Original Article

Obesity and undernutrition in sub-Saharan African immigrant and refugee children in Victoria, Australia

André MN Renzaho MPH, PhD, Carl Gibbons MSc, Boyd Swinburn MB, ChB, MD, FRACP Damien Jolley MSc and Cate Burns PhD

School of Exercise & Nutrition Sciences, Deakin University, 221 Burwood Highway, Burwood 3125 Victoria, Australia

The study assessed the anthropometric status of 337 sub-Saharan African children aged between 3-12 years who migrated to Australia. These children were selected using a snowball sampling method stratified by age, gender and region of origin. The prevalence rates for overweight and obesity were 18.4% (95%CI: 14 - 23%) and 8.6% (95%CI: 6% -12%) respectively. The prevalence rates for the indicators of undernutrition were: wasting 4.3% (95%CI: 1.6%-9.1%), underweight 1.2% (95%CI: 0.3%-3.0%), and stunting 0.3 (95%CI: 0.0%-1.6%). Higher prevalence of overweight/obesity was associated with lower household income level, fewer siblings, lower birth weight, western African background, and single parent households (after controlling for demographic and socio-economic factors). Higher prevalence rates for underweight and wasting were associated with lower household income and shorter lengths of stay in Australia respectively. No effect was found for child's age, gender, parental education and occupation for both obesity and undernutrition indices. In conclusion, obesity and overweight are very prevalent in SSA migrant children and undernutrition, especially wasting, was also not uncommon in this target group.

Key Words: **obesity, undernutrition, sub-Saharan Africa, children, migration, refugees**

Introduction

Undernutrition, defined as growth failure due to insufficient dietary intake and/or infectious disease[1], remains the biggest public health challenge in Africa. Various forms of undernutrition have been documented across Africa.[1,2] Stunting or chronic undernutrition (a height deficit that develops over a long period of time as a result of prolonged poor nutrition[1]) has been estimated to affect 35.2% of children across the continent (including Northern Africa) compared to 41.5% in sub-Saharan Africa (SSA).[2,3] Current estimates indicate that stunting declined globally by 8.9 percentage points for the period from 1980 to 1995 but there was no decrease in stunting in SSA during this period.[4] As with stunting, progress has been made in reducing the prevalence of underweight (a combination of chronic and acute undernutrition and measured by the weight-for-age index) globally over the last 2 decades except in SSA. While the prevalence of underweight for all developing countries averaged 26.7% in 2000, decreasing from 37.4% in 1980, in SSA rates have increased from 24.9% in 1980 in Eastern Africa to 35.9% in 2000, and from 30.1% in Western Africa in 1980 to 36.5% in 2000.[2,3]

In contrast, the prevalence of wasting or acute undernutrition (a condition reflecting recent rapid weight loss or a failure to gain weight as a result of sudden food shortage and/or infectious disease outbreak such as measles)[5] has been relatively lower than rates for stunting in non-emergency settings, with the highest prevalence being reported in western Africa (15.6%).[2,3] The rates for Africa vary between 2.9% and 15.6%, averaging 9.6%. However, higher rates have been reported in refugee settings, as a consequence of ethnic conflicts, natural disasters and war[6]. For example, Manoncourt and colleagues[7] reported acute undernutrition prevalence as high as 47-75% among displaced people in Somalia. In southern Sudan acute undernutrition prevalence has been reported to be about 21.2%.[8]

In the countries that provide the bulk of refugees and migrants to Australia from the Sub-Saharan region[9] there is a coexistence of undernutrition and overweight/obesity.[10-12] In these countries, prevalence rates for stunting, wasting and underweight among children vary between 30-58%, 4-12% and 12-48% respectively while the prevalence of overweight and obesity range from 5-17% and 1-5% respectively.[10,12] Prior to migration, causes of undernutrition in these countries have varied considerably

