby PK, Peterson KE, Berkey CS, Leppert J, Willett WC, Colditz GA. Dietary composition and weight change among low-income preschool children. Arch Pediatr Adolesc Med. 2003; 157:759–764. [PubMed: 12912781]
13. Centers for Disease Control & Prevention, National Centers for Health Statistics. 2000 CDC growth charts for the United States: methods and development. Vital Health Stat. 2002; 11:1–178.
14. U.S. Census Bureau. NAICS Definitions. Washington, DC: 2002. North American Industry Classification System. [WWW document]. URL: http://www.census.gov/eos/www/naics/ [accessed May 2014]
15. Burdette HL, Whitaker RC, Daniels SR. Parental report of outdoor playtime as a measure of physical activity in preschool-aged children. Arch Pediatr Adolesc Med. 2004; 158:353–357. [PubMed: 15066875]

Table 1

Evaluation of fruit and vegetable intake as reported by parents

How often did your child eat a serving of these foods during the past week?	
Vegetables (*n* = 18)	**Fruits (*n* = 14)**
Corn, peas, tomatoes, peppers (green, red or hot), carrots, broccoli, green beans, spinach, greens (mustard, turnip, kale), mixed vegetables, squash (orange or winter), yellow squash, zucchini, potatoes, sweet potatoes or yams, cabbage, coleslaw, cauliflower and lettuce salad	Banana, peaches, fruit cocktail, mixed fruit, orange, grapefruit, apple, pear, grapes, strawberries, melons, pineapples, raisins and prunes

Table 2

Individual and environmental-level characteristics of pre-school students (n = 78 from 17 day care centres)

Variable	Mean (±SD)
BMI	16.48 (1.79)
BMI z score *	0.42 (0.97)
Age	2.94 (0.69)
Gender (n [%])	
Male	38 (48.72)
Female	40 (51.28)
Race/ethnicity (n [%])	
White	42 (53.85)
Black	27 (34.62)
Other	9 (11.54)
Weight status	
Normal weight (BMI < 85th)	60 (76.92)
Overweight (85th ≤ BMI < 95th)	10 (12.82)
Obese (BMI ≥ 95th)	8 (10.26)
Fruit intake (servings/week)	14.36 (8.18)
Vegetable intake (servings/week)	17.59 (9.51)
Fast food count (1 mile)	5.47 (7.54)
Fast food count (2 miles)	18.99 (18.22)
Fast food count (4 miles)	53.74 (43.81)
Grocery count (1 mile)	2.58 (3.07)
Grocery count (2 miles)	8.03 (8.49)
Grocery count (4 miles)	25.71 (26.55)
Ratio of fast food to grocery stores (1 mile)	2.59 (3.10)
Ratio of fast food to grocery stores (2 miles)	2.60 (2.07)
Outdoor play (min/week)	692.67 (1988.80)
Total crime index	85.21 (82.11)

* BMI was adjusted for age and gender using U.S. CDC growth charts (13).

Table 3

Relationship of vegetable intake, ratio of fast food outlets to grocery stores (2 miles), outdoor play and BMI z score not adjusted and adjusted for race and gender: model selected from regression analysis

	Estimate coefficient (SE)	*P* value	Adjusted estimate coefficient (SE)	Adjusted *P* value
Vegetable Intake (servings/week)	−0.02 (0.01)	0.05	−0.02 (0.01)	0.04
Ratio of fast food outlets to grocery stores (2 miles)	0.12 (0.06)	0.06	0.12 (0.06)	0.05
Outdoor play (min/week)	−0.00 (0.00)	0.11	−0.00 (0.00)	0.10