Agricultural Research & Technology:
Open Access Journal

Research Article
Volume 1 Issue 3 - March 2016

Agri Res & Tech: Open Access J

Assessment of the Nutritional Status for the Children Under-Five in Khartoum State: A Policy Making Perspective

Samar Abdalla[1]*, Abdelmoneim Taha[2] and Eltighani Elamin[3]

[1]*Assistant professor at Agricultural Economics and Policy Research Centre (AEPRC), Agricultural Research Corporation (ARC), Sudan*

[2,3]*Professor at Agricultural Economics and Policy Research Centre (AEPRC), Agricultural Research Corporation (ARC), Sudan*

Submission: February 29, 2016; **Published:** March 10, 2016

***Corresponding author:** Samar Abdalla, Assistant professor at Agricultural Economics and Policy Research Centre (AEPRC), Agricultural Research Corporation (ARC), Khartoum North, Shambat, Sudan, Email: samar-122@hotmail.com

Abstract

The goal of this paper is assess the nutritional status for the children under-five in Khartoum State. About 396 children were chosen from the household's survey that conducted in Bahari, Khartoum and Umbada localities. The nutritional status was assessed through the anthropometric indicators i.e. weight-for-age, height/length-for-age and weight-for-height/length using the cut-off points (Z-Score). The outcomes show the prevalence of underweight (low weight for age) is higher under the moderate form compare to severe form and boys are likely to be severe underweight. Whereas, the prevalence of stunting (low height/length for age) in the severe form for girls in the age groups (11-20) month, (21-30) month, (31-40) month, and (41-50) month are about 22.2%, 76.5%, 75% and 28.6% respectively. The severe stunting is very higher in the girls than boys in the age groups (21-30) month, and (31-40) month. Conversely, the prevalence of wasting (low weight for height /length) in the severe form in the case of boys are around 66.7%, 53.8%, 77.8%, and 58.3% in the age groups (11-20) month, (21-30) month, (31-40) month, and (41-50) month, respectively. Further the results reveal both sex and ages variation in underweight, stunting and wasting among the under five years. The study recommends the importance of periodic monitoring of the nutrition status for the under-five years to capture those who are severe or at high risk. Enlighten the mothers through special nutrition program that help them to understand the important of adequate foods and ways of feeding practices.

Keywords: Anthropometrics; Nutritional status; Under-five; Z-score; Khartoum state

Introduction

Anthropometry is a widely used, inexpensive and non-invasive group of indicators measuring general nutritional status of an individual or a population [1]. Traditionally, human physical characteristics and measurements have been manually taken using rudimentary methods like calipers, rulers or measuring tapes [2-4]. On the other hand, the study and technique of captivating body measurements is also used for a comparison or classification basis. There are four basic measures that used to undertake anthropometric assessment; these are age, sex, weight, and length or height. When two of these variables are used together they are called an index. For instance, the anthropometric indices such as stunting (low height/ length-for-age), underweight (low weight-for-age), and wasting (low weight-for-height/ length) measure the nutritional outcomes at the individual level. The nutritional outcome is influenced by other aspects beyond the availability and accessibility to food (i.e. prerequisites for nutrition security, such as the interactions between food losses, intra-household food distribution, individual health and activity levels, and environmental quality).

There are many other anthropometric measures including mid-upper-arm circumference (MUAC), sitting height to standing height ratio (Cormic Index), and many skin fold measures. In this paper, the authors will concentrate only on the measurements and interpretation of the weight and height in children. The advantages and disadvantages of three indices relating weight to height and the information about them can be summarized below:

Weight-for-age: low weight-for-age index identifies the condition of being underweight, for a specific age. The

advantages of this index are that it may reflect both past (chronic) and/or present (acute) under nutrition, although it is unable to distinguish between the two terms.

Height/length-for-age: This index is an indicator of past under nutrition or chronic malnutrition. It's referring to stunting or short stature of individuals due to under nutrition. It cannot measure short term changes in malnutrition. For children below 2 years of age, the term is length-for-age; above 2 years of age, the index is referred to as height-for-age. Deficits in length-for-age or height-for-age are signs of stunting.

Weight-for-height/length: This index helps to identify children suffering from current or acute under nutrition or wasting and is useful when exact ages are difficult to determine. Weight-for-length (in children under 2 years of age) or weight for- height (in children over 2 years of age) is appropriate for examining short-term effects such as seasonal changes in food supply or short-term nutritional stress brought about by illness.