Correspondence address: Dr André M.N. Renzaho, Honorary and Senior Research Fellow, School of Health and Social Development, Deakin University, 221 Burwood Highway, Burwood 3125, Victoria, Australia
Tel/fax: 61 3 9466 9648
Email: renzaho@deakin.edu.au or renzaho@optusnet.com.au
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and have included food insecurity triggered by poverty, drought, armed conflicts, inadequate agricultural policies, poor governance, and the current HIV/ AIDS epidemic[13], inadequate social and care environment such as feeding practices, women's right and responsibilities, and impaired public health environment such as poor immunization status or poor access to clean water.[1,14]

Studies of migrant children from poor countries with an impaired health environment[15,16] indicate that the nutritional status of the children improves dramatically once they migrate to wealthier countries. However, this can also lead to childhood obesity and adult chronic disease.[15] Studies exploring the risk of obesity and the risk of developing chronic diseases later in life in migrants from poor countries have identified an array of risk factors and these include: genetic predisposition[17-20], length of stay in the host country, generation and acculturation,[19,21-25] cultural beliefs and values,[26,27] provenance status,[25,28-30] parity and stress,[31] poor quality of housing, physical inactivity and high alcohol consumption[23,31] and language barriers, religion and discrimination.[32]

Studies that have examined migrants from Africa specifically have shown that obesity and its consequences are the main nutritional issues[33-35] and that the above determinants also generally apply.[19,25,31,35] Migrants from Africa, however, seem to be more affected than from other regions of the world,[26,35] and, within African migrants, those from the west African countries appear to be the most affected by obesity.[35]

Despite the pre-and post-migration nutritional risk of SSA migrants, there is a scarcity of data assessing the nutritional status of the various SSA refugees and migrants who migrate to a wealthy country such as Australia. Therefore, the purpose of this study was to assess the anthropometric status of migrant and refugee children from sub-Sahara Africa. It is postulated that the population of migrant and refugee children in Australia from SSA exhibit a mixture of undernutrition and obesity with undernutrition being related to shorter time in Australia and obesity being related to a longer length of stay.

Methods

Participants

Anthropometric data were collected on 337 children aged between 3 and 12 years. Children were selected using the United Nations' classification of African regions and subregions (eastern, central western and southern Africa).[36] Although Sudan has been classified as a Northern African country[36], refugees and migrants from south Sudan were included in this study given their similarities to other Sub-Saharan Africans in terms of ethnicity and migration history. They were classified as central Africans given their linguistic and cultural similarities.[37] For South Africa and Zimbabwe, white families were excluded since they are known to be more economically and socially advantaged than their black counterparts.[38] This project was approved by Deakin University's Ethics Committee, and informed consent from parents was acquired.

Sampling strategy

A snowball sampling technique was used to recruit eligible members of Victoria's minority SSA population.[39] A series of consultative meetings with key community leaders and African social workers was carried out. The first step involved talking to African workers in the primary health care sector who created the links with key community leaders. In consultation with both African workers and community leaders, a committee called "African Review Panel" was established. The role of the panel was to facilitate access to SSA communities. Participants located through community health workers or African community organisations' networks were asked to nominate friends from their own networks. To enhance representativeness, the sampling was stratified by age, gender, and region. A matrix of 3 age-groups, gender, and 3 regions of origin was constructed. In each layer, an initial family with eligible children by age was identified. Then, the identified family was asked to identify or recommend other families from their region of origin that have children who meet the study age-related inclusion criteria. The next identified family was only visited after the preceding procedure was implemented across clusters. The process continued until the cluster was exhausted or saturated, that is, no more families could be identified. However, while cell sizes were proportional to the SSA population in Australia for eastern, central and western Africa, migrants of southern African origin were difficult to locate as the majority of them are white South Africans and Zimbabweans. Hence, only three households from this region were identified from which seven children were eligible for the study. Consequently, our coding of African regions merged southern with eastern Africa. The subsequent analysis was based on three regions: Central Africa, Eastern/Southern Africa and Western Africa.

