Original article

Associations among anthropometric measures, food consumption, and quality of life in school-age children in Tanzania

Mayumi Ohnishi[1], Sebalada Leshabari[2], Joel Seme Ambikile[2], Kazuyo Oishi[3], Yuko Nakao[4] and Mika Nishihara[3]

[1]Unit of Rehabilitation Sciences, Nagasaki University Graduate School of Biomedical Sciences, Japan
[2]School of Nursing, Muhimbili University of Health and Allied Sciences, Tanzania
[3]Unit of Nursing, Nagasaki University Graduate School of Biomedical Sciences, Japan
[4]Unit of Nursing, Kagoshima University Graduate School of Health Sciences, Japan

Abstract

Objectives: The factors associated with quality of life (QOL) and anthropometric measurements as outcomes of food consumption were examined among school-age children in Tanzania.
Methods: A cross-sectional study was undertaken in September 2013 in Tanzania. Anonymous self-administered questionnaire surveys were conducted in the Kiswahili language among primary school children in the fifth and/or sixth grade aged 10–14 years. The survey probed sociodemographic characteristics such as age, gender, living with family members, number of meals/snacks per day, food consumption in the previous 24 hours, and QOL, as well as anthropometric measurements (height and weight). The Rohrer index was calculated based on height and weight. After presenting the mean and standard deviation (SD) of height, weight, and the Rohrer index score by age and gender, the Rohrer index score was categorized into three groups (low weight, normal weight, and overweight) and analyzed according to sociodemographic characteristics and food consumption using the chi-square test. Furthermore, the QOL score was analyzed using the *t* test. Multivariate linear regression analysis was used to analyze the associations between the QOL score and sociodemographic characteristics and food consumption.
Results: A total of 694 children (male: 312; female: 382) participated in this study. According to the Rohrer index, 273 (39.3%) children were classified as low weight, 353 (50.9%) were normal weight, and 68 (9.8%) were overweight. A total of 459 (66.1%) children reported having had three or more meals and/or snacks on the day before the study. In addition, 127 (18.3%) children had not eaten any protein-rich food on the day before the study, although almost all had eaten at least one carbohydrate-rich food per day. Regardless of region, location, gender, and age, living without parents was associated with short stature ($P = 0.010$). A high QOL score was associated with having three or more meals and/or snacks per day ($P < 0.001$).
Conclusions: The security of physiological needs such as a guarantee of three meals per day could contribute to higher QOL among underserved children.

Key words: anthropometric measures, food consumption, quality of life, school-age children

(J Rural Med 2017; 12(1): 38–45)

Introduction

The life and health of people within socially disadvantaged populations, particularly children, are vulnerable to the influences of various social determinants of health and susceptible to difficult and dangerous conditions such as housing insecurity[1–3]. A study in South Africa indicated that the levels of anxiety and depression, affability, and resilience did not differ significantly between orphans and non-orphans, but there were relationships between caregivers' physical health, their caregiving capacities, and children's psychosocial wellbeing regardless of "orphanhood" status[4]. Orphans' health status is strongly dependent on their foster home environment, and there is evidence regarding the importance of developing and strengthening the health literacy

of orphans themselves[5].

Food security is a critical issue affecting the health conditions and wellbeing of orphans and their caregivers[6]. General self-rated health among orphans and vulnerable children was reported to be associated with increased access to food and medical health care, education, safe drinking water, and household income[7]. The consumption of three meals per day was associated with positive self-rated happiness among vulnerable children including orphans, as was no working activities such as being a street vendor or doing laundry by hand, good relationships with caregivers, and positive community attitudes towards orphans as a source of capacity for the community[8]. In addition, "living with mother" was one factor contributing to the frequency of consumption of carbohydrate-rich foods as staples among vulnerable children including orphans[9].

Low nutritional status among children is a challenge in rural areas and populations with low socioeconomic status (SES)[10–12]. On the other hand, childhood obesity and overweight prevalence are becoming global public health concerns, even in the high-SES populations of developing countries and industrialized countries[13–15]. Recent rapid economic growth in Africa has been accompanied by increases in social deprivation, including food security disparities. SES is an important predictor of food security and nutritional status[16]. The impacts of economic growth and development on food security and consumption should be considered when evaluating nutritional outcomes in societies undergoing rapid economic growth.