Anthropometric indicators measure directly the point of policy interest as they reflect under-nutrition and how it might affect health and well-being as argued by de Haen et al. [5]. Svedberg [6] pointed out the advantage of anthropometric indicators that they directly reflect the imbalances between energy intake and expenditure. Poor anthropometric outcomes are also associated with higher morbidity and mortality [7]. Although, anthropometric indicators measure nutritional outcomes, they do not cover specific nutrients that might be deficient. Nevertheless, it is argued that stunting might reflect long-term consequences of under consumption of the essential micronutrients such as vitamins and minerals as reported by Walker et al. [8] and Svedberg [6]. Another advantage of anthropometric norms, particularly for children under five, is that they are universal as the genetic potential growth for children is uniform [6]. Nonetheless, anthropometric measures are subject to measurement error including technical error of the measurements and the exact age of children is sometimes not known in some developing countries. To provide a figure of nutritional outcomes at the macro level, the anthropometric indicators are generally expressed as percentage or prevalence, i.e. frequencies. Anthropometric indicators are available for all countries though the series are not uniform in some countries since the data are not collected annually. They are published yearly by UNICEF in the State of the World's Children report series [9,10]. At country level, household surveys and nutrition surveillance surveys have been widely conducted.

Thus, the lack of up-to-date anthropometric data is a major issue in developing new patterns and products that target population or communities in the developing countries. Improvements in health care, nutrition and living conditions and the transition to a sedentary life style have changed the body dimensions of people over recent decades. Thus, measuring and monitoring the nutrition status of children under-five periodically is very important to determine the under consumption of micronutrients.

Research Objectives

The overall objective of this research is for informed policy making process to assess the nutritional status of the population under-five years using anthropometric measurements in Khartoum State. Specifically; this research aims to:

1. To reveal the conditions of being underweight among the children under five years using Weight-for-age index
2. To identify stunting among the children under-five years and reflects the under-nutrition and/or chronic malnutrition using the height-for-age index.
3. To identify the children who suffering from current or acute under-nutrition or wasting using weight-for-height/length index

Research Methodology

Study area

Khartoum State is one of the eighteen States of Sudan although; it is the smallest State by area (approximately 22,142 km^2). It contains the country's largest cities by population; Omdurman, Al-Khartoum Bahri and Khartoum. The city of Khartoum is the capital of the State as well as the national capital of Sudan. The State lies between longitudes 31.5 to 34° E and latitudes 15 to 16° N. It is surrounded by River Nile State in the north-east, in the north-west by the Northern State, in the east and south east by the States of Kassala, Gedarif and Gezira, and in the west by North Kordofan [11].

Khartoum State is geographically divided into three blocks (or clusters) these are further subdivided into localities. The blocks consist of approximately seven localities [11]. The census in 2008 estimates the population of Khartoum State to be about 5,274,321inhabitans, which composed of various tribes of the Sudan. The population is 79% urban and 74% of the State's population reported their region of origin to be outside Khartoum [12].

Most of the population works in the government services, the private sector, and banking. There are also a large number of merchants, and migrants and displaced people working in marginal activities. In the countryside most people are engaged in agriculture and grazing and thus; supply the capital, Khartoum, with vegetables, fruits, and dairy products. There are also some residents living on the banks of the rivers engaged in the trades and dependent on the rivers, such as pottery, brick-making and fishing [11]. About 79% of the population is depending on the agricultural activities in their livelihood system.

How to cite this article: Samar A, Abdelmoneim T, Eltighani E. Assessment of the Nutritional Status for the Children Under-Five in Khartoum State: A Policy Making Perspective. Agri Res & Tech: Open Access J. 2016; 1(3): 555564.

Sampling technique and sample size

A stratified random sampling cluster techniques was applied to select the sample of the households from blocks, localities, and administrative units in Khartoum State. The three localities are namely; Khartoum, Bahri, and Umbada were selected from the three blocks that constitute Khartoum State. As shown in Figure 1 Khartoum, Bahri, and Umbada localities were selected from the first second and third blocks, respectively. Accordingly, the three localities were nominated in order to select about 9 administrative units. In view of that, from Khartoum locality three administrative units were selected particularly; Maiew, Al Kalakla and Dar Elsalam. The administrative units of Elref Elshimali, Elselat and Elgeli were selected from Bahri locality. Additionally, Elameer, El Buga and Elsalam were chosen from Umbada locality. Therefore, about 320 households were selected from both localities and administrative units. As anthropometrics data are derived from household surveys accordingly, the population under five years was selected from the total sampled of the households. Thus, about 396 children under five years (one month to 59 month) from both boys and girls were used to assess their nutritional status.

