Study Risk factors of increased Z-Score of Body Mass Index in preschool-age children

Fathi Mahmoud El-Gamal (drfathimhelgamal1996@hotmail.com)
Ibn Sina National College for Medical Studies Medicine Program https://orcid.org/0000-0002-9012-2225

R Babader
Ibn Sina National College for Medical Studies Medicine Program

M Al-Shaikh
Ibn Sina National College for Medical Studies Medicine Program

A Al-Harbi
Ibn Sina National College for Medical Studies Medicine Program

J Al-Kaf
Ibn Sina National College for Medical Studies Medicine Program

W Al-Kaf
Ibn Sina National College for Medical Studies Medicine Program

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Research note

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Abstract

Objective: This study was conducted to explore the risk factors of increased BMI /Age Z score > + 2 SD in the preschool children.

Result: BMI/Age Z score > + 2 SD was found in 19.5% (146 /748) of the children. It was significantly more common among the children from areas with high socio-economic level (OR: 2.434; 95% CI 1.543, 3.841, and p < 0.000). Risk of being obese was significantly higher among the males (OR 0.630; 95% CI 0.431, 0.920, and p < 0.017) compared to females. The increased duration of breast feeding in infancy, was significantly associated with increased BMI/Age Z-score (b= 0.027, p< 0.004). Decreased age of the child was significantly associated with increased BMI/Age Z-score (b= - 0.013, p < 0.004). The children with stunted growth were 6.7 times fold likely to have BMI/Age Z Score > + 2 SD compared to the normal children (OR 6.733; 95% CI 3.799, 10.800, and p < 0.000), after allowing for other factors. No significant association was found between allergic disorders and BMI/Age Z score > + 2 SD.

Introduction

Pediatric overweight and obesity have increased worldwide.[1] It is linked with increased risk of long-term ailments in adulthood.[2] In Saudi Arabia there is an increased trend in the magnitude of obesity.[3] Prevalence of overweigh and Obesity in developed countries is higher compared with developing regions of the world.[4, 5] Overweight tended to be more common among girls, particularly in developing countries.[6] Associations between asthma and high BMI have been observed in studies of children and adults.[7, 8] This study focused on exploring the possible predictor factors of BMI/Age Z Score > + 2 SD in preschool children

Methods

This is a cross-sectional study, where a convenient sample of preschool children who visited the outpatient clinics with their relatives, but not as patients, in two hospitals during two month- period was selected. The total number of children examined was 748; this number was greater than the required minimum number (220 children) to increase power of the study (as assessed by G*power software, for α = 0.05, β = 0.95, effect size is 0.3, and degree of freedom = 5).[9] Data was collected from children's mothers after taking an informed written consent. Data was collected through: questionnaire: which provided information about personal and socio-demographic characteristics, feeding patterns, and clinical characteristics of the child; anthropometry : weights and lengths/heights of the children and their mothers according to standard procedures. [10, 11] Anthropometric analysis: The variables age, sex, weight and height were used. These measurements were used to provide the following indices: weigh-for-age, height-for-age, weight-for-height, and BMI for age. The indices generated were compared to standard reference values of WHO to obtain the corresponding Z-scores.[12] We used Z-scores to determine the nutritional status of the children. A child whose height-for-age Z-score was < − 2, from the median value of the reference population, was considered as stunted. The children with BMI/Age Z-score > + 2 Z to + 3

Z, from the median value of the reference population, were classified as overweight; and if it was > + 3 Z, obese.

3-ISAAC core questionnaire on asthma and allergy: It is used to diagnose bronchial asthma, allergic rhinitis and atopic eczema.[13]

Data analysis and statistical tests: Data was analyzed using the Statistical Package for Social Sciences (IBM SPSS, version 23, Armonk, NY: IBM Corp.). Multi-nominal Logistic regression method was used where BMI/Age Z score > + 2 SD was used as the dependent dichotomous variable and other variables were used as the independent dichotomous variables, where Odds ratios, 95% confidence interval (95%CI), and p values were calculated. Linear Multiple Regression Analysis was used to study the continuous variables that could significantly predict the BMI/Age Z Score. The level of significance was 0.05.

Results

The males were 357 (47.7%), and 391were females (52.3%). The BMI/age Z score > + 2 SD was found in 146 children (19.6%). Among the studied children 64 were overweight (8.6%), while 82 were obese (11.0%). The BMI/age Z score > 2 SD was found in 23.8% of the males, while it was recorded in16% of the females. The Mean age of the children who have BMI/Age Z score > + 2 SD was 29.19 months (SD 19.92), compared to 34.69 months (SD 20.79) for children who have BMI/Age Z score ≤ 2 SD (t-test = 2.887, p < 0.004). The risk of having BMI/Age Z Score > + 2 SD among children was higher in the Northern region compared to children in the Southern region of Jeddah (OR: 2.434; 95% CI 1.543, 3.841, and p < 0.000). The BMI/Age Z score > + 2 SD was significantly more common among the males compared to the females (OR 0.630; 95% CI 0.431, 0.920, and p < 0.017). However, the other socio-demographic factors like parents educational level, their occupation, or their monthly income were irrelevant to BMI Z score > + 2 Z among the studied children. The types of food administered to the children were irrelevant to BMI/Age Z scores > + 2 SD. The younger children have significantly higher values of BMI / Age Z – scores compared with the older ones (b= -0.013, p < 0.004). The family size, and the rank of the child among his siblings were, also, not significant determinants of the child BMI/Age Z score.