There have been few studies regarding the interrelations between anthropometric measurements, food consumption, and quality of life (QOL) among school-age children including orphans and vulnerable children in Sub-Saharan Africa. Here, we investigated the relationships between sociodemographic factors, anthropometric measurements, food consumption, and QOL among school-age children in the Sub-Saharan African country, Tanzania.

Methods

This study was conducted in Dar es Salaam (population in 2012: 4,364,541) and Moshi (population in 2012: 184,292), Tanzania, in September 2013. One of the three districts in Dar es Salaam was randomly selected. The selected district contained 140 governmental primary schools (81 from urban areas and 59 from rural areas). Moshi had 34 governmental primary schools (20 from urban areas and 14 from rural areas). Two primary schools from urban areas and two primary schools from rural areas in both cities were selected for this study. Urban and rural areas were defined according to the classification of the governmental school

Table 1 Numbers of study participants and subjects for analysis from each school

	Region	Location	Participants	Subjects for analysis
School 1	Dar es Salaam	Urban	120	118
School 2	Dar es Salaam	Urban	126	119
School 3	Dar es Salaam	Rural	148	144
School 4	Dar es Salaam	Rural	99	95
School 5	Moshi	Urban	59	58
School 6	Moshi	Urban	23	23
School 7	Moshi	Rural	73	73
School 8	Moshi	Rural	64	64
Total			712	694

list provided by the municipal offices. The numbers of study participants and subjects for analysis from each school are shown in Table 1.

Anonymous self-administered questionnaire surveys were conducted in the Kiswahili language among fifth and/or sixth grade primary school-age children to gather data on sociodemographic characteristics (age, gender, and family members living together), daily life conditions (working status and number of meals/snacks per day), food consumption in the previous 24 hours, QOL, and anthropometric measurements (height and weight). The height and weight of all questionnaire survey participants were measured by the authors and research assistants, all of whom were Muhimbili University nursing graduates and nursing teachers from Kilimanjaro Medical Training College. The Rohrer index score was calculated from height and weight, and scores of < 115 were classified as low weight, 115–145 as normal weight, and > 145 as overweight. The Rohrer index score was calculated as shown below[17].

Rohrer index score = weight (kg) / height (cm) $^3 \times 10^7$

A list of common breakfast, lunch, and supper foods in the study areas was formulated based on our previous interviews with school-age children who visited anti-retroviral treatment clinics, including 30 children in Dar es Salaam and 30 children in Moshi (unpublished). The participants completed the hard copy questionnaire by selecting options from the list illustrating their food consumption in the past 24 hours. If the list included no food that they had eaten, they provided the name of the food in the "others" section of the questionnaire. The reported foods consumed were categorized as carbohydrate-rich or protein-rich foods, and vegetables or others for analysis by identifying the main nutritional contents of each food mentioned by the participants (Table 2).

QOL was evaluated based on seven questions from the WHOQOL-BREF[18], adapted by the authors for the condi-

Table 2 Categorization of carbohydrate-rich and protein-rich foods

Carbohydrate-rich foods	Protein-rich foods
Rice	Beef
Ugali (dough made of maize flour cooked with water)	Goat meat
Bread/Chapati (Indian bread)	Chicken
Mandazi (fried bread)/Cake/Muffin	Roasted meat
Cassava/Potato/Sweet potato/Yam	Stew
Porridge	Liver
Cooked banana	Fish
Maize	Beans
Pasta	Egg
Groundnuts	Sausage
Sambusa (fried or baked pastry with filling of potatoes, lentils, and minced meat such as lamb, beef, or chicken)*	

*Food containing both carbohydrates and protein.

Box 1 Questions to evaluate the QOL of school-aged children

1) How would you rate your quality of life?
2) How satisfied are you with your health?
3) How satisfied are you with the support you get from your family and/or caregiver?
4) How satisfied are you with the support you get from your friends?
5) Do you have enough energy for everyday life?
6) Have you enough money to meet your needs?
7) How often do you have negative feelings such as unhappiness, despair, anxiety, or depression?

tions encountered by Tanzanian school children (Box 1), and evaluated on a five-point scale (1–5). The QOL score was calculated by totaling the number of points for the seven questions (maximum 35 points).

