Patterns and determinants of Z score of Height for Age, Weight for Age and Weight for Height among Preschool children in Jeddah city, Saudi Arabia.

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Abstract

Background: Stunted growth could lead to increased morbidity and mortality during childhood.

Objectives: To identify the major socio-demographic, and health risk factors of stunting in 2–6 years old Saudi children.

Design: Cross sectional study. Sampling and setting: It was a convenient sampling method, and was conducted at the outpatient clinics of two general hospitals in Jeddah city. Patients and methods: Total sample size was 748 preschool children. Data was collected on the children via personal questionnaire, ISAAC questionnaire on asthma and allergy in children, and anthropometric measurements. Indices for stunting (Height for age), underweight (weight for age), and wasting (weight for height) were compared to WHO reference values for normal children and Z scores for the indices were calculated. Multi-nominal Logistic regression and linear multiple regression were used. Odds ratio (OR) and 95% confidence intervals (95% CI) were calculated. The level of significance for this study was 0.05.

Results: Wasting was encountered among 3.11% of the children, while stunting was found among 22.91%, and underweight among 20.32% of the children. On the other hand overweight/obesity was found among 19.7% of the children. An obese child is 8 times more likely to be stunted (OR: 7.845; 95%CI: 4.103, 15.001), and child with under-weight was 17 times more likely to be stunted (OR: 16.782; 95%CI: 7.517, 37.470). Female child was less likely to be stunted compared to male (OR: 0.607; 95% CI: 0.374; 0.985, P < .043). Stunting was more common in early years of life (b=0.015). Short stature of the mother (b = 0.021), and decreased her BMI (b= 0.043) were significantly associated with stunting in their children (P < .05).

Conclusions: Male gender and very young age are significant risk factors of stunting. Double malnutrition was common among children with stunting. Hereditary may be an important determinant factor of stunting in children.

Key words: Malnutrition, Stunting, Children, Saudi Arabia.

Introduction

During early years of life proper nutrition is a major factor for sound growth, an efficient immune system, perfect function of organs, and nervous system development (1).

Survival of children is dependent to a great extent on nutritional condition, as poor nutrition increases likelihood of acquiring infections and other diseases (2 – 6).

In Saudi Arabia, the prevalence of stunting and other malnutrition disorders in children lies between the figures for developing and developed countries (7). Impairment of growth in early childhood has bad consequences in adulthood, namely impaired fertility, decreased body size, impaired work productivity, and liability for getting chronic disorders (8). About fifty percent of deaths among children worldwide are related to malnutrition (9). One of the indicators of community health and development is the nutritional status of under-five children (10). Growth of the child can be used to evaluate their nutritional status. Under weight, wasting and stunting are different forms of under-nutrition, and can be assessed by anthropometric indicators. Current nutritional status and chronic malnutrition are measured by wasting and stunting. Underweight is a sign of both chronic and acute malnutrition (11). Worldwide the prevalence of stunting (26%), wasting (8%) and underweight (16%) among children are common. Irreversible stunting is associated with poor nutrition in children less than 3 years of age (12). Stunting is significantly associated with increased death of under-five children (13, 14). This study focused on exploring the occurrence of under-nutrition, and investigating the association between its parameter and possible determinants, among preschool children in Jeddah City.

Methods

This cross sectional study was undertaken at the outpatient clinics of two general hospitals; one in a relatively high socioeconomic standard region (North of Jeddah city), and the other in a relatively lower Socio-economic standard region (South of Jeddah city). The total number of children enrolled in this study (748 children) was greater than the necessary minimum number needed for such a study (220 children, as assessed by G*power software, 15 for $\alpha = 0.05$, Power = 0.95, effect size is 0.3, and degree of freedom = 5).

Data were collected from the child's mother after taking informed written consent. The following tools were used to collect data:

1- Interviewing questionnaire which provided information on personal and socio-demographic characteristics of the parents; and feeding pattern, vaccination coverage, and clinical history of the child.