The increased duration of breast feeding in infancy, was significantly associated with the increase in BMI Z-score (b = 0.027, p < 0.004). The children with stunted growth were 6.7 times fold more likely to have BMI/age Z Score > + 2 SD compared to the normal children (OR 6.733; 95% CI 3.799, 10.800, and p < 0.000), after controlling for other factors. The BMI/Age Z score > + 2 in the children was independent of the BMI for their mothers, and was, also, independent of having asthma, or allergic rhinitis, or eczema or other infections.

Discussion

Early years of life is a critical period for evaluating the onset of obesity and application of control strategies; as increased BMI in childhood is linked to obesity and ill health in later years. [14] The weight of

children naturally fluctuates during growth, and so assessment of BMI in pediatric age groups necessitates the availability of reference charts which consider gender and age. A child with BMI for age and gender Z-score that is > 2 SD from the median of the reference population is classified as overweight, and if it is > 3 SD is considered obese. [12] The main objective of the present study was to assess the prevalence and predictors of BMI/age Z score > 2 SD among preschool children in Jeddah city KSA, using the WHO Child Growth Standards. Based on data collected from sample of the child population in Jeddah city KSA it was found that approximately 20% of preschool children have BMI/age Z score > 2 SD. This is contradicting to a previous study [15] who revealed that the overall prevalence of overweight in preschool children in developing countries was low (3.3%).[16] Results of the present study is in agreement with a study done in KSA. [3] Findings of the present study, also, are comparable to other countries such as Bahrain and Kuwait. [17, 18] Previous study revealed that 29.6% of preschool children were overweight, and 11.1% were obese with the prevalence of obesity being significantly higher for boys than girls.[19] The present study also, found increased prevalence of BMI/age Z score > 2 SD in males compared to females. Economically developed regions have a higher prevalence of obesity compared with developing regions of the world. In many developing societies, the adoption of a Western lifestyle, characterized by decreased physical activity and high caloric intake, is contributing to obesity, and to an alarming epidemiological transition marked by the shift in the leading causes of death from communicable to non-communicable diseases.[4] In the present study, after allowing for the confounding factors, children living in the economically developed North region of Jeddah city were more likely to become obese compared to the less economically developed South region of Jeddah. Although Saudi children were found to be more obese than Non-Saudi children, the difference was not significant after allowing for confounding socio-demographic factors. According to a systematic review, prevalence of overweight ranged from 1.9–21.9% among under five children of the Eastern Mediterranean Region countries. Predicting factors determining obesity in this region were massive marketing promotion of high fat foods and frequent snacking. [20] A similar study conducted on 500 children, 2–5 years old, in Iran; found that prevalence of overweight was 10.6% [9.6% among males and 11.7% among females] and obesity 7.6% [9.6% among males and 6.3% among females]. Excess weight was significantly associated with birth weight, mother's occupation and father's level of education. [21] In the present study, parental education or occupation were not significant predictors of BMI/age Z score over 2 SD in the studied children. These findings are supported by a previous study.[6] In a study conducted in Egypt on preschool children revealed that, the age of a child, family size, work status of a mother, mixed feeding in the first 6 months, and fat intake are significant predictors of a child's nutritional status. On the other hand they found that, birth order, fathers' and mothers' education, and family income were not significant predictors of children's nutritional status.[22] In the present study, gender and age of the preschool children were significant risk factors for having BMI/age Z score > 2 SD, while other variables like family size, ranking of the child, smoking habits of the parents, birth weight, feeding of the child during infancy and dietary habits were not significant. The North East of Iran study did not document any relationship between socioeconomic status and obesity; which is equivalent to the findings of our study. The Iranian study revealed no significant

association between obesity and birth order. It may be related to increasing the knowledge of parents and paying more attention to the nutrition and health care of their children. [23]

In a meta-analysis study, it was found that duration of breastfeeding was inversely and linearly associated with the risk of overweight. The risk of overweight was reduced by 4% for each month of breastfeeding.[24] Nevertheless, in the current study, after allowing for confounding factors, we got contradicting results, where prolonged breast feeding was risk factor for increased BMI Z score among Saudi children. Previous studies found significant link between sugary drink consumption and weight gain in children. [25,26] However, the present study did not find daily consumption of sweet food, intake of milk or fruits and vegetables as significant predictors of BMI/age Z score > 2 SD.