Anthropometric measurements

Weight was measured by portable electronic scales (UC-321 Co Ltd, London) to the nearest 50g. Children were measured without shoes and in light clothing. Height was measured to the nearest millimetre with a portable Harpenden Stadiometer (British Indicators Ltd, London). Body mass index (BMI-for-age) was used to define overweight and obesity, height-for-age (H/A) was used for stunting, weight-for-height (W/H) for wasting, and weight-for-age (W/A) for underweight. BMI-for-age was interpreted using published international standards[40] and W/A, H/A, and W/H indices were interpreted using the new National Center for Health Statistics/Center for Disease control reference values.[41] These references are published in age-specific Z-score values for W/A and H/A and height-specific Z-score values for W/H. However, for W/H, values are provided only for children whose height was less or equal to 121cm. W/H references for greater heights tend to be confounded by, and otherwise made unreliable by, pubertal growth factors, and are not widely used (Prof. Michael Golden, personal communication, 2001). Children were defined as suffering from wasting, stunting, or underweight if their respective z-scores for W/H, H/A, or W/A were calculated to be below –2. Birth-weight was assessed by a 4-point scale question where parents indicated whether the child was born very small, small, average or larger than normal.

Socio-demographic factors

Parents reported their child's age; their occupation; their educational attainment; the household annual income; the number of children living at home, and the household length of stay (LOS) in Australia

Data analysis

Data were entered using SPSS for Windows, version 10.0 (SPSS Inc. Chicago, III, USA) and analysed using Stata version 7.0 (Stata Corporation, Texas, USA). Because of the high correlation between the study variables, standard multiple regression was used to determine the best prediction of a dependent variable from several demographic and socio-economic variables. Where standard multiple regression was used, the "svyset command" in Stata was used to specify clustering within the household, stratification, and weighting prior to analysis. Where the outcome was binary, logistic regression was used. All analyses of the children's data have standard errors adjusted for clustering within household. For both standard and logistic regression the predictors were either continuous themselves, or they were categorical variables which were then transformed into a set of 'dummy' variables all of which were binary. For all the categorical variables, the lowest coded category was the reference. The relationship between two categorical variables (i.e. study outcome versus independent variable) was examined by chi-square test. The level of statistical significance was set at a probability of $p<0.05$ for all tests.

Results

Demographic characteristics

In total, 337 children were measured and weighed. The length of stay in Australia averaged 5.9 years (95% CI: 5.4 year-6.4 years). The majority of the sample came from eastern Africa (68.8%) mainly from the Horn of Africa (Table 1). Nearly three quarters came from countries that were not under British colonial rule.

Wasting, stunting and underweight

The prevalence rates for wasting, underweight and stunting were 4.3% (95%CI: 1.6%-9.1%), 1.2% (95%CI: 0.3%-3.0%) and 0.3 (95%CI: 0.0%-1.6%) respectively (Table 2). The relationship between W/A, H/A, and W/H and socio-demographic factors was assessed by linear regression (Table 3). The model incorporating all socio-demographic factors explained 10.9% ($p<0.01$) of the variance for W/A Z-score, 8.2% ($p<0.05$) of the variance for H/A Z-score, and 18.4% ($p<0.05$) of the variance for W/H Z-score (Table 4). W/A Z-scores tended to decrease as the number of siblings increased. Underweight and wasting were inversely associated with household income and length of stay (LOS) respectively (Table 4). Children with a higher than average birth weight had higher W/A, W/H and H/A z-scores than children with a lower than average birth weight. Parental occupation and education did not explain any more of the variance for W/A, H/A and W/H Z-scores.

