Socioeconomic predictors of unconstrained child growth in Muscat, Oman

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العوامل الاجتماعية والاقتصادية المنبِّئة بنموّ الطفل غير الـمُعَرْقَل في مسقط، سلطنة عُمان

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الخلاصــة: أجرَيْنا دراسة للتعرُّف على العوامل الاجتماعية والاقتصادية المصاحبة للنموّ غير الـمُعَرْقَل بين أطفـال في سن ما قبل المدرسة في مسقط، سلطنة عُمان. وقد أُخِذَتْ عيِّنة مـن الأطفـال المولـودين في عـام 1995 وأصبِّحت أعمارهم 28 – 43 شهراً من بين سجلات الأطفـال الصـحية لمركـزَيْن مـن مراكـز الرعايـة الصـحية. ثـم جُمعـت المعطيات الاجتماعية والسكانية من خـلال المقـابلات الشـفوية والقياسـات البشـرية في الأطفـال والأمهـات. وقـد استُخدم تحليل التحوُّف للتعرُّف على المؤشرات الاقتصادية والاجتماعية والحدود الفاصـلة الـتي رافقـت النمـوّ غـير الـمُعَرْقَل. ولوحظ أن الأطفال الذين ينتمون لأُسَر يزيـد دخلـها الشـهري على 800 ريـال عُمـاني وتكـون فيهـا الأمهات متعلِّمات لأكثر من 4 سنوات، قد وصلوا لمستويات من الارتفـاع بالنسبة للعمـر مقارنـةً بـالمراجع العالميـة الراهنة للنموّ. ومع تحرِّي استخدام هذا المعيار يمكن الحصـول على عيِّنـة ملائمـة لدراسـة منظمـة الصـحة العالميـة المتعدِّدة المراكز في مسقط.

ABSTRACT We conducted a study to identify socioeconomic factors associated with unconstrained growth among preschoolers in Muscat, Oman. A sample of children born in 1995 and aged 28–43 months was drawn from the Child Health Registers of 2 health care centres. Sociodemographic data were collected by oral interview and maternal and child anthropometry measured. Regression analysis was used to identify socioeconomic indicators and cut-offs associated with unconstrained growth. Children from households with a monthly income ≥ 800 Omani rials and mother's education ≥ 4 years attained height-for-age levels comparable to the current international growth reference. By screening using this criterion, we could obtain a suitable sample for the World Health Organization Multicentre Growth Reference Study in Muscat.

Facteurs socio-économiques prédictifs de la croissance optimale de l'enfant à Mascate (Oman)
RESUME Nous avons réalisé une étude pour identifier les facteurs socio-économiques associés à la croissance optimale des enfants d'âge préscolaire à Mascate (Oman). Un échantillon d'enfants nés en 1995 et âgés de 28 à 43 mois a été constitué à partir des registres de santé de l'enfant de deux centres de santé. Des données socio-démographiques ont été recueillies par entretien oral et des mesures anthro-pométriques de l'enfant et de la mère ont été effectuées. L'analyse de régression a été utilisée pour identifier les indicateurs socio-économiques et les valeurs limites associés à une croissance optimale. Les enfants issus de familles ayant un revenu mensuel égal ou supérieur à 800 rials omanais et dont la mère avait fait quatre années d'études ou plus présentaient des rapports taille/âge comparables à la référence internationale de croissance actuelle. Le dépistage utilisant ce critère pourrait nous permettre d'obtenir un échantillon approprié pour l'étude multicentrique de l'Organisation mondiale de la Santé sur la référence de croissance à Mascate.

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Introduction

Oman is situated in the south-east corner of the Arabian peninsula with a population of two and a half million, approximately one-quarter of whom are expatriates most of whom live in the Muscat region [1]. The country has experienced remarkable development in the past 30 years, to the extent that its health services, education and transport infrastructure are now comparable to the most developed countries in the world.

The National Center for Health Statistics/World Health Organization (NCHS/ WHO) reference for monitoring growth of infants and preschool children is currently used in many parts of the world. However, the WHO Expert Committee on the use and interpretation of anthropometry raised serious concerns about this reference and recommended that a new international reference be developed [2]. The WHO Multicentre Growth Reference Study (MGRS) was initiated with the aim of developing a truly international reference based on breastfed children living in optimal conditions [3–5].

In order to determine whether Muscat would be a suitable site to conduct the MGRS, socioeconomic, demographic and behavioural (feeding practices) factors associated with unconstrained growth among Omani children between the ages of 28 and 43 months were examined in a 2-phase study conducted from February to May 1998.