The mean and standard deviation (SD) of height, weight, and Rohrer index score by age and gender were calculated. The Rohrer index score was categorized into three groups (low weight, normal weight, and overweight) and analyzed according to sociodemographic characteristics and food consumption using the chi-square test. The QOL score was also analyzed according to sociodemographic characteristics and food consumption using the *t* test. Multivariate linear regression analysis was used to analyze the associations between QOL score and sociodemographic characteristics and food consumption. IBM SPSS statistics 22.0 was employed for statistical analysis. In all analyses, $P < 0.05$ was taken to indicate statistical significance.

This study was approved by the educational sectors of local government and the leaders of selected schools after being informed of the procedures and ethical issues prior to survey distribution. An oral explanation regarding study participation including ethical considerations, the voluntary nature of participation, and right to refusal if they did not wish to answer was provided to the participants before the survey. Privacy and confidentiality were protected during both survey distribution and data analysis processes, and participants were not asked to give their name or any information that would allow household identification. In addition, all data obtained were anonymized to ensure confidentiality. This study was approved by the Ethics Committee of the National Institute of Medical Research (NIMR) in Tanzania (approval number MINR/HQ/R.8c/Vol. II/149).

Results

A total of 694 school-age children (male: 312; female: 382) aged 10–14 years participated in this survey, which gathered information about sociodemographic characteristics, food consumption in the previous 24 hours, QOL, and anthropometric measurements (height and weight).

Table 3 shows the children's height (cm) and weight (kg) by age. Females exceeded males in both average height and weight in all age groups except weight for the 10-year-olds.

Table 4 shows children's sociodemographic characteristics, Rohrer index score, and QOL score. Based on the Rohrer index score, 273 (39.3%) children were classified as low weight, 353 (50.9%) as normal weight, and 68 (9.8%) as overweight. Other than gender, there were no significant

Table 3 Height and weight of school-age children in Dar es Salaam and Moshi, Tanzania ($n = 694$)

	Male				Female		
	n	Height	Weight	Rohrer index score	n	Height	Weight	Rohrer index score
		Mean ± SD	Mean ± SD	Mean ± SD		Mean ± SD	Mean ± SD	Mean ± SD
10 years old	15	136.9 ± 5.3	31.7 ± 5.0	123.2 ± 17.2	32	137.3 ± 5.4	30.9 ± 5.0	119.6 ± 17.2
11 years old	80	138.4 ± 5.7	32.3 ± 6.9	120.9 ± 16.8	157	140.4 ± 6.9	34.7 ± 7.1	125.0 ± 21.5
12 years old	101	141.5 ± 6.3	33.2 ± 5.3	117.2 ± 17.5	117	145.1 ± 6.8	37.3 ± 8.9	121.4 ± 22.2
13 years old	91	145.4 ± 8.5	36.3 ± 8.4	117.2 ± 17.3	69	148.1 ± 8.2	41.7 ± 9.0	128.1 ± 21.7
14 years old	25	151.1 ± 7.6	39.7 ± 6.1	114.9 ± 13.1	7	154.1 ± 7.1	47.8 ± 4.9	131.8 ± 20.2

Table 4 Sociodemographic characteristics, Rohrer index score, and QOL score of the study participants ($n = 694$)

	n	%	Rohrer index score						P-value (Chi-square test)	QOL score	P-value (t test)
			Low weight ($n = 273$)		Normal weight ($n = 353$)		Overweight ($n = 68$)				
			n	%	n	%	n	%		Mean ± SD	
Region											
Dar es Salaam	476	68.6	191	40.1	231	48.7	53	11.1	0.114	23.5 ± 3.8	0.001
Moshi	218	31.4	82	37.6	121	55.5	15	6.9		24.5 ± 3.6	
Location											
Urban	318	45.8	133	41.8	153	48.1	32	10.1	0.399	23.9 ± 3.3	0.065
Rural	376	54.2	140	37.2	200	53.2	36	9.6		23.8 ± 4.1	
Gender											
Male	312	45.0	137	43.9	162	51.9	13	4.2	< 0.001	24.2 ± 3.3	0.057
Female	382	55.0	136	35.6	191	50.0	55	14.4		23.6 ± 4.0	
Age group											
10–12 years old	502	72.3	188	37.5	268	53.4	46	9.2	0.097	23.9 ± 3.8	0.313
≥ 13 years old	192	27.7	85	44.3	85	44.3	22	11.5		23.6 ± 3.6	
Living with parent(s)											
Living without parents	115	16.6	41	35.7	62	53.9	12	10.4	0.691	23.2 ± 4.5	0.112[a]
Living with one parent	203	29.3	86	42.4	101	49.8	16	7.9		23.8 ± 3.7	
Living with parents	376	54.2	146	38.8	190	50.5	40	10.6		24.1 ± 3.5	
Working status											
Not working	645	92.9	253	39.2	329	51.0	63	9.8	0.943	23.9 ± 3.7	0.150
Working	44	6.3	17	38.6	22	50.0	5	11.4		23.1 ± 3.8	
Number of meals on the day before the survey											
≤ 2	235	33.9	84	35.7	124	52.8	27	11.5	0.293	22.6 ± 4.1	< 0.001
≥ 3	459	66.1	189	41.2	229	49.9	41	8.9		24.5 ± 3.4	
Consumption of protein-rich food on the day before the survey											
No	127	18.3	50	39.4	62	48.8	15	11.8	0.680	23.1 ± 4.0	0.014
Yes (at least once)	567	81.7	223	39.3	291	51.3	53	9.3		24.0 ± 3.7	