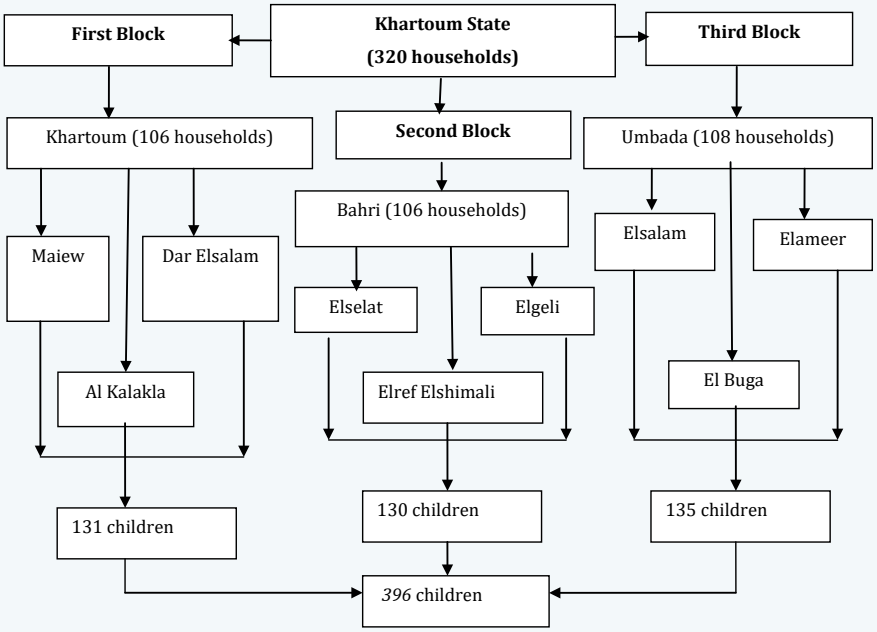

Figure 1: Stratified random sampling cluster technique and sample size of the selected children in Khartoum State, 2015
Source: Households Survey, 2015.

Data collection and data analysis

The anthropometry survey was made as a part the field survey in 2015. The field survey was conducted in Khartoum State using structured household's questionnaire. The household's questionnaire was used to collect the data and information on the socioeconomic characteristics, attitude, household's expenditure on food and non-food items, households coping strategies with food and nutrition insecurity and households behaviour. Additionally, the structured questionnaire was also aimed to collect anthropometric data with regard to the age, weight, height and length for the under-five years (one month to 59 month). The different information on the households was also used to interpret the anthropometry data.

The implementation of survey process required trained field staff. Accordingly, two persons who are very familiar with conducting and implementing such type of surveys were hired from Ministry of Health/ Primary Health Care in order to collect the vital, accurate and meaningful information. They were worked together with help of the other enumerators to conduct and complete the whole survey.

To conduct the anthropometric assessments specific equipments was used. The most common types of the equipments are scales and measuring boards. In our survey the enumerators use the weighing scale and height/length measurement board to collect data on weight, height and length of the children under five years. In our case we used the UNICEF *electronic scale (Mother-Child scale)* that reported by UNICEF [13]. The idea of the UNICEF *electronic scale* is requires the mother and child to be weighed simultaneously. Minimize the clothing on the child. Ensure the scale is not overheated in the sun and is on an even surface enabling the reading to be clear. Ask the mother to stand on the scale. Record the weight and include the reading with one decimal point (e.g. 65.5 kg). Pass the child to a person nearby.

How to cite this article: Samar A, Abdelmoneim T, Eltighani E. Assessment of the Nutritional Status for the Children Under-Five in Khartoum State: A Policy Making Perspective. Agri Res & Tech: Open Access J. 2016; 1(3): 555564.

Record the second reading with just the mother (e.g. 58.3 kg). The difference (e.g. 7.2 kg) is the weight of the child.