Methods

Phase I: data review
Available data from 2 surveys previously conducted by the Ministry of Health in collaboration with the United Nations Children's Fund [The National Health and Nutrition Survey (1991) and the National Vitamin A Study (1994)] [6,7]were reviewed to identify the factors associated with unconstrained growth. These studies had investigated some indicators of family socioeconomic status and taken anthropometric measurements of children younger than 5 years of age. We carried out secondary analysis of the existing anthropometric data by creating weight-for-age (WAZ), weight-for-height (WHZ) and height-for-age (HAZ) Z-scores in *Epi-Info* 6 EPINUT module and used these as the major outcome variables for comparing selected socioeconomic (SES) groups [8].

Phase II: rapid survey
A rapid survey was conducted from March through May 1998 to verify the associations among the variables observed in Phase I and establish suitable criteria for identifying children at lowest risk of poor growth. The sampling frame included children listed in the National Child Health Register (MR2). At the time of initial immunization, each child is assigned an MR2 number in the primary health care centre nearest to his/her residence. His/her address, telephone number, place and type of birth, type of delivery and birth weight are entered in the MR2.

The sample for the rapid survey included children born in 1995 at Royal and Khoula hospitals – where nearly all deliveries in the Muscat area occur – selected from the registers of 2 health centres, Baushar Polyclinic and Al Nahdha Outpatient Department. These 2 centres serve high SES residential clusters. At the time of the survey, the 1995 birth cohort was aged 28 to 43 months. The survey first selected children born to Arab fathers. To be eligible for further screening, the child had to be free of the risk factors for malnutrition specified by the Ministry of Health. These

are birth weight < 2.5 kg, Apgar score < 7, preterm or multiple birth, born with congenital anomalies, delivered by caesarean section or born outside a health facility.

Mothers whose children met the specified criteria were line-listed for contact by telephone and home visit. Screening home visits were to continue until a sample size of ≥ 300 children was obtained. This number was chosen in anticipation of the target sample size for the MGRS. The mother and child were measured and the birth information taken from the MR2 register was verified using the child health card. A standardized questionnaire interview was administered to obtain sociodemographic information.

Three pairs of field workers were trained to measure mothers' and children's weight using the UNISCALE and their standing height on a Leicester Portable Height Measure. A standardization session was conducted at the end of training to evaluate the field workers' performance.

After data collection, each questionnaire was reviewed for consistency and completeness. Data entry was done on a customized *Epi-Info* 6 data entry form. Anthropometric indicator Z-scores were calculated using the EPINUT module of the *Epi-Info* program [8] before exporting the data to *SPSS*, version 6.0 for analysis. For preliminary identification of socioeconomic factors associated with child growth, a regression analysis was carried out for HAZ in relation to parental education, household income and possession of selected household belongings. The stepwise regression procedure used selected only mother's education and household income as positive predictors of HAZ. More detailed analyses with the 2 variables then followed to establish cut-off points for selecting a sub-population with stunting prevalence < 5%.

Results

Data review

The mean HAZ for children whose mothers had a university degree was 0.01 compared with −0.88 for those with a post-secondary diploma and −1.16 for those with a high-school diploma. However, the number of women in these categories was too small to draw any conclusion. Average monthly income was 297 Omani rials (OR) or US$ 773. Although the prevalence of stunting declined as income increased, the sample was too small to determine a cut-off value associated with unconstrained growth. Further, since the surveys were not designed primarily to assess the relationship between SES and nutritional status, they did not give representative information on the characteristics of the upper socioeconomic class; in fact the average income reflected the predominance of low SES rural households in the surveys. The rapid survey in Phase II thus aimed to verify the relationships suggested by the earlier studies.

Rapid survey

Over 10 000 babies were born in the Muscat region in 1995 (5065 in Khoula and 5194 in Royal Hospitals respectively) [9]. The sampling frame from the 2 health centres comprised a total of 3409 children aged 28 to 43 months, 1929 of whom were Arabs. Among the Arab births, 210 were (11%) caesarean deliveries, 17 (0.9%) were multiple births, 116 (6%) had low Apgar scores and 107 (5%) were low-birth-weight babies. Exclusion on the pre-specified criteria left a sampling frame of 1421 children that were line-listed for contact by telephone. All families on the list were contacted and those that could be reached by telephone at the first attempt were screened (*n* = 338). No further at-

tempts were made to contact mothers who were not at home when first called, or whose telephone numbers were no longer in service or who were non-residents in the area. Screening stopped when an adequate sample was obtained ($n = 336$), after attempting to contact 560 of the line-listed subjects.