[a] ANOVA.

differences in the distribution of the Rohrer index score by region, location, living status with parent(s), current working status, or food consumption. Children in Dar es Salaam were more likely to be low weight or overweight compared to those in Moshi, although the differences were not significant (chi-square test, $P = 0.114$).

As shown in Table 4, 459 (66.1%) children reported having three or more meals and/or snacks in the day before the survey. Only two children (0.3%) reported that they did not eat any carbohydrate-rich foods as staples on the day before the survey; they were both orphans that had lost both parents. A significant difference was observed in the consumption of carbohydrate-rich food at least once per day between children living with and without parent(s) (Fisher's exact test, $P = 0.027$, data not shown in tables). As shown in Table 4, 127 (18.3%) children had not eaten any protein-rich food on the day before the survey. There was no significant difference in the consumption of protein-rich food at least once

Table 5 Factors associated with a higher QOL score among school-age children in Dar es Salaam and Moshi, Tanzania ($n = 694$)

	Height		Weight		Rohrer index score		QOL score	
	β	P-value	β	P-value	β	P-value	β	P-value
Region (Dar es Salaam / Moshi)	0.014	0.675	0.016	0.665	−0.006	0.887	0.083	0.029
Location (Urban / Rural)	−0.077	0.031	−0.049	0.194	0.018	0.647	0.001	0.971
Gender (Male / Female)	0.146	< 0.001	0.225	< 0.001	0.156	< 0.001	−0.083	0.033
Age	0.452	< 0.001	0.342	< 0.001	0.005	0.895	−0.055	0.165
Living with parent(s) (Living without parents / With one parent / With parents)	−0.089	0.010	−0.046	0.204	0.034	0.379	0.035	0.364
Working status (Not working / Working)	−0.027	0.431	0.004	0.921	0.014	0.716	−0.033	0.382
Number of meals on the day before the survey (≤ 2 / ≥ 3)	−0.015	0.418	−0.058	0.119	−0.074	0.065	0.172	< 0.001
Consumption of protein-rich food on the day before the survey (No / Yes, at least once)	0.009	0.787	0.013	0.720	−0.008	0.831	0.062	0.102
R^2	0.237		0.149		0.030		0.062	
F	26.412		14.912		2.649		5.626	
P-value	< 0.001		< 0.001		0.007		< 0.001	

per day between children living with and without parent(s) (chi-square test, $P = 0.296$, data not shown in tables).

The mean ± standard deviation (SD) of the QOL score was 23.9 ± 3.7 (data not shown in tables). Table 4 shows the mean ± SD of the QOL score according to sociodemographic characteristics and daily life conditions. Children in Moshi (23.5 ± 3.8) showed a significantly higher QOL score than those in Dar es Salaam (24.5 ± 3.6) (t test, $P = 0.001$). Children that had eaten three or more meals and children that had consumed protein-rich food at least once on the day before the survey (t test, $P < 0.001$, $P = 0.014$ respectively) showed significantly higher QOL scores than their counterparts.

Regardless of gender, age, and weight, the father's absence was related to shorter stature according to multivariate linear regression analysis ($P = 0.002$). However, regardless of gender, age, and height, the father's absence was not associated with lower weight according to multivariate linear regression analysis ($P = 0.529$). In addition, the same statistical analysis showed no associations between presence of the mother in the home and height ($P = 0.781$) or weight ($P = 0.621$) (data not shown in tables).