2- Anthropometric measurements: Weight and height of the child and the mother were measured. Anthropometric analysis: the variables age, sex, weight and height were used. These measurements were used to provide the following indices: weigh-for-age (WA), height-for-age (HA), and weight-for-height (WH), and body mass index for age (BMI /A). The indices generated were compared with standard reference values of WHO to obtain the Z-scores (16). From the z-scores, the nutritional status of the child was determined.

3- Operation definitions:

4- Stunting: A child whose height-for-age Z-score is below - 2 standard deviation (SD) from the median value of the reference population.

-Wasting: A child whose weight-for-height Z-score is below - 2 SD from the median value of the reference population.

-Underweight: A child whose weight-for-age Z-score is below - 2 SD from the median value of the reference population.

-Overweight/obese: A child whose BMI for age Z-score is more than 2 SD from the median value of the reference population is classified as overweight; and if it is more than 3 SD is considered obese.

4- ISAAC core questionnaire on asthma and allergy: was used to diagnose bronchial asthma, allergic rhinitis and atopic eczema (17-20).

Data analysis and statistical tests: Statistical Package for Social Sciences (IBM SPSS, version 22, Armonk, NY: IBM Corp.) was used. Linear Multiple Regression, and Multi-nominal Logistic regression method were used. Odds ratios (OR), 95% confidence interval (95% CI), and p values were calculated. The level of significance was 0.05.

Ethical considerations

Ethical clearance was obtained from the Institutional Review Board (IRB). Permission was obtained from the directors of the outpatient clinics for collecting data on preschool children. Informed consent was obtained from the mother of each child after providing information about the purpose of the study. In order to keep confidentiality of any information provided by study participants, the data collection procedure was anonymous.

Results

Characteristics of the studied children are shown in Table 1. The cases with stunting were 34 mild stunting (41.2 %), and 48 severe stunting (58.5% %). Both conditions were considered as one group: children with stunting (response variable). Males were more encountered among children with stunting (57.3%) compared to females (42.7%); this difference was statistically significant where Fisher's Exact Test was 4.56, and $P < .039$. Table 1 revealed that male children had 1.65 times the odds of suffering from stunting than females (OR: 0.607; 95% CI: 0.374, 0.985, and $P < .04$), when adjusting for other factors. Table 2 revealed that mean height of the mothers of children with stunting was significantly lower than mean height of mothers of the control children ($P < .007$). It revealed also that mean BMI of mothers of children with stunting was significantly lower than that of the mothers of children without stunting

(P < .001). Table 3 showed that decreased HAZ score was significantly associated with decreased age of the child (b = 0.015), decreased height of the mother (b= 0.021) and decreased BMI of the mother (b= 0.043). Table 4 depicted that smoking habit of the parents, environmental factors, gestational period and type of feeding in infancy and childhood were irrelevant to stunting of the children (P >.05). Table 5 revealed that children with excess weight had 7.8 times fold risk of stunting than those with normal BMI Z score (OR: 7.845; 95%CI: 4.103, 15.001). It shows, also, that children with under-weight had 16.78 times fold risk of stunting than those with normal weight (OR: 16.782; 95%CI: 7.517, 37.470).

Table 1: Multi-nominal logistic regression for socio-demographic independent factors on the dependent Stunting variable

Independent variables	B	Sig.	Exp (B)	95% Confidence Interval for Exp (B)	
				Lower Bound	Upper Bound
Intercept	1.96	<.000			
Place of study	0.195	<.480	1.215	0.708	2.086
Gender	-.499-	<.043	0.607	0.374	0.985
Nationality	-.241-	<.338	0.786	0.48	1.287
Educational level of the father	0.035	<.899	1.036	0.605	1.774
Educational level of the mother	-.391-	<.16	0.677	0.392	1.167
Occupation of the father	0.005	<.986	1.005	0.568	1.779
Occupation of the mother	0.371	<.23	1.449	0.791	2.656
Family history of allergy	0.205	<.409	1.228	0.754	1.999
Monthly income of the family	0.15	<.598	1.161	0.666	2.024