Table 1. Characteristics of participants

Factor	Description	*N* (337)	%
Gender	Male	165	49.0
	Female	172	51.0
Age group	3-5 years	118	35.0
	6-8 years	102	30.3
	9-12 years	117	34.7
Length of stay	1 year or less	9	2.7
	1-5 years	153	45.4
	6-10 years	126	37.4
	11 years or more	49	14.5
Region of origin	Central	63	18.7
	Eastern/Southern	239	70.9
	Western	35	10.4
Ex-colonial rule	Ex-English colony	92	27.3
	Non ex-English colony	245	72.7

Obesity and overweight

The overall prevalence rates for overweight and obesity were 18.4% (95%CI: 14 - 23%) and 8.6% (95%CI: 6% - 12%) respectively. Therefore, 27% of the study population were overweight or obese. The prevalence of overweight and obesity was similar among boys and girls of the same age. Univariate analysis indicated that a high prevalence of overweight and obesity was associated with: children born larger than normal ($\chi2=11.74$; $p = 0.008$); parents who migrated for educational opportunities and/or for financial/economic reasons ($\chi2= 14.37$, $p=0.002$); migration from former British colonies ($\chi2 = 7.83$, $p=0.005$); migration from western Africa, $\chi2=16.46$, $p=0.000$); parents who were unemployed or not in labour force ($\chi2=11.06$, $p=0.044$); living in Australia for 5 years or more ($\chi2=4.75$, $p=0.029$); and household composed of two children or less ($\chi2= 8.34$, $p=0.015$).

The trends indicated by non-parametric tests did not mirror the multivariate analysis. Using logistic regression, data presented in Table 4 show the crude and adjusted odds ratios describing the association between overweight and obesity, and potential risk factors. In the adjusted model, overweight/obesity was inversely related to household income level, child's birth-weight and the number of children (siblings) but positively associated with parental cohabitation. Although the risk of overweight/obesity increased with length of stay in the unadjusted model, this difference disappeared after controlling for other factors. Children of a western African background were more likely to be overweight/obese than children of a central African background. No effect was found for child's age, gender, parental education and occupation.

Discussion

This study assessed anthropometric indices in 3-to-12-year old SSA migrant children who had migrated to Victoria, Australia. The study found a coexistence of a relatively higher than expected prevalence of overweight/obesity and undernutrition among this target group. Such a pattern is consistent with findings of anthropometric studies among migrant children settling in developed countries[42-44] and among children in countries undergoing economic transition.[10,45] A study of Mexican-Indian migrant children settling in the US[42] found that the prevalence of combined overweight/obesity was 38% while

Table 2. Summary of means (or % for prevalence) of anthropometric variables (95%CI) in SSA children