After collecting the anthropometric data a comparison to standard references is recommended. The references standards are commonly used to standardize measurements were developed by US National Centre Health Statistics (NCHS) and are recommended for international use by the World Health Organization (WHO). The reference population chosen by NCHS was a statistically valid random population of healthy infants and children. The international reference standards can be used for standardizing anthropometric data from around the world. References are used to standardize a child's measurement by comparing the child's measurement with the median or average measure for children at the same age and sex. The difference in the measurements can be expressed by standard deviation units or z-scores. Thus, the Z-score application is considered the simplest way of describing the reference population and making comparisons to it. It is the statistic recommended in the nutritional assessments.

The Z-score or standard deviation unit (SD) is defined as the difference between the value for an individual and the median value of the reference population for the same age or height/ length or weight, divided by the standard deviation of the reference population. This can be written in equation form as:

Z-score (or SD score) = (observed value) - (Median reference value)

Standard deviation of reference population

Thus it's important to use the cut-offs points (used to differentiate between malnourished and adequately nourished segments of a population). The cut-offs enables the different individual measurements to be converted into prevalence statistics [14]. Cut-offs points are also used to identifying those children suffering from or at a higher risk of adverse outcomes. The children screened under such circumstances may be identified as eligible for special care. The most commonly-used cut-off with Z-scores is -2 SD, irrespective of the indicator used. Accordingly, Table 1 presents the malnutrition classification based on cut-off points for different systems as mentioned by Cogill [15].

The data collected for the present study are quantified and analyzed statistically, using SPSS Window software. The descriptive statistics technique was used to express the nutritional status of the children under-five using anthropometrics indexes (weight-for- age, height-for-age and weight-for-height) as percentage or prevalence, i.e. frequencies. The differences between more than two means were determined, using one-way analysis of variance (ANOVA table). Additionally, the differences between proportions were tested, using chi-square test.

Table 1: Malnutrition classification systems.

System	Cuts-off Points	Malnutrition classification
WHO	<-1 Z-score	Mild
	<-2 Z-score	Moderate
	<-3 Z-score	Severe
RTH	> 80% of median	Normal
	60% - < 80% of median	Mild-to-moderate
	< 60% of median	Severe
Gomez	> 90% of median	Normal
	75% - < 90% of median	Mild
	60% - < 75% of median	Moderate
	< 60% of median	Severe

Source: [15].

Results and Discussion

Distribution of children under-Five

The total sample was selected from three localities in Khartoum State namely; Bahari, Umbada and Khartoum. In view of that, Table 2 presents the distribution of the children below-five years among the localities and administrative units in Khartoum State, 2015. About 32.8% from the total sample children were selected from Bahari locality and the sample is distributed among the selected administrative units as follows 10.9% from Elgeli, 11.4% from Elref Elshimali and 10.9% from Elselat. Approximately 34.1% from the total selected children below five years was chosen from Umbada locality; specifically 11.6%, 10.9% and 11.6% were selected from Elameer, El Buga and Elsalam administrative units, respectively.

Alternatively, about 33.1% from the sample children below five years were selected from Khartoum locality and it's shared out among the administrative units as follows 10.1% from Maiew, 12.1% from Al Kalakla and 10.9% from Dar Elsalam.

Table 3 reveals the distribution of children under-five based on sex and age groups in Khartoum State, 2015. Both boys and girls under-five are classified into 6 age groups. About 10.2% from the total boys and 11% from the total girls are allocated in the age group (2-10) month. Generally, the majority of both boys and girls under-five are allocated in the age categories (11-20) month, (21-30) month, (31-40) month, and (41-50) months. Consequently, about 16.8% of the total percentage of boys and 24.5% of the total percentage of girls are allocated in the age group (21-30) month. The total percentages from both boys and girls below-five years in the age group (31-40) month are about 15.7%. Approximately, 25% and 21.5% from the total boys and total girls children, respectively; are allocated in the age category (41-50) month. A few percentages from both boys and girls under-five are allocated in the age group (51-59) month.

How to cite this article: Samar A, Abdelmoneim T, Eltighani E. Assessment of the Nutritional Status for the Children Under-Five in Khartoum State: A Policy Making Perspective. Agri Res & Tech: Open Access J. 2016; 1(3): 555564.

Table 2: Distribution of children under-five years by localities and administrative units in Khartoum State, 2015.

Source: field survey, 2015.

