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RESEARCH ARTICLE

THE ASSOCIATION BETWEEN CHILDHOOD OBESITY AND OBESOGENIC ENVIRONMENT IN PUBLIC KINDERGARTEN, JEDDAH, 2018 CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Obesity is not just an individual's problem but a public health issue, globally; the prevalence of childhood obesity is expected to reach 9.1% by 2020. Adiposity rebound occurs between the ages of three and five, the preschool years have been recognized as a critical period in growth and obesity development. One of the facts in childhood obesity is that overweight and obesity are mostly acquired after entering the school, the problem increased with the increasing age due to student's exposure to the outdoor food environment. The term "obesogenic environment" refers to environments, surroundings, opportunities, or conditions of life that promoting obesity in individuals or populations. The aim of this study was to identify the kindergarten environment factors associated with overweight classification among preschool children in Jeddah City. **Methods:** a cross-sectional study carried out in public kindergartens in Jeddah city, Saudi Arabia. The BMI-for-age percentile growth charts were used to assess the weight status of children. Environmental policy assessment and observation (EPAO) checklist was used to assess the obesogenic environment in kindergartens. **Result:** Parents of 198 children completed the questionnaire, 81.3% of children were of normal weight while 8.6% were obese. The mean total EPAO score of the all kindergartens was 23.2 (SD 7, range 15.23-33.32), with higher scores signifying more supportive and less obesogenic environments. It showed that the children who have excess weight were attending the high obesogenic kindergarten, while the children with normal weight were attending less obesogenic environment, P value= 0.001. **Conclusion:** This study conclude that elements of the childcare environment are associated with overweight classification in young children attending public kindergartens in Jeddah.

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INTRODUCTION

Obesity is not just an individual's problem but a public health issue (WHO, 2000). In 2010, obesity was estimated to cause 3.4 million deaths globally with a 3.9% of years of life lost while 3.8% accounted for disability-adjusted life-years (DALYs) (Ng et al., 2014). Globally, the prevalence of childhood overweight and obesity grew from 4.2% in 1990 to 6.7% in 2010 with expectations to reach 9.1% by 2020 (De Onis et al., 2010). Adiposity rebound occurs between the ages of three and five. During this age period, children develop the eating and physical activity behaviors that will influence their lifetime habits. Consequently, the preschool years (ages 3–5 years) have been recognized as a critical period in growth and obesity development (Barlow, 2007). Body mass index (BMI) is a measure used to determine childhood overweight and obesity. A child's weight status is determined using an age- and sex-specific percentile for BMI rather than the BMI categories used for adults. This is because children's body composition varies as they age and varies between boys and

girls. Overweight is defined as a BMI at or above the 85th percentile and below the 95th percentile for children the same age and sex. Obesity is defined as a BMI at or above the 95th percentile for children of the same age and sex (Barlow, 2007). Childhood obesity is considered as a serious public health problem. Its prevalence increasing at an alarming rate. Overweight and obesity are the results of positive energy balance. Although individual behavioral factors such as low levels of physical activity and/or dietary behaviors are thought to contribute to the epidemic of obesity, broader understanding of environmental factors has been extended (Hill et al., 2012). The term "obesogenic environment" refers to environments, surroundings, opportunities, or conditions of life that promoting obesity in individuals or populations (Lake and Townshend, 2006). Some articles revealed that the probability of being obese adult increased with the age of obese child and was higher at all ages for the group of very obese children (Whitaker et al., 1997). Therefore, the management of overweight and obesity in children should not be delayed until adulthood because then it becomes ever more difficult to

achieve lasting weight reduction (Koyuncuoğlu Güngör, 2014). One of the most facts in childhood obesity is that the overweight and obesity are mostly acquired after entering the school, the problem increased with the increasing age due to student's exposure to the outdoor food environment' as against home-cooked meals (Al-Mohaimed *et al.*, 2012). According to WHO report at 2000, body mass index begins to increase rapidly after a period of reduced adiposity during the preschool years (WHO, 2000). Consecutively, children who attend kindergarten for at least one year are at an increased risk of being overweight or obese at kindergarten entry (McGrady *et al.*, 2010). Current knowledge demonstrates that increased physical activity in early childhood is associated with great health impact, like improved bone health and a reduced risk of being overweight or obesity. The physical environment of kindergarten was the strongest predictor of activity levels, with more than 50% of the daily activity counts. These findings support a role of kindergarten in promoting structured physical activity programs and providing space and time for young children to be active (Finn *et al.*, 2002). This study examine the relationship between the public kindergartens' environment and children Body Mass Index (BMI) categories by using tool to measure the obesogenic environment (Ciotti, 2015). The aim of this study was to identify the kindergarten environment factors associated with overweight classification among preschool children in Jeddah City to provide evidence for future research and prevention programs in kindergartens.

