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Factors associated with growth faltering in children from rural Saudi Arabia

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Summary

Recent studies on the growth of children in Saudi Arabia have revealed that children under two years of age suffer from faltering growth when compared with the American reference population. The present study aims to identify parental and child characteristics associated with faltering growth among the children in a rural area of Saudi Arabia. A cross-sectional study of all women with a child less than three years of age in a rural community in NorthWestern part of Saudi Arabia was undertaken. Anthropometric measurements, socio-demographic and fertility variables were collected using a structured questionnaire. The indicators of growth were derived from the data and univariate and logistic models fitted to determine potential risk factors. There were 332 children, sex ratio 1.35 and 94.3% were less than 2 years of age. A low frequency (1.5%) had low weight for height, 11.4% low weight for age and 36.1% low height for age when compared with the American NCHS reference population. Multiple logistic regression suggested birth space > 2 years (OR = 0.44, 95% CI = 0.25 - 0.77), father's with primary or intermediate education (OR = 0.45, 95% CI = 0.25-0.90), birth weight > 2500gms. (OR = 0.8, 95% CI = 0.03-0.75), male birth (OR = 2.60, 95%. CI = 1.54-4.59) were variables statistically and independently associated with faltering growth. The pattern of growth of children under 2 years deviated negatively from their NCHS-WHO reference. This is similar to the previous findings from urban communities in Saudi Arabia. This growth faltering could be attributed partly to the inadequacy of the reference to compare growth pattern of children in all geographical areas, of the world. While the effects of different dietary habits may not be ruled out, it may be important to develop a different anthropometrics and nutrients growth chart that could be more appropriate to compare variation of infant growth in all nations of the world.

Keywords: *Faltering growth, children, variation, rural and factors*

Résumé

Les etudes sur la croissance des enfants en Saudi Arabie ont montré que les enfants de moins de 2 ans souffrent de défici de croissance quand comparé avec la population de reference Americaine. Cette étude avait pour but d'identifier les characteristiques parentales et défici de croissance parmi les enfants en zone rurale en Saudi arabie. Une étude sectionée sur les femmes ayant les enfants de moins de 3 ans dans la communauté rurale dans le Nord-ouest, Saudi arabi était faite. Les mesures anthropométriques, socio-démographiques et de fertilité variable étaient enregistrés a l'aide des questionnaire structurés. Les indications de dévelopment étaient derivés des données et des modéles non variant et logistiques pour déterminer les facteurs de risques potentiel. Sur 332 enfants de proportion sexuelle 1.35 , et 94.3% étaient moins de 2 ans. La faible fréquence (15%) avait un faible poids par rapport a la taille, 11.4% et 36.6% de faible taille quand comparé avec la population de reference Américaine(NCHS). La regression logistique multiple suggérent l ecart de naissance de plus de 2 ans (OR= 0.44, 95% CI= 0,25-0.77), leurs parents ayant une éducation primaire or tertiaire (OR=0.45, 95% CI= 0.25-0.90), Poids a la naissance de plus de 2500 gm (OR=0.8, 95% CI=0.03-0.75) et la naissance de males (OR=2.60,95%CI=1.54-4.59) étaient variable statistiquement et independenmment associés avec le defici de croissance. La fréquence de croissance chez les enfants de moins de 2 ans déviait négativement de leur reférence NHCS-WHO. Ce déficie de croissance pourrait etre aussi attribué a la reférence inadéquate pour comparaitre la frequence de croissance des enfants dans les lieux géographiques du monde. Cependant les effects des differents régime alimeantaires ne peuvent pas etre oublié; il serait important de developer plusieurs chartes d antrhropometriques et de nutrients plus appropriés pour comparer les variations de croissance chez les enfants dans les nations du monde.

Introduction

Child's growth is a well known indicator of health and nutritional status [1]. Simple anthropometric measurements such as height and weight as well as the demographic variables - age and sex are the basic data required to estimate indicators of good health and nutrition [2]. The availability of a reference growth chart has facilitated international comparison of the indicators of child growth [2,3,6]. Saudi Arabia is a rapidly growing nation and it's oil-wealth has been translated to a country having one of the highest per capita incomes in the world [7]. The government has also made health services available to all nooks and crannies of Saudi Arabia through the primary health care approach [8].