Localities	Frequency	Percentages (%)	Administrative units	Frequency	Percentages (%)
Bahari	130	32.8	Elgeli	43	10.9
			Elref Elshimali	45	11.4
			Elselat	42	10.6
			Total	130	32.8
Umbada	135	34.1	Elameer	46	11.6
			El Buga	43	10.9
			Elsalam	46	11.6
			Total	135	34.1
Khartoum	131	33.1	Maiew	40	10.1
			Al Kalakla	48	12.1
			Dar Elsalam	43	10.9
			Total	131	33.1
Total	396	100	Total	396	100

Table 3: the distribution of children under-five based on sex and age groups (months) in Khartoum State, 2015.

Remarks: Sample size is equal to 396 children- The numbers between brackets are the percentages

Source: field survey, 2015.

Age categories in months	Sex group		Total
	Boys	Girls	
2-10	20 (10.2)	22(11)	42 (10.6)
11-20	46 (32.5)	40(20)	86(21.7)
21-30	33(16.8)	49(24.5)	82(20.7)
31-40	34 (17.3)	28(14)	62(15.7)
41-50	49 (25)	43(21.5)	92 (23.2)
51-59	14(7.1)	18(9)	32(8.1)
Total	196 (100)	200 (100)	396(100)

Weight-for-Age

Weight-for-age, expressed as percentage or Z-score of individual weight to the median or 50th percentile of the international population references (i.e., WHO/NCHS growth references) is generally considered as one of the indicators of underweight. Table 4 shows the average of weight for children under-five according to their age groups. The average weights for under-five-years are increasing with their ages. From the table its clears that the average weight for the age group (2-10) month, (11-200 month and (21-30) month are about 7.62 kg, 8.84 kg, and 10.54 kg, respectively. The mean value of weight for the high age group (51-59 months) is about 14.30kg. The mean weights for the age groups 41-50 month and 51-59 month are approximately13.34 kg and 14.30 kg, respectively. The AVOVA table shows that the average weight is highly significant with age groups at level 1%; F-value test is equal to 88.35. Similar study conducted in India by Maken et al. [16] showed that that there is a gradual increase in average weight for both boys and girls from 2 to 10 years of age. They also observed that boys are heavier than girls at many age groups, and the differences are statistically significant.

Table 4: the average of weight (kg) for different age groups for the children under-five in Khartoum State, 2015.

Remarks: sample size is about 396 children- ***means statistically significant at level 1%.

Age groups (months)	N	Mean Value (kg)	SD. Deviation	F-test
2-10	42	7.62	1.55	88.35***
11-20	86	8.84	1.73	
21-30	82	10.54	2.38	
31-40	62	12.06	1.88	
41-50	92	13.34	2.08	
51-59	32	14.30	2.44	
Total	396	11.05	2.94	

How to cite this article: Samar A, Abdelmoneim T, Eltighani E. Assessment of the Nutritional Status for the Children Under-Five in Khartoum State: A Policy Making Perspective. Agri Res & Tech: Open Access J. 2016; 1(3): 555564.

The underweight, based on weight-for-age, is a composite measure of stunting and wasting and is recommended as the indicator to assess the changes in the magnitude of malnutrition over time as argued by Cogill [1]. It's also reflects the chronic or present under-nutrition. Accordingly, Table 5 reveals the nutritional status (frequencies and percentages) for the children according to weight-for-age Khartoum State, 2015. Besides sex variation in the distribution of weight-for-age mentioned above, Table 5 further shows that the frequencies of underweight i.e., (moderate plus severe forms). It's emerge the prevalence of underweight is high in the moderate form compare to the severe form. The prevalence of underweight in the moderate form (<-2 Z-score) in the case of boys in the age groups (11-20) month, (21-30) month, (31-40) month, and (41-50) month are about 45.5%, 42.9%, 57.1%, and 45%, respectively. While, the prevalence of underweight in the moderate form for girls in the same age groups are about 54.5%, 57.1%, 42.9% and 55% respectively. Thus, this indicates that the prevalence of underweight under moderate form is considerably higher in these age groups for girls in compared to boys. Indeed, the nutritional status with respect to weight-for-age seems to be better in the lower age group (i.e 2-10 month) as compared with the higher age groups. Conversely, the prevalence of underweight in the severe form (< -3 Z-score) in the case of boys in the age groups (11-20) month, (21-30) month, (31-40) month, and (41-50) month are about 76.9%, 41.7%, 60%, and 66.7%, respectively. While, the prevalence of underweight in the severe form for girls in the same age groups are about 23.1%, 58.3%, 40% and 33.3%, respectively. It appears that the severe underweight higher among the boys in compared to the girls. It is clearly shown from the table that boys are likely to be severe underweight as compared to girls. However, the differences in the distribution of undernourished individuals between age groups are not statistically significant for both boys and girls.