MATERIALS AND METHODS

This is a cross-sectional study carried out in public kindergartens in Jeddah city, Saudi Arabia, from October to November 2018. From each of the geographical areas of Jeddah city, one kindergarten was randomly selected resulting in four kindergartens included. The children were selected from the updated student list using a systematic random sampling. The students received both the Consent forms having detailed information about the conducted study with the well-structured questionnaire with close-ended questions, which includes sociodemographic data to be filled in by parents and return it back to researcher. All children included in the study were between 4 to 6 years old, whose parents gave their consent to participate in the study with a total of 198 children. In cases of unanswered questions, telephone contact was made to obtain the information from parents. At kindergartens, previously trained medical students collected anthropometric measurements of weight and height. Following CDC guideline, height was measured with a measuring non-elastic tape, height was measured as the distance between the highest point of the head and the floor and record to the nearest 0.1 centimeter (CDC, 2018). Weight was measured using an electronic weight scale, children were barefooted wearing minimal clothing, without any jackets or accessories with approximation to the nearest decimal fraction (CDC, 2018). The BMI-for-age percentile growth charts was used to assess the weight status of children. After plotting the score of BMI in a relation of child's age and gender we considered, those >85 percentiles as overweight, >95 percentiles an obese, while those <85 percentiles were considered normal (Barlow, 2007). Children without anthropometric data were excluded from the sample. Environmental policy assessment and observation (EPAO) checklist: was used to assess the obesogenic environment in kindergartens, which is valid and reliable tool and used in previous literature (Hesketh *et al.*,

2018; Ward *et al.*, 2008). The (EPAO) checklist include two domains: nutrition environment, which covers the breakfast delivered, beverage and staff behavior, and physical activity (PA) environment, which covers the child behavior, sedentary activities and staff behavior, indoor and outdoor free spaces and classroom spaces. The EPAO includes 64 individual items and is described elsewhere (Ward *et al.*, 2008). Those individual items are integrated into five nutrition sub scores and eight PA sub scores, Two nutrition subscale scores (ie, Whole grains; High-sugar/high-fat foods) could therefore not be calculated, as Many kindergartens do not serve meal (ie, require children to bring packed lunch).

The item responses on the EPAO checklist were converted from their raw response to a 3-point score (0, 1, and 2) with higher scores for more healthier environment, averaged within a given subscale, and multiplied by 10, with the average of all subscale scores representing the respective nutrition or PA score (Ward *et al.*, 2008). The nutrition and PA scores were summed to create the total environment score. A higher value for each scale indicated a more healthful, less obesogenic environment. Data were collected, coded and entered in the SPSS software version 25. Descriptive characteristics of the children and parents were presented by frequencies (qualitative variables). To examine associations of BMI categorization (converted to two categories normal weight and excess weight) with obesogenic environment categorization (high obesogenic or less obesogenic), a chi-square test was used.

RESULTS

Parents of 198 children completed the questionnaire, 81.3% of children were of normal weight while 8.6% were obese. Demographic data of children and parents is illustrated in table 1. Domain subscale and total scores for EPAO are shown in table 2. Across the four kindergartens, the mean total EPAO score (including eight physical activity and five nutrition domains) was 23.2 (SD 7, range 15.23-33.32), with higher scores signifying more supportive and less obesogenic environments. The average physical activity subscale score was 12.4 (SD 3.4, range 8.49-16.74) and average nutrition subscale score was 10.8 (4.1, 6.74-16.58). The results showed that, the children who have excess weight were attending the high obesogenic kindergarten (low total EPAO score), while the children with normal weight were attending less obesogenic environment (high total EPAO score) P value= 0.001, table 4. The result showed that, (n=29, 78.4%) of children with excess weight were joining kindergarten for more than 1 year, while, (n=8, 21.6%) of children with excess weight were joining the kindergarten for less than 1 year, this difference between children weight and years of attending kindergarten was statistical significant P value= 0.015, table 4. Table 3 showed that, (n=31, 81.1%) of children with excess weight were associated with high level of mother education (high school and above), while, (n=7, 18.9%) of children with excess weight are associated with low level of mother education, p value=0.03, statistically significant. In other hand, high level of father education were associated with n=28, 75.7% of children with excess weight, p value= 0.03 which is statistically significant. (n=27, 73%) of children with excess weight were associated with employee fathers, p value =0.009, while only (n=15, 40.5%) of children with excess weight were associated with employee mothers, p value=0.41.

