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The relationships between dietary patterns and socioeconomic status with anthropometric and body composition indices in Iranian preschool children: A cross-sectional study

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Abstract

Background: The prevalence of overweight and obesity among Iranian children is on the rise. Dietary patterns (DPs) and socioeconomic status (socioeconomic status (SES)) may relate to children's excess weight as a predictor of the risk of obesity in adulthood that may vary by geographical regions.

Aim: The relationship between DPs and the development of obesity in preschool children has not been adequately evaluated. The present study evaluates this relationship by considering SES.

Methods: A total of 320 preschool children (4–6 years) were randomly selected from three different areas of Mashhad based on economic status. Dietary intake was evaluated using a semi-quantitative food frequency questionnaire completed by the children's parents. Anthropometric and body composition variables were measured by means of valid tools and standard methods. socioeconomic status data were collected through a researcher-made questionnaire.

Results: Three dominant DPs of 'healthy', 'unhealthy', and 'meat-free' were identified using factor analysis. The prevalence of overweight and obesity among the children who followed meat-free DP was significantly higher than that of other children ($p = 0.004$). The means and standard deviations of energy intake, body mass index (BMI), waist circumference, fat-free mass, and fat mass were 1187.97 ± 356.87 Kcal/day, 16.23 ± 2.28 kg/m^2, 54.28 ± 6.49 cm, 16.24 ± 2.23 kg, and 4.62 ± 2.70 kg respectively. Being in the higher levels of SES was significantly related to height ($p = 0.02$), energy intake ($p < 0.001$), BMI ($p = 0.003$), waist circumference ($p = 004$), and fat mass ($p = 0.002$).

Conclusions: Adherence to meat-free DP and being in the highest levels of SES may be associated with a greater chance of developing overweight and obesity. Therefore, meat consumption and SES can be used to predict childhood overweight and obesity.

KEYWORDS
anthropometry, dietary pattern, socioeconomic status, statistical factor analyses

1 | INTRODUCTION

The worldwide prevalence of overweight and obesity among children is increasing.[1] In England, the National Child Measurement Program reported that 25% of preschool children are overweight or obese.[2] Similarly, in the United States, one-third of all children and adolescents are affected by overweight and obesity.[3] High prevalence rates of overweight and obesity have also been observed among Iranian children.[4] However, limited studies have assessed the prevalence of overweight and obesity specifically in preschool children in Iran. Recent studies conducted in the cities of Rafsanjan and Birjand reported prevalence rates of 8.15% and 10.6%, and 7.6%, respectively.[5,6]

Childhood obesity poses significant health risks, including a higher likelihood of developing chronic diseases and experiencing early mortality, impacting the quality of life.[7,8] Additionally, excess adipose tissue developed during childhood tends to persist into adulthood.[9] The dietary intake of children plays a crucial role in their health, with significant implications for the risk of childhood obesity.[10] Moreover, overweight and obesity developed in childhood typically continues into adulthood and are associated with the risk of developing chronic diseases such as diabetes, hypertension, coronary arteries, and fatty liver disease[11,12] which impose high costs on the healthcare systems.[13–15]

Dietary patterns (DPs) have gained recognition as a valuable tool to assess the impact of an overall diet on health outcomes.[16,17] Analysis of DPs assesses the effects of the overall diet rather than individual nutrients or foods on health outcomes and is a more accurate predictor of central adiposity and chronic diseases.[18,19] Analyzing DPs provides a comprehensive view of the diet's effects, considering the interactions between various nutrients and chemicals consumed together, which reflects real-life dietary habits.[20]

Previous studies have shown that obesity is also closely related to socioeconomic status (SES)[21,22] and approximately 70% of childhood obesity is due to the influence of families. Parental eating habits and the parent's SES can greatly affect the obesity status of the child.[23,24] SES could predict overweight and obesity in kindergarten children.[25] Children with low SES have been shown to be typically less physically active and more obese[26]; however, this relationship may not always be the same.[27]

Currently, the examination of the relationship between DPs, SES, and body composition as well as anthropometric indices in diverse geographic locations is crucial. The goal of the present study was to evaluate the relationships between DPs and SES with growth and body composition indices in preschool children of Mashhad. We hypothesized that low SES and high intake of unhealthy foods could be associated with obesity and accelerated growth status in preschool children aged 4–6 years.