Moreover, Table 5 presents that the percentages of the normal or adequate weight for age for under-five i.e., (mild plus normal forms). The prevalence of the normal weight for age in the mild form (<-1 Z-score) in the case of boys in the age groups (11-20) month, (21-30) month, (31-40) month, and (41-50) month are about 52.4%, 37.5%, 50%, and 51.9%, respectively. While, the prevalence of the normal weight for age under mild form for girls in the same age groups are about 47.6%, 62.5%, 50% and 48.1%, correspondingly.

Therefore, the present outcomes indicate that there are variations between the sex and age groups with respect to the percentage distribution of weight for age, despite the absence of statistical significance. Also, children in the lower age group are better in weight-for-age as compared with those in the higher age groups. Comparing with other study, Maken et al. [16] found that boys are about 1.47 times likely to be underweight as compared to girls in India.

Table 5: Nutritional status for the children under five years according to weight-for-age in Khartoum State, 2015.
Remarks: the sample size is about 396 children- Numbers between brackets are the percentage.

Age categories	Sex	Severe (< -3 Z-score)	Moderate (<-2 Z-score)	Mild (<-1 Z-score)	Normal	Total
2-10	Boys	2 (50)	2 (66.7)	5(71.4)	11(39.3)	20(47.6)
	Girls	2 (50)	1(33.3)	2(28.6)	17(60.7)	22(52.4)
	Total	4 (100)	3(100)	7(100)	28 (100)	42(100)
11-20	Boys	10(76.9)	5(45.5)	11(52.4)	20(48.8)	46(53.5)
	Girls	3(23.1)	6(54.5)	10(47.6)	21(51.2)	40(46.5)
	Total	13(100)	11(100)	21(100)	41(100)	86(100)
21-30	Boys	5(41.7)	6(42.9)	9(37.5)	13(40.6)	33(40.2)
	Girls	7(58.3)	8(57.1)	15(62.5)	19(59.4)	49(59.8)
	Total	12(100)	14(100)	24(100)	32(100)	82(100)
31-40	Boys	3(60)	8(57.1)	9(50)	14(56)	34(54.8)
	Girls	2(40)	6(42.9)	9(50)	11(44)	28(45.2)
	Total	5(100)	14(100)	18(100)	25(100)	62(100)
41-50	Boys	6(66.7)	9(45)	14(51.9)	20(55.6)	49(53.3)
	Girls	3(33.3)	11(55)	13(48.1)	16(44.4)	43(46.7)
	Total	9(100)	20(100)	27(100)	36(100)	92(100)
51-59	Boys	2(40)	4(57.1)	2(20)	6(60)	14(43.8)
	Girls	3(60)	3(42.9)	8(80)	4(40)	18(56.3)
	Total	5(100)	7(100)	10(100)	10(100)	32(100)
Total	Boys	28(58.3)	34(49.3)	50(46.7)	84(48.8)	196(49.5)
	Girls	20(41.7)	35(53.3)	57(53.3)	88(51.2)	200(50.5)
	Total	48(100)	69(100)	107(100)	172(100)	396(100)

How to cite this article: Samar A, Abdelmoneim T, Eltighani E. Assessment of the Nutritional Status for the Children Under-Five in Khartoum State: A Policy Making Perspective. Agri Res & Tech: Open Access J. 2016; 1(3): 555564.

Height or length for age

Height or length-for-age, expressed as percentage or Z-score of individual height or length to the median or 50th percentile of the international population references (i.e., WHO/NCHS growth references) is generally considered as one of the indicators of stunting. Table 6 shows the average of height/ length for children under-five according to their age groups in Khartoum State. Similar to weight, the average height/length (cm) for the children under-five-year is increasing with their ages. From the table it's clearly shown that the average height/length for the age group (2-10) month, (11-20) month and (21-30) month are about 69.5 cm, 76.8 cm, and 83.1 cm, respectively. The mean value of height (cm) for the higher age group (51-59 months) is about 103cm. The AVOVA table shows that the average height/ length is significantly differences with age groups at level 1%, F-value test is equal to 169.88. Study in India revealed that girls are by and large better than boys in respect of height-for-age especially after 4 years of age [16].