Table 1. demographic data

Child characteristics	No.	%
Age		
4-5 years	95	48.0
5-6 years	103	52.0
Gender		
Male	97	49.0
Female	101	51.0
Weight status		
Normal weight	161	81.3
Overweight	20	10.1
Obesity	17	8.6
Parents characteristics		
Father education		
Illiterate/primary or intermediate school	26	13.1
High school and above	172	86.9
Mother education		
Illiterate/primary or intermediate school	18	9.1
High school and above	180	90.9
Father occupation		
unemployed	26	13.1
employee	172	86.9
Mother occupation		
Housewife	112	56.6
Employee	86	43.4

Table 2. The obesogenic assessment of the four kindergartens using EPAO checklist

	KG1	KG2	KG3	KG4	Mean(sd)
Nutrition environment subscale					
Beverage	7.30	16.30	8.20	12.7	11.1(4.1)
Nutrition environment	13.30	20	13.30	13.3	14.9(3.3)
Staff behaviors	8.30	20	1.6	1.6	10.3(7.6)
Nutrition training and education	12	20	4	4	11(6.8)
Nutrition policy	6.6	6.6	6.6	6.6	6.6(0)
Average nutrition score	9.5	16.58	6.7	6.7	10.8(4.1)
Physical activity subscale					
Active opportunities	6.6	10	3.3	6.6	6.6(2.7)
Sedentary opportunities	13.3	20	13.3	20	16.6(3.8)
Sedentary environment	13.3	20	6.6	13.3	13.3(5.4)
Portable play environment	5.7	11.4	5.7	8.5	7.8(2.7)
Fixed play environment	7.5	12.5	5	7.5	8.1(3.1)
Staff behaviors	12	20	4	12	12(6.5)
Physical activity training and education	15	20	10	15	15(4.08)
Physical activity policy	20	20	20	20	20(0)
Average physical activity score	11.6	16.7	8.49	12.86	12.4(3.4)
Total EPAO score	21.18	33.32	15.23	23.3	23.2(7.5)

Table 3. Family characteristics and child weight

Studied Sample Items	Normal weight 161		Excess weight 37		Significant Tests
	No.	%	No.	%	
Mother education					
Illiterate, primary or intermediate	11	6.8%	7	18.9%	0.03*
High school and above	150	93.2%	30	81.1%	
Mother occupation					
Housewife	90	55.9	22	59.5	0.41
Employee	71	44.1	15	40.5	
Father education					
Illiterate, primary or intermediate	17	10.6%	9	24.3%	0.03*
High school and above	144	89.4%	28	75.7%	
Father occupation					
Un-employee	16	9.9%	10	27%	0.009*
Employee	145	90.1%	27	73%	
Family size					
Less than 6	116	72.0%	24	64.9%	0.25
More than 6	45	28.0%	13	35.1%	

*chi-square test

Table 4. Kindergartens and child weight

Studied Sample Items	Normal weight 161		Excess weight 37		Significant Tests
	No.	%	No.	%	
Kindergartens					
KG1	35	21.7	8	21.6	0.001*
KG2	57	35.4	3	8.1	
KG3	32	19.9	17	45.9	
KG4	37	23.0	9	24.3	
Obesogenic environment:					
Obesogenic	104	64.6	34	91.9	0.001*
Non-obesogenic	57	35.4	3	8.1	
Number of years at kindergarten					
Less than 1 year	71	44.1	8	21.6	0.015*
More than 1 year	90	55.9	29	78.4	