In spite of a high level of economy, availability of food and health care delivery systems, recent anthropometric studies have shown Saudi Arabian children to suffer from faltering growth [9,10,11]. In particular, the pre-school children were reported to have stunted and wasted growth when compared to the American Center for Health Statistics (NCHS) reference growth chart [11-13]. Some authors suggested genetic factors, inappropriate food supplement and/or poor selection of the type of feed given to these children as possible reasons [9,14,15]. These studies however, were largely concentrated in urban centers and well baby care clinics. Personal characteristics of both parents and children have not been exhaustively examined in the quest for reasons for observed faltering growth of children less than 2 years in particular [9,15,16]. Therefore, this study was undertaken in a rural population of Saudi Arabia to ascertain if previous findings apply and to identify parental and child characteristics associated with deviations in Saudi Arabian

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children aged 0-24 months, from their American counterpart as reference [16,17].

Materials and methods:

The study took place in Al-Oyynah, a rural community in the NorthWestern part of Riyadh, Capital of Saudi Arabia. The community has an estimated population of 2000 inhabitants and this cross-sectional health survey was carried out between April and May 2000. The study covered all the households in this rural community. The data collection procedure was by personal interview conducted by the nurses in the primary health care center serving this community. The nurses completed a structured questionnaire on all women having children less than 3 years of age in each household. Information collected included the socio-demographic and fertility characteristics of the parents, anthropometric measurements of the children, their feeding patterns and recent health problems.

The data was analyzed in a microcomputer using the EPIN-INFO statistical software for data entry, and the SPSS software for statistical analysis. The anthropometric software package ANTHRO developed by WHO was used for calculating the anthropometric indicators of malnutrition, stunted and wasted growth [18]. In this study, child is defined to suffer growth faltering if any of the anthropometric indicator such as height-for-age, weight-for-age and weight-for-height was lower than two standard deviations of the American NCHS, reference growth chart [16,17]. The children with height-for-age less than 2 standard deviations of the NCHS were defined as having stunted growth [2,6].

These two variables served as our outcome measure and in a univariate analysis, their associations with each of the parental, children, fertility or feeding characteristics, were examined for statistical significance. The chi-square test was used to examine the statistical significance of the association between any two categorical variables while the t-test was used to test the significance of means between continuous variables, when data is classified into two groups. Variables significantly associated with the dependent variables at the 10% probability level in the univariate analysis were included as covariates in a multiple logistic regression model for describing the relationship between faltering growth and the children and other characteristics [19].

Table 1: Age and sex distribution of children into weight-for-height,weight-for-age and height-for-age in standard deviation multiples of the NCHS/CDC reference population.

Age (month)	Sex	No. of (%) children	≤ - 2 SD	Normal	≥ 2 SD
Weight-for-height					
0-5.99	M	50	2.0	94.0	4.0
	F	29	-	86.2	13.8
6-11.99	M	36	2.8	86.1	11.1
	F	29	-	79.3	20.7
12-23.99	M	94	2.1	85.1	12.8
	F	75	1.3	69.3	29.3
24-35.99	M	11	0.0	100.0	0.0
	F	8	0.0	75.0	25.0
All	M	191	2.1	88.5	9.4
	F	141	0.7	75.2	24.1
Weight-for-age					
0-5.99	M	50	12.0	82.0	6.0
	F	29	3.4	93.2	3.4
6-11.99	M	36	41.7	58.3	-
	F	29	27.6	72.4	-
12-23.99	M	94	5.3	93.6	1.1
	F	75	4.0	93.3	2.7
24-35.99	M	11	0.0	36.4	63.3
	F	8	0.0	62.5	37.5
All	M	191	13.6	80.6	5.8
	F	141	8.5	87.2	4.3
Height-for-age					
0-5.99	M	50	52.0	40.0	8.0
	F	29	24.1	72.4	3.4
6-11.99	M	36	61.1	38.9	-
	F	29	51.7	48.3	-
12-23.99	M	94	33.0	67.0	-
	F	75	22.7	76.0	1.3
24-35.99	M	11	9.1	27.3	63.6
	F	8	12.5	50.0	37.5
All	M	191	41.9	52.4	5.8
	F	141	28.4	68.1	3.5

Results

There were a total of 332 respondents but data on age of the mothers was not available on five or 1.5% of the women. The age of the remaining 327 mothers ranged from 17 years to 40 years with a mean of 28.9 years (SD= 4.7 years) with more than a third (34.0%) in the 30-34 years age group. At the time of the survey the women had a total of 1,581 children ever born to them giving a mean of 4.8 children per woman (SD = 2.2). The number of children ever born to the mothers ranged from a minimum of one to a maximum of ten children with a median of 5 children.