Table 2: Mean values of personal characteristics of the children and the mothers

Variables	Stunting	Mean	SD	t-test	*P*-value
Age (Months)	No	45.64	15.48	1.408	<.160
	Yes	43.07	12.96		
Number of children in the family	No	2.78	1.35	1.178	<.240
	Yes	2.59	1.23		
Rank of the child among his siblings	No	2.42	2.33	0.806	<.420
	Yes	2.20	1.17		
Duration of main feeding in infancy	No	17.63	8.62	0.571	<.568
	Yes	16.94	9.34		
BMI of the mother	No	28.25	6.68	3.314	<.001
	Yes	25.69	4.50		
Height of the mother	No	159.51	8.01	2.694	<.007
	Yes	156.15	17.77		

Table 3: Linear Multiple regression analysis of some continuous independent variables and dependent HAZ score variable

Independent variables	Unstandardized Coefficients		Standardized Coefficients	t-test	Sig. *P-value*
	B	Std. Error	Beta		
(Constant)	-5.256-	1.431		-3.672-	<.000
Age (Months)	0.015	0.006	0.13	2.569	<.011
Number of children in the family	0.086	0.066	0.067	1.313	<.190
Duration of main feeding in infancy	-.007-	0.01	-.039-	-.763-	<.446
BMI of the mother	0.043	0.013	0.166	3.238	<.001
Height of mother [cm]	0.021	0.008	0.136	2.659	<.008

Table 4: Multi-nominal logistic regression for environmental and dietary independent factors on the dependent Stunting variable

Independent variables	B	Sig. *P*-Value	Exp(B)	95% Confidence Interval for Exp(B)	
				Lower Bound	Upper Bound
Intercept	3.008	<.012			
Smoking of the father	0.026	<.927	1.026	0.591	1.781
Smoking of the mother	-.025-	<.966	0.976	0.319	2.983
Keeping animals at home	0.309	<.666	1.362	0.335	5.531
Keeping birds at home	-.716-	<.278	0.489	0.134	1.78
Keeping plants at home	-.017-	<.973	0.984	0.373	2.591
House nearby industrial city	-.158-	<.719	0.854	0.361	2.019
Gestational period of the child	-.757-	<.17	0.469	0.159	1.382
Vaccination coverage of the child	0.057	<.882	1.059	0.498	2.251
Main feeding in infancy	0.244	<.342	1.277	0.772	2.112
Eat food with preservatives, daily	-.376-	<0.175	0.687	0.399	1.182
Eat sweet food, daily	0.084	<.759	1.088	0.636	1.862
Drink milk, daily	-.160-	<.595	0.852	0.472	1.537
Eat fruits and vegetables, daily	-.340-	<.180	0.712	0.433	1.17

Table 5: Multi-nominal logistic regression for clinical disorders independent factors on the dependent Stunting variable

Independent variables	B	Sig. P-value	Exp(B)	95% Confidence Interval for Exp(B)	
				Lower Bound	Upper Bound
Intercept	0.398	<.665			
Repeated URT infections	-.353-	<.377	0.703	0.321	1.537
Treatment for parasitic infection	-.973-	<.107	0.378	0.116	1.233
Treatment for anemia	0.528	<.242	1.695	0.7	4.103
ISAAC diagnosed asthma	0.458	<.218	1.581	0.763	3.278
ISAAC diagnosed rhinitis	-.531-	<.178	0.588	0.272	1.273
ISAAC diagnosed eczema	-.277-	<.511	0.758	0.332	1.732
Obesity	2.06	<.000	7.845	4.103	15.001
Underweight	2.82	<.000	16.782	7.517	37.47
Wasting	-1.718	<.000	0.18	0.073	0.439

Discussion

Stunting is one of the most important measures of children's overall heath, and it indicates the quality of care provided to different community sectors in nations. Millions of children around the world suffer from diminished linear growth due to lack of adequate nutrition and neglected child health care (21). Screening for stunting among at risk population should be asserted in order to discover stunting and hence enhance the current health conditions. Nowadays, in developing countries, due to changes in lifestyle, socio-demographic pattern, type of diet, and increased prevalence of infectious diseases, the problems of over nutrition and different types of under nutrition have become major health problems (22-23). Prevalence of severe stunting in Saudi Arabia was 2.8%, and it was 10.9% for moderate stunting. This indicates that more care should be done to raise standard of nutritional status of Saudi children (7).