*chi-square test

DISCUSSION

We found that kindergarten environment, particularly related to nutrition and physical activity environment, are appear to be associated with child adiposity. Both nutrition and physical activity environment scores indicating a more healthful environment were associated with normal weight children. The prevalence of overweight and obesity among children in this study was 10.1% and 8.6%, respectively. At 2015, previous study done at Jeddah, they found the prevalence of overweight and obesity among preschool children was 10 and 15%, respectively (Heba *et al.*, 2017). WHO review about the prevalence of obesity in EMRO countries (Musaiger, 2011), found that, the prevalence of overweight among preschool children ranged from 1.9% in Oman to 18.4% in Syria. A previous review (Hammad and Berry, 2017) indicated that, there were a mixed results in literature in terms of parental education and occupation, in their relation with child weight and It was not clear why this difference existed. In Riyadh, a study (Al Alwan *et al.*, 2013) conclude that the high education level and working of parents can related to obesity in children, This study found the high educational level of parents associated with overweight of preschool children. On the other hand, our result conclude that no statistical difference between normal weight and excess weight children in relation to maternal job. Considering paternal work, results showed that 73% of children with excess weight were associated with working fathers (p value=0.009), this is the statistically significant association. A study (Al-Mohaimed *et al.*, 2012) revealed that the smaller sized families showed a significant increase in the percentages of overweight and obesity than larger families, this inverse relationship not showed in our study, we found that 64.9% of children with excess weight lived with small size family, but the result was not statistically significant.

Regarding kindergartens environment, it was assessed by EPAO checklist, which contain 2 domains, nutrition environment and physical activity environment, each domain include 2 component, observation and documents review. Although, limited literature was conducted environmental assessments of childcare centers (Martyniuk *et al.*, 2016; Bower *et al.*, 2008; Vanderloo *et al.*, 2014), we can assessed the obesogenic environment of public kindergartens in Jeddah. The nutrition environment include the following subscale: beverages; staff nutrition behaviours; nutrition environment; nutrition training and education; and nutrition policy. The mean score of nutrition environment in all the kindergartens was 10.8(4.1), almost similar to other studies (Martyniuk *et al.*, 2016; Sisson *et al.*, 2016). The overall nutrition environment score of the all kindergartens was lower than overall physical activity environment score, it is mean that the physical activity environment was supportive and less obesogenic. Our results showed that nutrition policy subscale scored low in the all kindergartens (table 2), its indicate that nutrition policies within public kindergartens in Jeddah are lacking. Regarding the staff behaviours observed in nutrition environment, the KG2 scored the highest, while KG3 and KG4 scored low, the staff at that KG sat with the children during meals but consumed unhealthy foods in front of the children, did not tend to consume the same food as the children, given that children are more likely than older children to be influenced by adult figures at mealtimes. Considering beverage subscale, there were limited juice and sugar-sweetened beverages, but a limited access to water indoors and

outdoors was observed in all KGs. The KG2 scored highest in staff nutrition and education, staff were observed discussing healthy foods with children, Nutrition-related posters, pictures or books were seen on-site, all staff were trained in nutrition of children, while the others kindergartens were lacking in this subscale. All kindergartens have formal nutrition education to the students and a nutrition curriculum. Regarding physical activity environment, it include the following subscale: active opportunities, sedentary opportunities, sedentary environment, portable play environment, fixed play environment, staff physical activity behaviours, physical activity training and education, and physical activity policy. The result showed that, the overall physical activity environment scored higher than nutrition environment, the mean score of physical activity environment in all the kindergartens was 12.4(3.4), our score is higher than study done at London (Vanderloo *et al.*, 2014), their mean score of PA environment was 8.33(1.13). Another study in U.K (Hesketh *et al.*, 2018), found that, mean score of PA environment was 10.8(105). The physical activity policy subscale scored high in all kindergartens, and this was consequence of Ministry of Education initiative to increase physical activity in schools, as result of that, training and education scored high. The result showed that there was statistical differences between high obesogenic environment and children with excess weight; it is mean that, the children who attend high obesogenic environment seems to be overweight. A less obesogenic, healthier total environment was associated with normal weight children; this is consistent with other studies (Hesketh *et al.*, 2018; Sisson *et al.*, 2016). That find relation between kindergarten environment and children weight.

Conclusion

This is the first study to demonstrate that elements of the childcare environment are associated with overweight classification in young children attending public kindergartens in Jeddah. Overall, the present study revealed that the nutrition environment within public kindergartens in Jeddah might require improvement. Policy makers, researchers and public health professionals could collaborate to develop guidelines that support kindergarten facilities to create a healthier nutrition environment by making improvements in the following areas: food and beverage servings; staff behaviours; nutrition training and education; and nutrition policy.

Limitation

This study has some limitations that should be considered. The main limitation is that this is a cross-sectional study which limited our ability to establish cause-and-effect relations. We did not include the private kindergartens; this may affect the generalizability of the result, as they have higher socioeconomic status.

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Conflicts of interest: The authors declare no conflict of interest.

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