Boys												
Age-group (years)	3-5 years			6-8 years			9-12 years			Total		
(*N*)	(57)			(58)			(50)			(165)		
Mean weight (Kg)	19.5	(18.3,	20.7)	27.1	(25.6,	28.7)	42.3	(39.0,	45.7)	29.1	(27.2,	31.0)
Mean height (cm)	108.6	(106.1,	111.0)	126.4	(124.5,	128.3)	146.6	(143.4,	149.7)	126.4	(123.6,	129.1)
Mean BMI	16.4	(15.9,	17.0)	16.9	(16.1,	17.6)	19.5	(18.4,	20.7)	17.5	(17.0,	18.0)
Mean H/A Z-score	1.3	(0.9,	1.7)	1.0	(0.7,	1.2))	0.7	(0.4,	1.1)	1.0	(0.8,	1.2)
Mean W/A Z-score	1.8	(1.2,	2.3)	1.6	(1.1,	2.2)	1.7	(1.1,	2.3)	1.7	(1.4,	2.0)
Mean W/H Z-score (a)	0.6	(0.1,	1.1)	1.1	(-0.3,	2.5)	-	-	-	0.9	(0.3,	1.4)
Obesity (%)	5.3	(1.0,	15.0)	8.6	(3.0,	19.0)	14.0	(6.0,	27.0)	9.1	(5.0,	15.0)
Overweight (%)	19.3	(10,	32)	20.7	(11.0,	33.0)	12.0	(5.0,	24.0)	17.6	(12.0,	24.0)
Stunting (%)	0.0	-	-	0.0	-	-	2.0	(0.1,	10.6)	0.6	(0.0,	3.3)
Underweight (%)	5.3	(1.1	14.6)	1.7	(0.0,	9.2)	0.0	-	-	2.4	(0.7,	6.1)
Wasting (%) (a)	7.8	(2.2	18.9)	7.1	(0.2,	33.8)	-	-	-	7.6	(2.5,	16.8)
Girls												
Age-group (years)	3-5 years			6-8 years			9-12 years			Total		
(*N*)	(61)			(44)			(67)			(172)		
Mean weight (Kg)	17.9	(17.1,	18.8)	26.7	(24.4,	29.0)	38.6	(36.4,	40.7)	28.2	(26.5,	29.9)
Mean height (cm)	105.4	(103.4,	107.5)	124.2	(121.8,	126.5)	143.7	(141.5,	145.8)	125.1	(122.3,	127.9)
Mean BMI	16.0	(15.6,	16.4)	17.1	(16.1,	18.2)	18.6	(17.7,	19.4)	17.3	(16.8,	17.8)
Mean H/A Z-score	1.0	(0.7,	1.3)	0.8	(0.4,	1.1)	0.7	(0.4,	0.9)	0.8	(0.6,	1.0)
Mean W/A Z-score	1.2	(0.8,	1.6)	1.6	(0.8,	2.4)	1.1	(0.6,	1.5)	1.3	(1.0,	1.5)
Mean W/H Z-score (a)	0.6	(0.2,	0.9)	0.4	(-0.4,	1.1)	-	-	-	0.5	(0.2,	0.9)
Obesity (%)	6.6	(2.0,	16.0)	13.6	(5.0,	27.0)	6.0	(2.0,	15.0)	8.5	(5.0,	13.0)
Overweight (%)	11.5	(5.0,	22.0)	25.0	(13.0,	34.7)	22.4	(13.0,	34.0)	19.2	(14.0,	26.0)
Stunting (%)	0.0	-	-	0.0	-	-	0.0	-	-	0.0	-	-
Underweight (%)	0.0	-	-	0.0	-	-	0.0	-	-	0.0	-	-
Wasting (%) (a)	0.0	-	-	6.7	(0.2,	31.9)	-	-	-	1.4	(0.0,	7.3)

(a) Based on children whose height is less or equal to 121 cm for which reference values are available. References values were not available for older children. % of total are based on *N* boys= 66; *N* girls=74, Boys; 3-5: *N*=51; 6-8: *N*=15; 9-12: *N*=0. Girls; 3-5:*N*=59; 6-8; *N*=15 and 9-12: *N*=0

the prevalence rates for underweight and stunting were 1.2% and 4.8% respectively. A coexistence of a high prevalence of undernutrition and overweight/obesity has also been reported in various countries in sub-Saharan Africa,[10,12,45] Middle East, North America and Latin America.[11] Even in wealthy countries such as the UK or Australia despite the high prevalence of obesity, significant pockets of undernutrition have been reported in these countries.[46,47] In the current study, wasting was mainly in young boys who were recent arrivals to Australia (less than two years). The observed prevalence for wasting was probably underestimated because the prevalence was computed for only children whose height was less than or equal to 121cm (*N*=140) for which references values for W/H are available.[41] Amongst migrant SSA children with a longer stay in Australia, the nutritional status was substantially different, with obesity becoming more prevalent. Increasing obesity with increased length of stay has been previously described.[15,19,21-25] In addition, the findings that children of a western African background have a higher risk of obesity than children from other African regions have been reported in other studies.[35] This will be a major public health challenge for this population.

An inverse relationship between overweight/obesity prevalence and SES is typical of the pattern in wealthy countries.[48-50] This pattern was found in SSA migrant children using household income but not parental education or occupation as markers of SES. In fact there seem to be inconsistencies regarding the relationship between SES and the risk of obesity among migrants from sub-Saharan Africa to the developed world. Studies examining relationship between obesity and its risk factors, and income and educational level of African Americans

Table 3. Odds ratios (OR) and 95% confidence interval (CI) of overweight and obesity and socio-demographic variables