After a systematic review about obesity and asthma during childhood, it was concluded that an association between asthma and obesity in the pediatric population was extremely likely.[27] However, in the present study, although, asthma was positively associated with increased BMI Z score, this association disappeared when logistic regression was used to allow for effect of different socio-demographic and clinical factors. Findings of the present research were supported by other study. [28] Although, previous study claimed positive association between obesity and both allergic rhinitis and eczema,[29] yet the present study, failed to find such an association. Stunting is prevalent in many developing countries; it is a possible risk factor for being overweight, as it may cause a series of long-lasting changes, such as reduced energy expenditure, increased risk to the effects of a high-fat diet, reduced-fat oxidation, and impaired regulation of food intake. [30] In the present study it was found that increased BMI/Age Z Score > 2 SD was significantly associated with stunting in preschool children.

In conclusion, the present work gives insight on the importance of increased BMI/Age in preschool children in Jeddah, KSA. The prevalence of BMI/Age Z Score > 2 SD is 19.7%. This study demonstrated that increased BMI/Age in children can be affected by age, and socio-economic status, among other factors. The double malnutrition problem, including stunting and obesity, among preschool age children is common. This study does not support the link between the increased BMI/Age and the occurrence of allergic disorders. Tackling increased BMI in preschool children is vital to reverse the pediatric obesity epidemic. The analyzed results have an important implication for future research and it is recommended to follow up on various regions across the country in the future. The remarkable efforts to implement programs to prevent such phenomena from continuing, among this particular age group, in the future are recommended.

Limitations of this study.

Among the limitations of this study, was that we used a convenient sampling method to enroll children. We relied, also, on the recall of the clinical history of the child by the mother. However, our results were very close to studies conducted in Saudi Arabia and in other parts of the world.

Abbreviations

BMI
Body Mass Index
SD
Standard deviation
SPSS
Statistical package for Social Sciences
Od
Odds Ratio
CI
Confidence interval
Z
SD under the normal probability distribution curve

Declarations

-Ethics approval and consent to participate

Ethical clearance was obtained from the institutional review board (Protocol identifier 006MP25082019; Application of human ethics committee approval -2-, 17/12/2016). Permission was obtained from the directors of the outpatient clinics for collecting data from the children and their mothers. Data collection procedure was anonymous.

Consent of participants : A written consent to participate in the study was obtained from each mother of each child.

-Consent for publication

Not applicable

-Availability of data and materials

Authors present the data on the main paper.

-Competing interests

All authors declare that they have no competing interests.

-Funding

Not applicable

-Authors' contributions

1. El-G Conceived and designed the study

2. El-G, R.B, A Al-H, M. Al-S, J.A. W.A: Performed the experiment:
3. El-G Analysis of the data.
4. El-G, R.B, A Al-H, M. Al-S, J.A. W.A Wrote the manuscript

All authors read and approved the final manuscript.

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Tables

Table 1: Logistic regression of the different independent variables on BMI/Age Z Score over 2 SD

Independent variables	B	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
				Lower Bound	Upper Bound
Intercept	1.765	.001			
Area of residence	.890	.000	2.434	1.543	3.841
Nationality	-.089-	.664	.915	.613	1.366
Gender	-.462-	.017	.630	.431	.920
Educational level of the father	.157	.467	1.170	.766	1.786
Monthly income	.104	.672	1.109	.686	1.793
Educational level of the mother	-.049-	.824	.953	.621	1.460
Occupational of the father	.053	.814	1.054	.680	1.633
Occupational of the mother	.110	.657	1.116	.688	1.811
Monthly income	.104	.672	1.109	.686	1.793
Gestational period	-.208-	.543	.812	.415	1.588
Main feeding in infancy	-.034-	.868	.966	.645	1.448
Eat food with preservatives, daily	-.176-	.461	.839	.526	1.338
Eat sweet food daily	-.097-	.668	.907	.582	1.414
Drink milk , daily	-.079-	.752	.924	.567	1.507
Eat fruits and vegetables, daily	-.344-	.191	.709	.423	1.187
Treatment for anemia	.030	.947	1.031	.425	2.497

Table 2: Multiple regression of independent variables and BMI/Age Z-Score

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	.328	.442		.742	.458
Age (Months)	-.013-	.004	-.139-	-2.915-	.004
Number of children in the family	-.185-	.132	-.137-	-1.405-	.161
Rank of the child among his siblings	.122	.132	.089	.923	.357
Duration of main feeding in infancy	.027	.010	.129	2.872	.004
BMI of the mother	.000	.012	.000	.010	.992

Table 3: Logistic regression between BMI/Age Z Score over 2 SD and allergic disorders and stunting.

Independent variables				95% Confidence Interval for Exp (B)	
	B	Sig.	Exp (B)	Lower Bound	Upper Bound
Intercept	-.117	.781			
Stunting growth	1.900	.000	6.688	4.438	10.079
ISAAC diagnosed asthma	.129	.588	1.138	.713	1.817
ISAAC diagnosed rhinitis	.377	.153	1.458	.869	2.448
ISAAC diagnosed eczema	-.558	.245	.572	.224	1.465
Repeated respiratory tract infection	-.331	.291	.719	.389	1.328
Family history of allergy	.212	.312	1.236	.820	1.863