2 | MATERIALS AND METHODS

2.1 | Study participants

Eligible participants were healthy, living in Mashhad, attending preschool, aged between 4 and 6 years, and had got parental consent. Children with chronic illnesses and those whose parents were not satisfied with their participation in the study were excluded.

2.2 | Sample size

Considering the Type I error of 5% ($\alpha = 0.05$) and the Type II error of 20% ($\beta = 0.2$; power = 80%) and referring to the previous study regarding children's BMI,[28] a sample size of 320 was estimated. We recruited these children with stratified random sampling, and strata were created by SES.

2.3 | Dietary assessment

Dietary intake was evaluated using a semi-quantitative item-based food frequency questionnaire (FFQ) with 160 items using standard serving size. The validity and reliability of this questionnaire were previously evaluated.[29] In this study, we used a modified version of this FFQ for children.[30]

A trained nutritionist interviewed the children's parents or guardians to determine the consumption frequency and the amount of each food item consumed during the past year per day, week, month, or year. Using the household scales, the gram equivalent for each consumed food item was determined and reported by day for each person.[31] To perform factor analysis, major DPs were identified. To explore DPs, food items were divided into 24 groups based on the similarity of their nutrients, the researchers' opinions, and the previous studies.[32,33]

2.4 | Anthropometric and body composition measurements

Body weight was measured with a precision of 100 g using a Beurer digital scale (Beurer BG13, Germany) with minimal clothes and without shoes. Height was measured using a non-stretched tape measure without shoes while the shoulders were in a relaxed position. The body mass index (BMI) Z-score for age and sex was calculated using the World Health Organization Child Growth Standards software (AnthroPlus, World Health Organization, Geneva, Switzerland, 2007). The weight status of children was reported in

four categories, including underweight (z-score <2 standard deviations (SD), normal (z-score ≥−2 SD and ≤1 SD), overweight (z-score >1 SD and ≤2SD), and obese (z-score >2 SD).[34,35] Moreover, Body composition, including fat and lean body mass, was measured by IN body S10.[36]

2.5 | Assessment of SES

SES was determined by asking questions about the ownership of a house and the number of rooms (s), the economic status of the area of residence, parents' education and job, the number of trips per year, the ownership of a vehicle, computer or laptop, smart TV, and side-by-side refrigerator. Area-level deprivation information was gathered by a researcher-made questionnaire used in a previous study.[37] According to this questionnaire, families were categorized into three groups: poor, moderate, and good.

2.6 | Statistical analysis

All statistical analyses were conducted using the Statistical Package for Social Sciences (SPSS, version 25; Chicago, IL). The Kolmogorov-Smirnov test was used to determine the normality of the data, and data were reported as mean ± SD or number (percentage). Quantitative variables were compared in two groups by student *t*-test and in three groups by ANOVA. The Chi-square test was used to compare qualitative data. Major DPs were determined by exploratory factor analysis and the principal component method. The orthogonal varimax rotation was applied to identify major DPs. To determine the number of DPs, the eigenvalue and Scree plot were used. The loading factor for each food group was calculated by summing the daily number of foods consumed and their factor score matrix. The best-derived factors were labeled as three DPs based on the interpretation of the data and referring to the previous studies.[38–40]

2.7 | Ethical consideration

The research protocol and consent forms were approved by the Research Ethics Committee of Mashhad University of Medical Sciences (registration number: IR.MUMS.fm.REC.1396.773). Written informed consent signed by the children's parents or guardians was obtained from all the participants.

3 | RESULTS

Table 1 shows the characteristics of the children. Most children were male (51%), and the average body weight, total body fat, and fat-free mass were 21.3 (kg), 4.62%, and 16.24%, respectively. The food groups and food items have been shown in Table 2. As shown in Table 3, three DPs were extracted based on the food groups and factor loadings. The first DP, "healthy DP", included fruits and natural juices, vegetables, grains, dairy products, meat, fish, and shrimp. The second, "unhealthy DP", consisted of poultry, tea and coffee, oils and fats, dairy, chocolate desserts, sweet desserts, yogurt drinks, soft drinks, industrial juices, confectionery sweets, packaged sweets, and biscuits. The last DP was named "Meat-free DP", which included snacks, legumes, eggs, ketchup, pickles, and salt. Table 4 shows the results of the linear regression analyses between some independent variables and DPs. Our findings did not show any association between DPs, growth indices, and body

TABLE 1 Description of Qualitative and quantitative variables of participants.