Nearly half of the 332 children (50.9%) in this study were aged between 1 and 2 years, while 23.8% were less than 6 months and only 5.7% were above two years of age. There was a male preponderance in each of the age groups with an overall sex-ratio of 135 males for every 100 females. The weight-for-height, height-for-age and weight-for-age distribution of the children in standard deviation scores of the NCHS reference population are presented in Table 1 for each age and sex groups. The percentage of children who were less than two standard deviations of the American reference and therefore classified as low weight-for-height was 1.5%, low-weight-for height was higher in males than females (2.1% vs 0.7%). The females on the other hand have higher proportions of children greater than 2 standard deviations of the American reference, (high weight for height) and this pattern increased with increasing age. The proportion of children whose weight for age was less than 2 standard deviations of the American reference population was 11.4%, higher in males (13.6%) than females (8.5%). The third indicator of growth, height for age, had a generally high proportion below two standard deviations of the reference population (36.1%) and this was statistically significantly higher in males (41.9%) than females (28.4%), $P<0.05$. For the last two indicators of growth, the highest proportion below 2 standard deviations when compared to the American reference were recorded among children 6 to 12 months.

There were few children older than two years in this study and these children had the lowest proportion of stunting and wasting and the highest proportions of those above 2 standard deviations of the American reference.

The univariate analysis of the children characteristics suggested that children in the younger age group (less than 1 year) were more likely to have stunted growth compared to children 2 years and above. Table 2 revealed children between 6 and 12 months were more than 11 times as likely to have low height-for-age than those above 2 years. Also, males demonstrated a higher proportion of stunted growth than females; while children with low birth weight have more than 5 time likelihood to have low height-for-age stunted growth. There is a marginal statistically significant association between stunted growth and birth spacing $P = 0.051$ with those born within less than two years of the preceding birth who were more than 50% more likely to have stunted growth.

Table 2: The distribution of children according to low height-for-age and estimate of relative risk of demographic characteristics.

Characteristics	No. of children	Low height for age	R.R.	95% Conf-Interval (CI)
Age(months)				
0-5.99	79	33 (41.8)	6.10	1.22 - 41.00
6-11.99	65	37 (56.9)	11.23	2.20 - 76.92
12-23.99	169	48 (28.4)	3.37	0.71 - 21.99
24-35.99	19	2 (10.5)	1.00	
Gender				
Male	191	80 (41.9)	1.82	1.11 - 2.98
Female	141	40 (28.4)	1.0	
Birth weight				
< 2500 gms	19	14 (73.7)	5.47	1.78 - 17.91
≥ 2500 gms	313	106 (33.9)	1.00	
Birth order				
1-4	135	45 (33.3)	1.00	0.77 - 2.29
5-6	118	47 (39.8)	1.32	0.59 - 2.05
7+	79	28 (35.4)	1.10	
Birth-space				
< 2 years	104	46 (44.2)	1.65	1.00 - 2.73
≥ 2 years	228	74 (32.5)	1.00	

Analysis of parental variables such as total children alive to mother and father, education of father and mother, income to the family and mothers' age showed that fathers with low levels of education was the only statistically significant variable associated with stunted growth ($P < 0.05$).

Both the age at which bottle-feeding started and period of breast-feeding were associated significantly but statistically significant with stunted growth ($P > 0.05$) Variables statistically associated with stunted growth at the 10% level were included in a multiple logistic regression model with stunting as the dependent variable.

The multiple logistic regression model revealed birth-space (OR = 1.95; 95% CI = 1.11 - 3.39), father with primary or intermediate education (OR = 2.33, 95% CI = 1.17 - 4.64), children 6 months and below (OR = 11.67, 95% CI = 2.15 - 63.23), children aged 6 months but less than 1 year (OR = 23.65, 95% CI = 4.27 -130.94), twin birth (OR = 11.41; 95% CI = 3.47 - 37.51) and females (OR = 0.59, 95% CI = 0.23 - 0.68) to be strongly and independently associated with stunted growth. The regression coefficients are presented in Table 4.

Table 5 shows the relationship of same child characteristics and faltering growth. The frequencies of faltering growth were examined for each of the children demographic

Table 3: The distribution of children according to low height-for-age and estimate of relative risk of parental socio-demographic characteristics.