The mean ± SD number of children living together was 2.32 ± 1.82. The maximum and minimum numbers of children living together were 15 and 0 (i.e., the participant was the only child in the household) respectively. The number of children living together was not associated with height ($r = 0.014$, $P = 0.709$), weight ($r = 0.004$, $P = 0.927$), Rohrer index score ($r = −0.027$, $P = 0.482$), number of meals on the day before the survey ($r = 0.028$, $P = 0.461$), or QOL score ($r = −0.066$, $P = 0.087$) according to Spearman's rank correlation coefficient (data not shown in tables).

Regardless of region, location, gender, and age, living without parents was associated with short stature (multivariate linear regression analysis, $P = 0.010$). Using the same model, a high QOL score was associated with having three or more meals and/or snacks per day ($P < 0.001$) (Table 5).

Discussion

Regardless of region and location of residence, 39.3% of participants were of low weight, and only 50.9% were normal weight according to the Rohrer index score. After adjusting for region, location of residence, gender, and age, there were no significant associations between height, weight, or the Rohrer index score and number of meals or protein-rich food consumption on the day before the survey. A previous study in Ghana indicated a significant association between region of residence and stunted growth in children[11], although no associations were observed between region and/ or location of residence and anthropometric measurements such as Rohrer index scores in this study. Dar es Salaam is markedly larger than other cities in Tanzania, and availability and accessibility of daily necessities such as soap, toilet paper, and food are high. However, with the exception of gender, there were no significant differences in the distribution of the Rohrer index score by region, location, living status with parent(s), current working status, or food consumption in this study. Urban food insecurity should also be recognized, because of high food prices[19]. The majority of the population in low SES conditions may not experience the positive impact of economic development on child growth even in Dar es Salaam. Living with both parents contributed to taller stature compared to living with one or no parents in this study, although no such associations were observed for weight or Rohrer index score. Height for age is an indicator

of stunting due to chronic lack of nutrition and is associated with low SES[20]. Having the father and/or both parents in the household may reduce negative impacts on children's wellbeing and life conditions, because the income status of men is generally higher than that of women[21]. For example, the father's presence contributed to better schooling of children, although the same association was not observed for the mother's presence[22, 23]. The father's absence may influence household income and/or food security, and adversely affect long-term aspects of children's growth such as height.

Previous studies indicated that the number of children in the household was related to children's nutritional and growth status such as stunting[11, 24], but no such differences were observed in this study. Although some participants reported living in homes where there were numerous children, > 75% of the participants lived with three or fewer children in this study. Therefore, the number of children in the household did not affect children's food consumption or anthropometric measurements in this study.

On the other hand, regardless of region and location of residence, about 10% of the participants was overweight according to the Rohrer index score. As mentioned in the introduction, childhood obesity and overweight prevalence have been observed even in high-SES populations in developing and industrialized countries[13–15]. There is an inverse association between SES and childhood obesity in industrialized countries, especially in low-SES populations[14], because of greater access to energy-dense diets among low-SES populations in industrialized countries[13]. Further studies are required to identify background factors and mechanisms underlying the relations between region and location of residence and anthropometric measurements of school-age children in Tanzania. However, low-SES populations should be considered at risk of poor nutritional status, irregular child growth, and unbalanced food consumption such as high dependence on energy-dense diets, resulting in higher levels of overweight and obesity.

Limited access and/or not consuming three meals and/or snacks per day were associated with low QOL in this study, suggesting the importance of determining the mechanisms underlying the relationships between a healthy life, including food security and a high QOL. A previous study performed in South Africa indicated associations of food security and access to medical services with better emotional wellbeing of orphans, although SES such as the household asset index and monthly household expenditure showed no such associations[25]. Experiences in Canada indicated that a small monthly income supplementation for each child aged under six years significantly reduced food insecurity among vulnerable households such as low-income and single-parent families[26]. Physiological needs including food are de-

fined as the most fundamental human needs in Maslow's hierarchy of needs, followed by safety— including financial security, health, and wellbeing— and needs of belonging including family and intimacy. The results of this and previous studies explain the importance of food security including number of meals per day as physiological needs rather than orphanhood status, and household income and/or poverty level as safety and belonging needs. Caregivers' condition and caregiving capacity as safety needs are more likely to be related to children's wellbeing and/or QOL than orphanhood status as a belonging need.