Qualitative variables	N	%	Qualitative variables	N		Quantitative variables	
Gender			*Socio-economic status*				Mean ± SD
Female	153	48.3	Disadvantaged	92	28.8	Weight (kg)	21.35 ± 6.41
Male	164	51.7	Semi advantaged	93	29.2	Height (cm)	113.18 ± 7.64
Family members			Advantaged	134	42.0	BMI (kg/m^2)	16.23 ± 2.28
2–3	121	38.2	*Father's education*			BMI-Z score (kg/m2)	0.46 ± 1.28
4–5	189	59.6	Elementary and middle school	63	17.3	WC (cm)	54.28 ± 6.49
≥6	7	2.2	High school and diploma	192	52.7	AC (cm)	18.21 ± 5.58
Father's job			Bachelor's degree and higher	109	28.0	Fat mass (kg)	4.62 ± 2.70
Self-employment	236	75.4	Child *Family status*			Fat-free mass (kg)	16.24 ± 2.23
Government job	75	23.9	Lives with both parents	307	97.2	Energy (kcal/day)	1187.97 ± 356.87
Unemployed	2	0.7	Lives with one parent	9	2.8		

Note: The results are described as number and percentage.

Abbreviations: AC, arm circumference; BMI, Body Mass index; WC, waist circumference.

TABLE 2 The food groups and their food items.

Food groups	Food items
Whole grains	Whole meal breads, whole grain breakfast cereals, popcorn
Grain	Bread, rice, pasta, potatoes
Vegetables	Tomatoes, cucumbers, carrots, cabbage, lettuce, spinach, dark vegetables, green beans, mushrooms
Fruits	Dates, tangerines and oranges, apples, pears, yellow or black plums, nectarines, peaches, apricots, cherries and sour cherries, strawberries, grapes, pomegranates, figs, watermelons, melons and cantaloupes, pineapples, kiwis, natural juices
Dairy	Milk, cheese, yogurt, curd, cocoa milk
Meats	Red meat, heart and guts
Fish	Fish, shrimp
Poultry	Chicken, fried and, grilled chicken
Fast food	Pizza, sausages and burgers
Legumes	Lentils, peas, beans, split peas, mung beans
Nuts and seeds	Nuts, seeds, sesame
Dairy desserts	Porridge, rice milk, ice cream
Sweet desserts	Jelly, chocolate, jam, honey, candy, toffee, pastilles, yellow flakes, halva, cotton candy, sugar
Confectionery sweets	Confectionery sweets including all kinds of cakes, creamy and dried sweets
Packaged sweets and biscuits	Cakes, cookies, plain biscuits, creamy biscuits
Egg	Boiled or fried eggs, omelet
Drinks	All kinds of carbonated drinks, all kinds of sweet drinks and industrial juices
Tea and coffee	Tea, coffee, nescafe, cappuccino
Tomato paste	Tomato paste
Ketchup	Ketchup
Salinity	A variety of pickles and olives
Fats	Liquid and solid vegetable oils, butter, animal oils, mayonnaise, cream
Snacks	Chips and puffs
Yogurt drink	Dough

composition in preschool children except for BMI Z-score and overall energy intake.

Based on Table 5, there was a significant relationship between energy intake ($p < 0.001$), BMI ($p = 0.003$), waist circumference ($p = 0.004$), height ($p = 0.02$), and fat mass ($p = 0.002$). These findings indicated that with one unit increase in BMI, waist circumference, height, or fat mass, the likelihood of being in a "good" SES increased.

TABLE 3 Distribution of factor loadings for Dietary patterns (DPs) of preschool children.