This case-control study analyzed 496 children aged 2 – 6 years for risk factors associated with stunting. This is one of the first studies in Saudi Arabia looking at risk factors associated with stunting and the first study to link stunting with a much higher increased risk of being overweight in KSA.

The present study depicted the gender of the child to be a strong risk factor for stunting among young children. There are contradicting results in the literature about whether boys or girls are more vulnerable to stunting (7, 24-27). However, our findings are in line with a previous study (28). Many studies found boys to be more prone to stunting compared to girls in such a young age. In line with these conclusions, our data identified male children to be at a greater risk of stunting compared to females. The reason behind such a difference is not clear. Our study did not find significant association of stunting among children and socio-economic status of their families, or paternal education. The reasons behind that could be due to the similarity of the living condition which does not allow the impact of socioeconomic factor to influence the linear growth of the children. The present study found that HAZ score increased progressively as age increased i.e. stunting was more common in the second and third year and decreased from the 4th to the 6th years. This is in line with other studies (29-32). This particular young age group is vulnerable to infectious diseases as they start to reduce breast feeding, with its protective immunity, as well as exposure to food with its possible contamination, together with increasing dietary requirements (33-36).

Low birth weight children are significantly more likely to be stunted, as they are born with deficient reserves of Vitamin A, iron and zinc as well as low reserves of nutrients essential for growth (25, 37–39). In the present study we didn't find significant association between gestational period and decreased linear growth of the children, particularly after controlling for the confounding factors. This could be explained by the fact that Jeddah is an economically developed city, and most of the people are well off and hence mothers, in both regions, may have better healthcare knowledge, and health care resources. Similarly, in the present study paternal education, occupation, and monthly income were not significant predictors of stunting among children. This is inconsistent with the results of previous studies (25, 29, 30, 40–45).

Undernourished mothers usually have children with stunting. Studies from countries with low socioeconomic conditions reached to similar conclusions (29, 40, 42). Maternal nutritional deficiency is usually associated with deficiency in vitamin A, iodine, vitamin B2, vitamin B1, and

others (7). Consequently, infant nutritional deficiency is a result of maternal nutritional deficiency for these nutrient elements (38, 46). The present study revealed that 43.9% of cases had double nutritional problems (stunting and overweight/obese), compared to 11.4 % of the controls (X2=51.85, P < .000). This is in line with several other studies (40-48). The multi-nominal logistic regression in the present study revealed, also, that the children with stunting were 7.8 times more likely to be overweight/ obesity than those with normal linear growth (OR: 7.8; 95% CI: 7.517, 34.47), after allowing for the confounding factors. This could be explained by the hypothesis of poor diet quality (47). The present study showed that short stature of the mothers was significantly associated with decreased linear growth in 2 – 6 years children. This is in line with other studies (49, 50). This could be explained by the small uterine size which may lead to deficient nutrition supply to the fetus (51).

In conclusion our results provide evidence that male children and those aged between 2 to 4 years are more likely to suffer from stunting. It revealed, also, that an increase in stunting proportion was significantly linked to decrease in mother's height and her BMI. Moreover, overweight and underweight of the children were associated significantly with increasing risk of stunting. Accordingly, it is recommended that more care should be done by concerned health care personnel to prevent malnutrition and control its consequences among under six years Saudi children.

Limitations of this study

The questionnaire data were completed by the parents of the 2- 6 years old children, and were obtained retrospectively. It was also a hospital-based case control study, we can't exclude self-selection bias.

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