Consumption of carbohydrate-rich foods was not analyzed in this study, because almost all participants ate carbohydrate-rich foods at least once per day. Bivariate analysis showed statistically significant relations between protein-rich food consumption and QOL in this study, although multivariate linear regression analysis did not show statistical significance. When carbohydrate-rich food consumption needs are satisfied, we estimated that children may expect consumption of quality foods such as protein-rich foods, although further studies are required to clarify the relationship between children's QOL and consumption of quality foods. As carbohydrate-rich foods including bread, rice, plantain, and taro are usually staples in the study areas, they are likely to be the first choice of food under conditions with insufficient options and capacity for survival. On the other hand, there was no clear difference in quality food consumption, such as of protein-rich foods, between children living with or without parent(s), although previous studies indicated that food security is dependent on household economic status[24, 27], which is in turn associated with the presence of the father in the household and his support[28, 29].

This study had several limitations. Only the number of meals per day and variations in consumption of carbohydrate-rich foods and protein-rich foods were assessed, while quantity of food and nutritional intake were not included in the analyses. We did not assess the consumption of tea, milk, and/or other types of drinks containing sugar. This study also did not rigorously evaluate children's growth using the Z-score of height for age and weight for age according to Tanzanian standards for school-age children that were not appropriate, although the Rohrer index score is a means of assessing weight for height among school-age children. This is because the objectives of this study were to evaluate the relationships between factors related to anthropometric measurements, food consumption, and QOL in general in Tanzania, not to assess the details of school-age children's growth monitoring through multi-dimensional measurements. As this study had a cross-sectional design, it was not possible to evaluate the long-term influence of SES and food consumption on children's growth and anthropometric

measurements to determine the relationships between these factors on children's self-rated QOL.

Measures to avoid deaths such as reducing deaths among young people are needed in low-SES populations. In addition, this study suggested the need to improve the living environments and conditions of vulnerable children, such that they can receive the continued and stable support necessary to lead a safe and healthy life. It is especially important to ensure food security, defined as three meals per day, to satisfy their physiological needs. In addition, under socially disadvantaged conditions, it is important to improve not only individual capacity, but also family and community capacities to secure positive development for health promotion.

Conflict of Interest: None declared.

Acknowledgements

References

1. Frank DA, Neault NB, Skalicky A, *et al*. Heat or eat: the Low Income Home Energy Assistance Program and nutritional and health risks among children less than 3 years of age. Pediatrics 2006; 118: e1293–e1302. [Medline] [CrossRef]

2. Cutts DB, Meyers AF, Black MM, *et al*. US Housing insecurity and the health of very young children. Am J Public Health 2011; 101: 1508–1514. [Medline] [CrossRef]

3. Nabunya P, Ssewamala FM, Ilic V. Family economic strengthening and parenting stress among caregivers of AIDS-orphaned children: results from a cluster randomized clinical trial in Uganda. Child Youth Serv Rev 2014; 44: 417–421. [Medline] [CrossRef]

4. Govender K, Reardon C, Quinlan T, *et al*. Childrens psychosocial wellbeing in the context of HIV/AIDS and poverty: a comparative investigation of orphaned and non-orphaned children living in South Africa. BMC Public Health 2014; 14: 615. [Medline] [CrossRef]

5. Ohnishi M, Nakamura K. Underserved adolescent orphans' knowledge regarding sexually transmitted infections and HIV/AIDS and sexual behaviour in a setting with a high prevalence of HIV. Japanese Journal of Health and Human Ecology 2010; 76: 237–251. [CrossRef]

6. Littrell M, Boris NW, Brown L, *et al*. The influence of orphan care and other household shocks on health status over time: a longitudinal study of childrens caregivers in rural Malawi. AIDS Care 2011; 23: 1551–1561. [Medline] [CrossRef]

7. Goodman ML, Seidel SE, Kaberia R, *et al*. How can we improve healthcare access and general self-rated health among orphans and vulnerable children? Findings from a Kenyan cross-sectional study. Int J Public Health 2015; 60: 589–597. [Medline] [CrossRef]

8. Ohnishi M. Association between orphans' subjective happiness and their daily life in an underserved setting. The Japanese Journal of Health and Medical Sociology 2011; 22: 41–55.