Food groups	Healthy dietary pattern	Unhealthy dietary pattern	Meat-free dietary pattern
Snakes	_	_	0.517
Poultry	_	0.465	_
Legumes	_	_	0.467
Tea and coffee	_	0.551	_
Fast food	_	_	_
Nuts and seeds	_	_	_
Oils and fats	_	0.386	_
Dairy chocolate desserts	_	0.318	_
Fruits and natural juices	0.549	_	_
Grains	0.637	_	_
Whole grains		_	_
Sweet desserts	_	0.549	_
Egg	_	_	0.346
Ketchup	_	_	0.617
Soft drinks and industrial juices	_	0.395	_
Pickles and salts	_	_	0.408
Confectionery sweets	_	0.422	_
Packaged sweets and biscuits	_	0.354	_
Vegetables	0.522	_	_
Meats	0.505	_	_
Fish and shrimp	0.495	_	_
Tomato paste	_	−0.334	_
Yogurt drink	_	0.318	_
Dairy products	0.387	_	_

4 | DISCUSSION

In the present study, three distinct DPs of "healthy", "unhealthy", and "meat-free" were detected. The ingredients of "healthy" DP in the current study were very similar to other studies[41,42] and contained higher number of fruits and natural juices, vegetables, grains, dairy products, and fish compared to the other DPs. Dietary patterns related to various chronic diseases typically begin before puberty and may only change minimally over time. Obesity, cardiovascular diseases, hypertension, diabetes, and cancer are all chronic diseases that can be prevented by changing one's DP and/or lifestyle choices during childhood and adolescence.[43] The present study contributes to the limited research available in this population, offering a deeper understanding of how dietary habits and socioeconomic factors influence measures of body composition. By focusing on a specific age group and geographical location, this

research offers unique insights that can inform targeted interventions and policies to promote healthy growth and development among Iranian preschool children.

Our findings showed a significant relationship between meat-free DP and BMI Z-score. In other words, more adherence to the "meat-free" diet was associated with a higher BMI Z-score. However, no relationship between the two other DPs and anthropometric indices was seen. Naja et al.[44] examined the association between DPs and obesity and did not find a significant association between the traditional Lebanese DP (high intakes of vegetables, legumes, bread, rice, pasta and cereals, bulgur, fruits, fish, and vegetable oils) and the odds of being overweight in the study population. Also, no associations were found between the identified DPs (Western and Lebanese traditional patterns) and obesity (BMI z-score ≥2).[44]

Previous studies mainly focused on adults,[45,46] cross-sectional,[47,48] and cohort designs.[49] Therefore, finding the relationship between DPs and obesity may not be generalizable to Iranian children owing to cultural factors affecting intake.[50] A study conducted by Vieira-Ribeiros et al. on children aged 4–7 years in Brazil illustrated that children with a higher intake of "unhealthy" DP had greater general and central body adiposity compared to those consuming foods aligned with a "healthy" DP.[49] Since the current study is the first to evaluate the relationship between DPs and SES with anthropometric and body composition indices in Iranian preschool children, conducting similar studies to clarify other dimensions of these relationships is necessary.

The present study clarified that the improvement in SES of the children resulted in a significant increase in indices associated with energy intake (e.g., BMI, waist circumference, and fat mass). Obesity is an ongoing public health problem, which has adverse health consequences for both children and adults; thus, obesity prevention is a key public health priority.[51,52] Our study showed a significant relationship between some obesity indicators and high , which supports previous findings from other studies conducted in India, Sri Lanka, Vietnam, and Colombia.[53–56] Furthermore, studies in India and Ukraine have shown that there is a relationship between social welfare and BMI.[57,58] Also, in developing countries, the prevalence of overweight and obesity in children increases with the improvement of SES.[59] Additionally, Chen et al, in a cross-sectional study revealed that children with a higher SES were more likely to be overweight or obese than those with a SES.[60]

However, one study in Korea showed that low SES is significantly associated with an increased prevalence of overweight and obesity.[61] This finding can be explained in part by the fact that children with low

TABLE 4 Simple linear regression coefficients and respective confidence intervals for the association of dependent variables and Dietary patterns (DPs) in children aged 4–6 years.