	Overweight/obesity Unadjusted			Overweight/obesity Adjusted *	
	N (%)	OR	(95%CI)	O.R	(95% CI)
Age (years)	337 (27.0)	1.04	(0.95, 1.13)	1.04	(0.92, 1.17)
Number of children [a]	337 (27.0)	***0.85***	***(0.75, 0.96)#***	***0.82***	***(0.70, 0.96)#***
LOS (years)**	337 (27.0)	***1.06***	***(1.01, 1.12)#***	1.02	(0.93, 1.12)
Gender					
Girls	172 (26.7)	*ref*		*ref*	
Boys	165 (27.3)	0.97	(0.60, 1.58)	1.13	(0.63, 2.01)
Living with partner [b]					
Single parent	73 (31.5)	*ref*		*ref*	
Nuclear family	264 (25.8)	1.33	(0.75, 2.33)	***2.39***	***(1.13, 5.04)#***
Place of birth					
Refugee camps/COO**	213 (23.9)	*ref*		*ref*	
Australia	124 (32.3)	0.66	(0.41, 1.08)	0.81	(0.34, 1.96)
Birth-weight					
Very small/Small	61 (13.1)	*ref*		*ref*	
Normal	208 (28.4)	0.23	***(0.09, 0.57)#***	***0.23***	***(0.08, 0.68)#***
Larger than normal	61 (39.3)	0.61	(0.34, 1.10)	***0.49***	***(0.25, 0.97#)***
Household income level					
$46,000 or more	52 (40.4)	*ref*		*ref*	
$30,000-$45,000	104 (28.8)	2.26	***(1.12, 4.38)#***	***3.36***	***(1.41, 8.01)#***
$29,000 or less	165 (23.0)	1.36	(0.78, 2.36)	***2.14***	***(1.07, 4.30)#***
Parents' education prior to migration					
Tertiary/Further education	108 (28.7)	*ref*			
High school	144 (30.6)	1.74	(0.88, 3.44)	1.07	(0.41, 2.80)
Primary or less	85 (18.8)	1.90	(0.99, 3.63)	1.49	(0.70, 3.17)
Occupation					
Unemployed/not in labour force	240 (23.3)	*ref*		*ref*	
Labour (skilled and unskilled)	27 (44.4)	0.62	(0.35, 1.11)	1.65	(0.67, 4.06)
Professional/Admin	70 (32.9)	1.63	(0.66, 4.05)	2.76	(0.86, 8.84)
Region of Origin					
Central Africa	63 (11.1)	*ref*		*ref*	
Eastern/Southern Africa	239 (28.0)	***3.12***	***(1.44, 7.23)#***	2.25	(0.82, 6.21)
Western Africa	35 (48.6)	***7.61***	***(2.74, 21.11)#***	***4.62***	***(1.09, 19.66)#***

* Model adjusted for factors in the table; ** LOS= Length of stay, COO=country of origin; [a]Number of children living in the households at the time of the survey; [b]Living with partner? Yes=1 (nuclear family), No=0 (single parent); # Bold and Italic means significantly different from reference at p<0.05

have reported a positive relationship,[51,52] while others found no relationship.[53-55]

This inconsistency could be due to the difficulties of measuring SES in studies of recent immigrants and differences in LOS and age-groups of the target population. In the developed world, SES is usually defined by income level, educational attainment, occupation or location of residence (based on deprivation indices).[26,56-58] Among SSA populations, SES is culturally defined and usually refers to wealth and body sizes have traditionally been used as a marker of social rank.[27,59,60] Brown has reported that African American women view bigness as a sign "of health, prosperity and a job well done."[26] Renzaho has reported that for SSA "big body size characterizes social rank, status and power and such views determine how food rules are defined and sustained".[27] Consistent with these findings is the fact that health behaviours of SSA are culturally determined independent of educationally attainment.[37,61,62] And as a result of corruption, income level is neither dependent on nor commensurate with occupation due to corrupt governments and political instability.[63-65] Furthermore, occupation is not a function of educational attainment due to nepotism.[63,66] The difficulty associated with measuring SES among migrant and minority populations has been recognized by various researchers.[67-71]