Characteristics	No. of children	Low height for age	R.R.	95% Conf-Interval (CI)
Mother's total pasrity alive				
< 5	250	91 (36.4)	1.0	
5 +	80	28 (35.0)	0.94	0.54 - 1.64
Father's children alive				
< 5	228	83 (36.4)	1.0	
5 +	102	36 (35.3)	0.95	0.57 - 1.60
Mother's education				
No formal "	137	44 (32.1)	1.01	0.46 - 2.24
Pry/Intermediate	97	45 (46.4)	1.85	0.82 - 4.21
Secondary	54	17 (31.5)	0.98	0.38 - 2.53
Post-secondary	44	14 (31.8)	1.0	
Father's education				
No formal "	40	8 (20.0)	0.26	0.79 - 0.78
Pry/Intermediate	173	73 (42.2)	0.04	0.0 - 0.27
Secondary	21	19 (90.5)	0.47	1.0 0.02-7.63
Post-secondary	21	20 (95.2)	1.0	
Income per family				
< S.R 5000	112	42 (37.5)	0.68	0.29 - 1.62
S.R. 5000-S.R 9999	118	63 (33.5)	0.57	0.25 - 1.30
S.R. 10,000 and above	32	15 (46.9)	1.0	
Mother's age				
< 25	86	30 (34.9)	1.54	0.71 - 3.38
25 - 29	71	27 (38.0)	1.76	0.79 - 3.97
30 - 34	113	47 (41.6)	2.05	0.99 - 4.29
35 +	62	16 (25.8)	1.00	

Table 4: Estimates of regression coefficients of the variables in the logistic model for calculating the probability of stunted growth.

Variables	Regression Coefficients			
	B	S.E (B)	OR	95% CI
Constant:	-4.4667			
Birth space	0.6669	0.2827	1.95	1.11, 3.39
Father's edu.				
None	0.3393	0.5227	0.71	0.26, 1.98
Pry/Intermediate	0.8474	0.3510	2.33	1.17, 4.64
Secondary	0.2811	0.4328	1.32	0.37, 3.09
Post-secondary			1.00	
Child's age (months):				
0-5.99	2.4567	0.8623	11.67	2.15, 63.23
6-11.99	3.1633	0.8732	23.65	4.27, 130.94
12-23.99	1.6307	0.8391	5.11	0.99, 26.45
24 +			1.00	
Twins	2.4344	0.6073	11.41	3.47, 37.51
Female	0.9232	0.2762	0.39	0.23, 0.68

Table 5: The distribution of faltering growth and estimated relative risk of children characteristics in rural Saudi Arabia

Characteristics	No. of children	Low height for age No. (%)	R.R.	95% Conf-Interval (CI)
Age(months)				
0-5.99	79	34 (43.0)	6.4	1.29 - 43.25
6-11.99	65	38 (58.5)	11.96	2.34 - 82.01
12-23.99	169	49 (29.0)	3.47	0.73 - 21.99
24-35.99	19	2 (10.5)	1.00	
Gender				
Male	191	82 (42.9)	1.83	1.13 - 3.00
Female	141	41 (29.1)	1.00	
Birth weight				
<2500 gms	19	15 (78.9)	7.12	2.14 - 26.07
≥ 2500 gms	313	108 (34.5)	1.00	
Birth order				
1-4	135	49 (36.3)	1.00	
5-6	118	46 (39.0)	1.12	0.65 - 1.93
7+	79	28 (35.4)	0.96	0.53 - 1.93
Birth-space				
< 2 years	104	48 (46.2)	1.75	1.06 - 2.89
≥ 2 years	228	75 (32.9)	1.00	
Multiplicity of birth				
Single	311	107 (34.4)	1.00	
Twins	21	16 (76.2)	6.10	2.03 - 19.63

Table 6: Estimates of regression coefficients of the variables in the logistic model for calculating the probability of faltering growth.

Variables	Regression Coefficients			
	B	S.E (B)	OR	95% CI
Constant:	-2.5190	1.1015	0.44	0.25, 0.77
Birth space	0.8310	0.2930		
Father's edu.				
None	0.7010	0.5621	2.02	0.67, 6.07
Pry/Intermediate	-0.6780	0.3694	0.51	0.25, 1.05
Secondary	-0.4253	0.4447	0.65	0.27, 1.56
Post-secondary			1.00	
Child's age (months):				
00-05.99	-2.2979	0.8310	0.10	0.02 - 0.51
6-11.99	-3.0095	0.8448	0.05	0.01- 0.26
12-23.99	1.5760	0.8089	0.21	0.04 - 1.01
24 +			1.00	
Birth-weight				
< 2500gms	-1.6820	0.8830	0.18	0.03 - 1.05
Twins	1.4755	0.7743	4.37	0.96 - 19.95
Female	-1.0316	0.2843	0.36	0.20 - 0.62