	Waist circumference		
Dietary pattern	***β***	**95% CI**	***p*-value**
Healthy	0.240	0.502–0.982	0.525
Unhealthy	−0.373	1.140–0.395	0.340
Meat-free	0.296	0.404–0.996	0.406
	Fat mass		
	β	**95% CI**	***p*-value**
Healthy	−0.061	0.261–0.383	0.711
Unhealthy	−0.221	0.112–0.553	0.192
Meat-free	0.040	0.264–0.344	0.798
	BMI Z-score		
	β	**95% CI**	***p*-value**
Healthy	−0.007	−0.162–0.147	0.927
Unhealthy	−0.044	−0.205–0.116	0.587
Meat-free	0.063	−0.083–0.208	0.004
	Energy		
Healthy	266.33	233.73–298.93	0.001
Unhealthy	137.32	107.06–167.58	0.001
Meat-free	57.65	29.75–85.55	0.001

TABLE 5 Relationship between growth and body composition indices with socioeconomic status in children.

	Socio-economic situation			
Variables	**1**	**2**	**3**	***p***
Weight	20.4 (4.70)	19.8 (3.95)	20.2 (6.50)	>0.05
Height	114 (5.78)	114 (6.00)	112 (8.40)	0.02
BMI	15.5 (2.20)[b]	15.5 (1.05)[C]	16 (2.00)	0.003
Waist circumference	52.5 (6.00)[a]	53.5 (5.63)	54 (7.85)	0.004
Arm circumference	16.5 (2.00)[a]	17.5 (3.35)	17.3 (3.50)	>0.05
Fat mass	3.9 (1.80)[a]	3.5 (2.20)[C]	4.1 (3.30)	0.002
Fat-free mass	16.5 (2.17)	16.4 (2.97)	15.9 (3.28)	>0.05
Energy	1004.1 (319.2)[b]	1192 (455.12)[C]	1240.5 (509.80)	<0.001

Note: Kruskal–Wallis test; socio-economic situation: 1. Poor; 2. Medium; 3. Good; post hoc: a: 1&2; b: 1&3; c: 2&3.

levels of social welfare are more likely to consume fewer fruits and vegetables and a greater quantity of non-expensive energy-dense foods, which is associated with a greater risk of obesity.[62] A study on children aged 8–12 years showed that fruit and vegetable consumption was associated with a lower risk of obesity, whereas consumption of fast-food and chocolate (both typically high in saturated fat) was associated with a greater risk of obesity.[63] The explanation for such contradictory findings may be differences in the participants (e.g., age, sex), sample size, unadjusted confounders, using multiple variables for assessing the socioeconomic status, and the places where the studies were conducted (e.g., urban or rural areas). Therefore, it is necessary to consider SES when applying strategies to prevent overweight and obesity in children.

Interestingly, the study also highlighted the mediating role of socioeconomic factors in the association between DPs and obesity and found that the relationship between unhealthy DPs and obesity was partially mediated by SES, indicating that socioeconomic factors contribute to the development of obesity through their influence on dietary choices and access to healthy food options. These findings support the importance of considering SES as a key determinant in understanding the relationship between DPs and obesity in children.

There are some potential limitations in the present study. First, since the analyses were cross-sectional, causal inferences cannot be made. Second, longitudinal studies are needed to confirm these preliminary findings, and sample size should be considered as our cohort may not represent the general Iranian population, especially from an SES point of view. Finally, although many potentially confounding variables have been controlled, some socioeconomic and genetic factors may have still confounded our estimation.

5 | CONCLUSION

The current study identified three DPs, namely "healthy," "unhealthy," and "meat-free" among the children. The prevalence of overweight and obesity was significantly higher in children following the "meat-free" pattern compared with those following other DPs. These findings highlight the importance of considering SES and meat consumption when developing interventions for childhood obesity. Future studies are recommended to employ structural equation modeling (SEM) and mediation analysis to further explore the direct and indirect relationships between SES, meat consumption, and childhood obesity. Such analyses can provide a deeper understanding of the underlying mechanisms and inform more targeted interventions.

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AUTHOR CONTRIBUTIONS

M.KH, E.N.E., and N. P: formal analysis. M.KH and S.P: writing—original draft preparation. E.N.E, and M.M and A.M.H: writing—review and editing. All authors have read and agreed to the published version of the manuscript.

CONFLICT OF INTEREST STATEMENT

The authors declare no potential conflicts of interest concerning the research, authorship, and/or publication of this article.

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