9. Kawasaki R, Tabuchi Y, Ohnishi M. Factors associated with food consumption among adolescent orphans in Nigeria. Japanese Journal of Health and Human Ecology 2014; 80: 199–207. [CrossRef]

10. Hong R. Effect of economic inequality on chronic childhood undernutrition in Ghana. Public Health Nutr 2007; 10: 371–378. [Medline] [CrossRef]

11. Darteh EK, Acquah E, Kumi-Kyereme A. Correlates of stunting among children in Ghana. BMC Public Health 2014; 14: 504. [Medline] [CrossRef]

12. Shinsugi C, Matsumura M, Karama M, *et al*. Factors associated with stunting among children according to the level of food insecurity in the household: a cross-sectional study in a rural community of Southeastern Kenya. BMC Public Health 2015; 15: 441. [Medline] [CrossRef]

13. Wang Y, Lim H. The global childhood obesity epidemic and the association between socio-economic status and childhood obesity. Int Rev Psychiatry 2012; 24: 176–188. [Medline] [CrossRef]

14. Pérez Rodrigo C. Current mapping of obesity. Nutr Hosp 2013; 28(Suppl 5): 21–31. [Medline]

15. Pienaar AE. Prevalence of overweight and obesity among primary school children in a developing country: NW-CHILD longitudinal data of 69-yr-old children in South Africa. BMC Obes 2015; 2: 2. [Medline] [CrossRef]

16. Hien NN, Kam S. Nutritional status and the characteristics related to malnutrition in children under five years of age in Nghean, Vietnam. J Prev Med Pub Health 2008; 41: 232–240. [Medline] [CrossRef]

17. Nishida M, Funahashi T. Validity of indices (BMI, Rohrer index, Broca method) for assessment of obesity. Nihon Rinsho 2009; 67: 301–306 (in Japanese). [Medline]

18. World Health Organizaion *THE WORLD HEALTH ORGANIZATION QUALITY OF LIFE (WHOQOL)-BREF* World Health Organization, Geneva, 2004. http://www.who.int/substance_abuse/research_tools/en/english_whoqol.pdf (accessed 7 January 2017).

19. Birhane T, Shiferaw S, Hagos S, *et al*. Urban food insecurity in the context of high food prices: a community based cross sectional study in Addis Ababa, Ethiopia. BMC Public Health 2014; 14: 680. [Medline] [CrossRef]

20. World Health Organization Global Database on Child Growth and Malnutrition. http://www.who.int/nutgrowthdb/about/introduction/en/index2.html (accessed 17 June 2016).

21. Gonzakes C, Jain-Chandra S, Kochhar K, *et al*. IMF staff

discussion note, Catalyst for change: empowering women and tackling income inequality https://www.imf.org/external/pubs/ft/sdn/2015/sdn1520.pdf (accessed 17 June 2016).

22. Timaeus IM, Boler T. Father figures: the progress at school of orphans in South Africa. AIDS 2007; 21(Suppl 7): S83–S93. [Medline] [CrossRef]

23. Parikh A, Desilva MB, Cakwe M, et al. Exploring the Cinderella myth: intrahousehold differences in child wellbeing between orphans and non-orphans in Amajuba District, South Africa. AIDS 2007; 21(Suppl 7): S95–S103. [Medline] [CrossRef]

24. Omuemu VO, Otasowie EM, Onyiriuka U. Prevalence of food insecurity in Egor local government area of Edo State, Nigeria. Ann Afr Med 2012; 11: 139–145. [Medline] [CrossRef]

25. Pappin M, Marais L, Sharp C, et al. Socio-economic status and socio-emotional health of orphans in South Africa. J Community Health 2015; 40: 92–102. [Medline] [CrossRef]

26. Ionescu-Ittu R, Glymour MM, Kaufman JS. A difference-in-differences approach to estimate the effect of income-supplementation on food insecurity. Prev Med 2015; 70: 108–116. [Medline] [CrossRef]

27. Oldewage-Theron WH, Dicks EG, Napier CE. Poverty, household food insecurity and nutrition: coping strategies in an informal settlement in the Vaal Triangle, South Africa. Public Health 2006; 120: 795–804. [Medline] [CrossRef]

28. Madhavan S, Townsend NW, Garey AI. Absent Breadwinners: Father-Child Connections and Paternal Support in Rural South Africa. J South Afr Stud 2008; 34: 647–663. [Medline] [CrossRef]

29. Madhavan S, Richter L, Norris S, et al. Fathers financial support of children in a low income community in South Africa. J Fam Econ Issues 2014; 35: 452–463. [Medline] [CrossRef]