characteristics. The relative risks of these characteristics were estimated by the odds ratio using the categories assumed to have the lowest risk as reference. The result of the univariate analysis, suggested that children less than one year, males, low birth weight, birth space less than two years and twins have significantly higher risk of faltering growth. Indeed, the children less than 1 year are found to be more than 8 times as likely to have faltering growth as those two years and above. Also, twins are 6 times as likely than singletons, while children with low birth weight are 7 times more likely, males and birth space less than two years have only about 2 times more likelihood of faltering growth.

The multiple logistic regression models revealed the following variables to be statistically significant and independently associated with faltering growth. Birth space > 2 years (OR = 0.44, 95% CI = 0.25 - 0.77), fathers with primary or intermediate education (OR = 0.51, 95% CI = 0.25 - 1.05), and female birth (OR = 0.36, 95% CI = 0.20 - 0.62). Twin birth has more than four-fold risk of faltering growth. The father's education was the only statistically significant variable associated with faltering growth among all the parental variables examined.

Discussion

The finding in this study of a very low percentage of children with low-weight-for-height, an indicator for wasting is consistent with previous reports in Saudi Arabia [9,10,15,20]. In a study of growth patterns in well baby care clinics, the percentage of low weight-for-height was 2%, a figure slightly higher than the present study of 1.5% that have been recorded for a rural community [9]. This suggests that the children could not have suffered from current malnutrition [1]. And this is not unexpected with the high per capita income, abundance of food supply and accessibility, to good health delivery system in Saudi Arabia [7,8,21].

The high percentage of stunting which was as high as 36.1% in the present study is also in consonance with previous reports by various studies in the Kingdom of Saudi Arabia [9,10,11,15]. A low height-for-age is described as an indicator of past malnutrition and was more defined among children 6 to 12 months when linear growth is markedly affected [6,24]. However, the effect of breast feeding and other feeding practices of the infants examined in this study did not reach the 5% statistical significant relationship with low height-for-age. Previous reports identified feeding on starchy foods as possible explanation but not conclusive [9,22]. Others have suggested that the use of the American population NCHS as reference for comparisons may not be realistic [11,13,23]. The finding of such a high percentage of stunted growth in the past had been attributed to genetic rather than nutritional deficiencies [9,10,11,15,21]. Recently, it has been demonstrated that infants who are breast-fed exclusively grow quite differently in their first year of postnatal life than infants fed formula. This unique explains the deviation from the NCHS/WHO/CDC international reference which was constituted from infants mostly fed formula [25,26]. The women in Saudi Arabia have been reported to practice breast feeding in the first 3 months [9,14,15].

The study also showed that females have lower proportion of low weight-for-height, low height-for-age and low weight-for-age. This is in consonance with past reports elsewhere [9,12,15,20]. Females are known to advance faster in growth than males even in the presence of adverse environmental conditions [6,24] The increased risk of stunted growth in the age group 6 to 12 months was also consistent with previous reports [9]. In fact it is known that genetically, growth in life emerge and stabilize between the age group 6 to 24 months as found in this study [15,24]. The fact that the proportion with stunted growth reduced with increasing age may be interpreted that Saudis could be genetically shorter than their American

counterparts [9,11,16,24] But this is an extreme view which may change if a new reference is used that considers the current nutritional management of infants [25].

The univariate analysis suggested that children with low birth weight could be five times more at risk of stunted growth. Will the frequency of children with low birth weight was low and a larger sample size may be needed to explain this relationship. However, the multivariate analysis technique which identified birth-spacing as one of the five variables significantly associated with stunted growth could be important. Birth spacing of less than two years before the index child, could affect the nutritional care, particularly breast feeding, and this could lead to stunted growth. The same reasons may be advanced for the effect of twining. Twins could be affected both by biological and genetic factors as well as nutritional or environmental factors [11]

The multivariate logistic model also suggested that fathers with primary or intermediate education is associated with stunted growth. This revelation look vague as it could have been easily explained if it were mother's education. However, education of males is higher than females in the Saudi population and they could have dominated the mothers feeding practice at home [14,21]. More so these are the males likely to be married to women with little or no education and of high parity. However, further studies on the pattern of dietary intake of the children might throw more light on the observed lower height-for-age than the NCHS reference.

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