Description of the sample

Table 1 presents the socioeconomic characteristics of the surveyed sample ($n = 336$). The mean age of the children ± standard deviation was 34.8 ± 3.6 months (range, 28 to 43 months). The average family monthly income was 954 ± 1353 OR (US$ 2484) (range, 77 to 21 405 OR). Maternal education ranged from none to 16 years (mean, 7.9 ± 4.9 years). About 12% of the mothers were illiterate while just over 16% were educated beyond high school.

The median number of people living in the house was 10 (range, 3–57), the average family size was 6 (range, 2–17) and 39% of the families had at least 1 servant. All households had at least 1 refrigerator and few reported not having a telephone (8.3%), television (0.3%) or car (6.3%). A majority (87%) lived in their own house and 24% of the mothers worked outside the home (Table 1). Only 1 mother reported smoking, and all expressed willingness to participate in the MGRS, although in 2 cases, the fathers objected.

Child and maternal anthropometric status

The overall mean WHZ among the children in the survey was -0.77 ± 1.0, and the mean HAZ and WAZ were -0.38 ± 1.1 and -0.96 ± 1.1 respectively. The overall stunting rate was lower (5%) than wasting (7%) and underweight (15%). The mean birth

Table 1 **Socioeconomic characteristics of the study population**

Socioeconomic indicators and categories	No.	%
Household monthly income (OR) (n = 336)		
< 199	11	3.3
200–399	54	16.1
400–599	67	19.9
600–799	57	17.0
800–999	14	4.2
1000+	133	39.6
Mean: 953.6 ± 1353 OR		
Mother's education (n = 331)		
Illiterate	40	12.1
Some school (between 1 and 5 years)	80	24.2
Primary (at least 6 years)	52	15.7
Preparatory (at least 9 years)	39	11.8
Secondary (12 years)	66	19.9
Secondary +	54	16.3
Mean: 7.9 ± 4.9 years		
Ownership of residence (n = 336)		
Own house	292	86.9
Rented house	15	4.5
Rented apartment	16	4.8
Government housing	13	3.8
Mother working outside the home (n = 334)	79	23.7

	Median	Range
Living conditions (n = 336)		
Household size	10	3–57
Family size	6	2–17
Servants	0	0–5
Rooms (excluding bath/kitchen)	5	2–14
Bathrooms	3	1–10
Refrigerators	2	1–8
Telephones	2	0–7
Television sets	2	0–10
Cars	2	0–6

OR = Omani rials (1 US$ = 0.384 OR).

weight was 3.1 + 0.4 kg and mean maternal height was 155.6 ± 5.4 cm.

Socioeconomic indicators

Analysis was conducted to identify the SES characteristics associated with unconstrained growth. There was a rising trend in HAZ as monthly household income increased, from –0.69 below 600 OR to 0.04 at 1600 OR and higher income levels. Similar trends were observed in WAZ and WHZ at low monthly incomes but there was a plateau for both indicators beginning from 1100 OR. A similar pattern was observed with mother's height. The analysis also indicated a positive relation between growth status and mother's education with a plateau beginning at post-secondary education.

Children were then classified into different SES levels based on income alone, mother's education alone, and different combinations of income and mother's education levels (Table 2). The objective was to select the indicator that could define a sub-population with a mean HAZ of zero and mean WAZ and WHZ as close as possible to zero. The results showed that the best indicator of unconstrained growth was obtained by the combination of monthly income ≥ 800 OR and mother's education ≥ 4 years. As shown in Table 2, the group selected on this criterion had a mean HAZ of 0.0 with < 1% classified below –2 SD and an average –0.5 Z-score WAZ and WHZ (with 5% and 3% below –2 SD respectively). These children's (n = 129, or 38%) HAZ was 0.6 SD higher and their mothers were 2.8 cm taller than the rest of the sample (n = 207).

Mobility

Because the MGRS involved a 2-year follow-up, information was collected on mobility, including duration of residence at current address, immediate post-delivery residence outside Muscat and annual travel on vacation. The average household had lived at their current residence for 25 years (range, 1–47 years). Only 15.5% of women stayed with their mothers for the 40 days following delivery, and of these, only 2.1% went outside the Muscat area. In all 130 (39%) of the mothers interviewed had travelled outside Oman for holiday at least once since the index child was born. The average length of holiday was 15 days, and most travel took place in the summer (June to August).

Feeding patterns

Exclusive breastfeeding for the first 4 months of life was reported by 22% of the interviewed mothers, while 59% breastfed predominantly for the same period of time. Complementary foods were introduced at average age 5 months (range, 3–12 months), and 78% continued to breastfeed until at least the child's first birthday. The mean duration of breastfeeding was 18 months (range, 1–36 months).