Table 6: The average of height and length (cm) for different age groups for the children under-five years in Khartoum State, 2015.

Remarks: sample size is about 396 children- *** means statistically significant at level 1% - For children below 2 years of age, the term is length-for-age; above 2 years of age, the term is height-for-age.

Age groups (months)	N	Mean Value (cm)	SD. Deviation	F-test
2-10	42	69.5	6.6	
11-20	86	76.8	6.6	
21-30	82	83.1	7.8	
31-40	62	90.8	5.4	169.88***
41-50	92	97.2	8.0	
51-59	32	103.1	5.6	
Total	396	86.4	12.4	

Stunting based on low height/length-for-age, stemming from a slowing in the growth of the fetus and the child and resulting in a failure to achieve expected length/ height as compared to a healthy and well nourished child of the same age, is a sign of stunting. Stunting is an indicator of past growth failure (i.e. chronic malnutrition). It is associated with a number of long-term factors including chronic insufficient protein and energy intake, frequent infection, sustained inappropriate feeding practices and poverty.

Table 7 shows the nutritional status of both boys and girls according to height/length for age in Khartoum State, 2015. Besides sex variations in the distribution of height/length for age, Table 7 also reveals that the frequencies (percentages) of stunting for under five years (i.e., moderate plus severe forms). As the same as underweight, the prevalence of stunting is higher in the moderate form compare to the severe form. The prevalence of stunting in the moderate form (<-2 Z-score) in the case of boys in the age groups (11-20) months, (21-30) months, (31-40) months, and (41-50) month are approximately 66.7%, 41.7%, 61.5%, and 55.6%, correspondingly. While, the prevalence of stunting in the moderate form for girls in the same age groups are about 33.3%, 58.3%, 38.5% and 44.4% respectively. As a result, this implies that the prevalence of stunting under moderate forms is considerably higher in these age groups for boys in compared to girls. In the same line, the nutritional status with respect to height/length for age looks to be better in the age groups of (2-10) month, and (51-59) month as compared with the other age groups. On the other hand, the prevalence of stunting (low height or length for age) in the severe form (< -3 Z-score) in the case of boys are about 77.8%, 23.5%, 25%, and 71.4% in the age groups (11-20) month, (21-30) month, (31-40) month, and (41-50) month, correspondingly. Whereas, the prevalence of stunting in the severe form for girls in the same age groups are about 22.2%, 76.5%, 75% and 28.6% respectively. It emerges that the number of severe stunting is very higher in the girls than boys in the age groups (21-30) month, and (31-40) month. It's clear that girls are relatively stunting in compared to boys in these age groups. Whereas, the prevalence of stunting under severe form is very higher in the boys compare to girls in the age groups (11-20) month and (41-50) month. However, the results show the variation in height/ length for age among the age groups is statistically significant at level 10% for both boys and girls (chi-square =29.8).

Moreover, Table 7 presents that the percentages of normal or adequate height/length for age for under-five i.e., (mild plus normal forms). The adequate height/length for age in the mild form (<-1 Z-score) in the case of boys in the age groups (11-20) month, (21-30) month, (31-40) month, and (41-50) month are around 62.5%, 44.8%, 55%, and 55%, respectively. At the same time, the prevalence of adequate height/length for age under the mild form for the girls in the same age groups are about 37.5%, 55.2%, 45% and 45%, respectively. Alternatively, the present findings indicate that there are differences between the sexes and percentage distribution of height/length for age, despite of the absence of the statistical significant. Furthermore, children in the lower age groups are better in height/length for age as compared with those in the higher age groups.

Likewise, Maken et al. [16] found that the proportions of boys with normal, moderate, and severe forms of growth retardation are 47.06%, 40.78% and 12.16%, respectively. In the case of girls, these frequencies are found to be 55.16%, 30.56% and 13.89%, respectively. They also indicated that the overall prevalence of under-nutrition (moderate plus severe forms) for all age groups is higher in boys than in girls, and it is statistically significant.

How to cite this article: Samar A, Abdelmoneim T, Eltighani E. Assessment of the Nutritional Status for the Children Under-Five in Khartoum State: A Policy Making Perspective. Agri Res & Tech: Open Access J. 2016; 1(3): 555564.