Despite these difficulties in measuring SES, various studies have consistently reported a positive relationship between income level (as measure of SES) and the risk of obesity but an inverse relationship between undernutrition

Table 4. Adjusted regression coefficients and 95% confidence interval (CI) of W/H, W/A and H/A Z-scores and socio-demographic variables [a]

	W/A			H/A			W/H		
	β	(95% CI)		β	(95% CI)		β	(95% CI)	
Age (years)	-0.02	(-0.11,	0.08)	-0.06	(-0.12,	0.00)	0.42	(-0.12,	0.97)
Number of children	***-0.14***	***(-0.25,***	***-0.04)#***	-0.03	(-0.10,	0.04)	-0.17	(-0.40,	0.06)
LOS (years)	0.04	(-0.05,	0.12)	0.01	(-0.04,	0.06)	***-0.12***	***(-0.23,***	***-0.01)#***
Gender									
Girls	*ref*			*ref*			*ref*		
Boys	0.25	(-0.21,	0.71)	0.06	(-0.21,	0.33)	0.21	(-0.56,	0.98)
Living with partners									
Single parents	*ref*			*ref*			*ref*		
Nuclear family	***-0.67***	***(-1.31,***	***-0.04)#***	0.07	(-0.32,	0.47)	-0.71	(-2.08,	0.67)
Birth place									
Refugee camps/COO	*ref*			*ref*			*ref*		
Australia	0.30	(-0.43,	1.03)	0.21	(-0.23,	0.64)	0.71	(-0.36,	1.77)
Birth-weight									
Very small/small	1 (ref)			1 (ref)			1 (ref)		
Average	0.53	(-0.12,	1.18)	0.30	(-0.09,	0.70)	***1.07***	***(0.21,***	***1.94)#***
Larger than normal	***1.62***	***(0.81,***	***2.42)#***	***0.88***	***(0.42,***	***1.34)#***	***0.97***	***(0.06,***	***1.87)#***
Household income level									
$46,000 or more	*ref*			*ref*			*ref*		
$30,000-$45,000	-0.41	(-1.20,	0.38)	-0.01	(-0.46,	0.43)	-1.00	(-2.38,	0.37)
$29,000 or less	***-0.85***	***(-1.63,***	***-0.08)#***	0.01	(-0.47,	0.49)	-1.08	(-2.29,	0.13)
Parent's educational level									
Tertiary/Further education	*ref*			*ref*			*ref*		
High school	-0.49	(-1.09,	0.10)	-0.43	(-0.92,	0.06)	-0.15	(-1.17,	0.87)
Primary or less	-0.22	(-0.92,	0.48)	-0.13	(-0.67,	0.40)	-0.84	(-2.17,	0.49)
Occupation									
Unemployed/not in labour force	*ref*			*ref*			*ref*		
Labour (skilled/unskilled)	-0.12	(-1.08,	0.83)	-0.15	(-0.77,	0.46)	-0.37	(-1.84,	1.10)
Professional/Admin	-0.02	(-0.75,	0.71)	-0.06	(-0.63,	0.51)	-0.25	(-1.37,	0.87)
Region									
Central Africa	*ref*			*ref*			*ref*		
Eastern/Southern Africa	0.17	(-0.49,	0.82)	***-0.48***	***(-0.88,***	***-0.08)#***	0.57	(-0.51,	1.65)
Western Africa	0.52	(-0.57,	1.61)	-0.19	(-0.86,	0.48)	0.94	(-0.75,	2.63)
	r^2= 0.109, p<0.01			*r^2= 0.082, p<0.05*			*r^2= 0.184, p<0.05*		