Discussion

The results of this study revealed the presence in Muscat of a sub-population of high SES households where children experienced unconstrained growth. They corroborate the conclusions reached by similar studies conducted in Ghana and India [10,11], supporting the case for a single global reference based on a pooled sample of children from diverse ethnic backgrounds.

The study aimed to determine the cut-off points for socioeconomic characteristics that favoured unconstrained growth in this population. Family income and maternal education were negatively associated with stunting, suggesting that both high in-

Table 2 **Child and maternal anthropometry for different socioeconomic subgroups**

Variable	No. included	HAZ	WAZ	WHZ	Mother's height (cm)
Income (OR)					
800	153	−0.09	−0.62	−0.54	156.9
900	127	−0.07	−0.56	−0.48	157.1
1000	113	−0.04	−0.50	−0.44	157.1
1100	93	−0.02	−0.43	−0.39	157.3
Mother's education (years)					
≥ 4	244	−0.27	−0.85	−0.71	156.1
≥ 9	159	−0.14	−0.70	−0.61	157.0
≥ 12	120	−0.11	−0.60	−0.51	157.0
Income (mother's education ≥ 4 years)					
500	195	−0.12	−0.75	−0.68	156.5
600	172	−0.07	−0.67	−0.61	156.9
700	150	−0.00	−0.58	−0.55	157.1
800	129	0.00	−0.52	−0.47	157.3
900	111	0.04	−0.46	−0.43	157.6
1000	100	0.05	−0.43	−0.40	157.5
1100	85	0.11	−0.35	−0.34	157.6
Income (mother's education ≥ 9 years)					
500	147	−0.06	−0.63	−0.57	157.2
600	136	−0.05	−0.59	−0.53	157.5
700	122	0.01	−0.51	−0.47	157.7
800	108	0.01	−0.44	−0.38	157.9
Income (mother's education ≥ 12 years)					
500	113	−0.03	−0.54	−0.48	157.2
600	105	0.00	−0.49	−0.44	157.4
700	97	0.05	−0.42	−0.39	157.7
800	87	0.07	−0.33	−0.29	157.8

HAZ = height-for-age Z-score; WAZ = weight-for-age Z-score; WHZ = weight-for-height Z-score.
OR = Omani rials (1 US$ = 0.384 OR).

come and maternal literacy are important predictors of optimal growth in Oman. These results are in line with those of studies conducted in other developing countries [*10–14*]. The average income observed in the present survey (954 OR) was more than 3 times the average (297 OR) found in the previous national surveys [*6,7*]. Clearly, the population in Muscat was wealthier than the national average, but for the

MGRS, it was necessary to further select a sub-population with evident unconstrained child growth.

We used HAZ, the index of attained linear growth, as the main criterion for unconstrained growth because it is a more appropriate measure of long-term nutritional well-being and overall SES than are the weight-based indicators WAZ and WHZ. Despite the more marked shift of the sample's mean WAZ and WHZ (–0.5 SD) from the NCHS/WHO reference median, the proportions classified as underweight (5%) and wasted (3%) were not markedly different from the reference population prevalence rates [2].

This study also addressed concerns about the availability of an adequate sample for the MGRS's recruitment target. An estimated 38% of the Muscat population met the eligibility criterion defined by this survey (income ≥ 800 OR and maternal education ≥ 4 years). By screening all the 10 000 births occurring annually in Royal and Khoula Hospitals, the expected sampling base of 3800 affluent mothers would be sufficient to provide the MGRS sample of 300 neonates recruited in a period of 12 months.

In conclusion, the results of the survey support the choice of the Sultanate of Oman as the Middle East site for the new international reference of child growth and nutrition.

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Training workshop to develop nutrition surveillance capabilities of member states to improve the monitoring and evaluation capacities in nutrition programmes

The World Health Organization Regional Office for the Eastern Mediterranean organized a training workshop in Alexandria from 7 to 15 March 2004 to develop nutrition surveillance capabilities of Member States in order to improve the monitoring and evaluation capacities in nutrition programmes. The objective of the workshop was to prepare Member States to establish national nutrition surveillance systems, with a focus on the control and prevention of micronutrient deficiencies, which will enable Member States to monitor the iron and folate nutrition of their populations. Participants from Bahrain, Islamic Republic of Iran, Jordan, Kuwait, Morocco and Oman attended the workshop together with representatives from the Centers for Disease Control and Prevention and the United Nations Children's Fund.