Note: Los= Length of stay (LOS), age and number of children entered as continuous variables. [a] Model adjusted for factors in the table.
Bold and italic means significantly different from reference at p<0.05

and income level among African populations in their native environment.[72] The observed prevalence of overweight and obesity in the current study is comparable to the prevalence reported among Australian children.[73] Studies of childhood obesity in Australia showed that the prevalence of overweight/obesity more than doubled while that of obesity tripled between 1985 and 1995.[73,74] A study by Goodman *et al.*,[74] found that, among 7-to-11-year old boys, the prevalence of combined overweight/obesity increased more that doubled over a 15-year period, from 11.2% in 1985 to 26.2% in 2000. For girls, the increase over a 15-year period was from 12.9% in 1985 to 28.4% in 2000. The same data indicate that obesity increased from 1.5% in 1985 to 9.9% in 2000 among boys and from 1.9% in 1985 to 7.1% in 2000 among girls. These data suggest that the rate of childhood obesity in Australia is rising at an annual rate of 1 percentage point. Hence, the fact that SSA migrant children recorded a high overweight/obesity prevalence over a short period of time seems unsurprising.

The current study has several methodological limitations associated with interpreting the observed anthropometric measurements of SSA migrant children. This study used new reference standards and may not be comparable to previous studies using different definitions. In addition, snowball sampling strategy, and the age of the 1995 NNS dataset does not permit a well-informed comparison between populations. Nevertheless, we can hypothesize from the study findings that a substantial proportion of SSA migrant children arrive in Australia undernourished but very quickly become overweight or obese. Such a trend highlights the need for screening, nutritional support and advice programs aimed at preventing increase of overweight/obesity in migrant children from nutritionally impaired backgrounds.

However, although it seems clear that SSA children are likely to be at higher risks of undernutrition and overweight/obesity, empirical and contemporary evidence is required to inform policy change in Australia. Hence, there is an urgent need for more detailed interventions to manage wasting among newly arrived migrants and to reduce of obesity in established migrants, especially those who have been in Australia five years or longer. Current nutritional initiatives in Australia would benefit from increased awareness of the potential range of nutritional problems identified among this sample of migrants. Nutritionists working with child migrants should be especially conscious of the coexistence of obesity and undernutrition among migrants or refugees from SSA or comparably nutritionally-impaired backgrounds. They should endeavour, within their current framework, toward preventing the negative effects of post-migration nutrition problems. Culturally appropriate obesity interventions are needed for migrant children. These must be informed by research that explores the determinants of the lifestyle changes that drive the rapid development of obesity observed in migrant children in the current study.

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Original Article

Obesity and undernutrition in sub-Saharan African immigrant and refugee children in Victoria, Australia

André MN Renzaho MPH, PhD, Carl Gibbons MSc, Boyd Swinburn MB, ChB, MD, FRACP
Damien Jolley MSc and Cate Burns PhD

School of Exercise & Nutrition Sciences, Deakin University, 221 Burwood Highway, Burwood 3125 Victoria, Australia

澳洲維多利亞來自撒哈拉沙漠地區之非洲移民與難民兒童的肥胖與營養不良狀況

此研究評估337名年齡3-12 歲由 撒哈拉 沙漠之 非洲移 民(SSA) 到澳 洲的 兒童體位狀況。受檢兒童採用雪球選樣方法，並以年齡、性別及原生地區分層。這 些兒童的過重及肥胖的盛行率分別為18.4% (95% CI=14-23%)及8.6% (95% CI=6-12%)。營養不良的各種指標盛行率：耗損4.3% (95% CI=1.6%-9.1%)、過輕 1.2% (95% CI=0.3%-3.0%)及發育遲緩0.3% (95% CI=0.0%-1.6%)。 過重/肥的高盛行率與家庭收入較低、兄弟姐妹人數較少、出生體重較低、西非背景及單親家庭 (在控制人口學變項及社經因素) 有關。 體 重過輕及 耗損 的高盛行率分別與家庭收入較低及居住在澳洲時間較短有關。而兒童的年齡、性別、父母親教育程度及職業對肥胖及營養不良則沒有影響。總而言之，肥胖與過重在SSA移民兒童中有極高的盛行率，而營養不良，尤其是耗損，在這個目標族群也並非不普遍。

關鍵字：肥胖、營養不良、撒哈拉沙漠非洲地區、兒童、移民、難民。