Table 7: Nutritional status for the children under five years according to the height/length-for-age in Khartoum State, 2015.

Remarks: the sample size is about 396 children- Numbers between brackets are the percentage - the differences in the distribution of height or length for age are statistically significant with ages groups at level 10% (chi-square =29.8*).

Age categories	Sex	Severe (< -3 Z-score)	Moderate (<-2 Z-score)	Mild (<-1 Z-score)	Normal	Total
2-10	Boys	0 (0)	3(50)	4(50)	13(50)	20(47.6)
	Girls	2(100)	3(50)	4(50)	13(50)	22(52.4)
	Total	2(100)	6(100)	8(100)	26(100)	42(100)
11-20	Boys	7(77.8)	6(66.7)	15(62.5)	18(40.9)	46(53.5)
	Girls	2(22.2)	3(33.3)	9(37.5)	26(59.1)	40(46.5)
	Total	9(100)	9(100)	24(100)	44(100)	86(100)
21-30	Boys	4(23.5)	5(41.7)	13(44.8)	11(45.8)	33(40.2)
	Girls	13(76.5)	7(58.3)	16(55.2)	13(54.2)	49(40.2)
	Total	17(100)	12(100)	29(100)	24(100)	82(100)
31-40	Boys	1(25)	8(61.5)	11(55)	14(56)	34(54.8)
	Girls	3(75)	5(38.5)	9(45)	11(44)	28(45.2)
	Total	4(100)	13(100)	20(100)	25(100)	62(100)
41-50	Boys	10(71.4)	5(55.6)	11(55)	23(46.9)	49(53.3)
	Girls	4(28.6)	4(44.4)	9(45)	26(53.1)	43(46.7)
	Total	14(100)	9(100)	20(100)	49(100)	92(100)
51-59	Boys	0(0)	2(66.7)	2(25)	10(52.6)	14(43.8)
	Girls	2(100)	1(33.3)	6(75)	9(47.4)	18(56.3)
	Total	2(100)	3(100)	8(100)	19(100)	32(100)
Total	Boys	22(45.8)	29(55.8)	56(51.4)	89(47.4)	196(49.5)
	Girls	26(54.2)	23(44.2)	53(48.6)	98(52.6)	200(50.5)
	Total	48(100)	52(100)	109(100)	187(100)	396(100)

Weight-for-Height/ Length

Weight for height or length is described as percentage or Z-score of individual weight expected of a child of the same length or height to the median or 50th percentile of the international population references (i.e., WHO/NCHS growth references) is generally considered as one of the indicators of under- nutrition.

Wasting is the result of a weight falling significantly below the weight expected of a child of the same length or height. Wasting indicates current or acute malnutrition resulting from failure to gain weight or actual weight loss. Wasting is caused by inadequate food intake, incorrect feeding practices, disease, and infection or, more frequently, a combination of these factors. Wasting in individual children and population groups can change rapidly and shows marked seasonal patterns associated with changes in food availability or disease prevalence to which it is very sensitive.

The prevalence of children of low weight for height/length (under nutrition or wasting) according to their age and sex groups is given in Table 8. It is seen that boys are relatively under-nutrition in compared to girls. In addition to the sex variation in the distribution of weight for height/length, Table 8 also depicts that the frequencies of wasting for under-five population (i.e., moderate plus severe forms). It's clear that the prevalence of wasting is high in the severe form compare to the moderate form. The prevalence of under-nutrition in the moderate form (<-2 Z-score) in the case of boys in the age groups (11-20) month, (21-30) month, (31-40) month, and (41-50) month are about 66.7%, 40%, 40%, and 53.3%, respectively. The prevalence of wasting in the moderate form for girls in the same age groups are about 33.3%, 60%, 60% and 46.7% respectively. Thus, it indicates that the prevalence of wasting under moderate form is higher for both boys compared to girls in the age groups (11-20) month and (41-50) month. Generally, the nutritional status with respect to weight for height or length seems to be better in the low and high age groups (2-10) month and (51-59) month as compared with the other age group (11-21) month, (21-30) month, (31-40) month, and (41-50) month. Conversely, the prevalence of wasting (low weight for height or length) in the severe form (< -3 Z-score) in the case of boys are around 66.7%, 53.8%, 77.8%, and 58.3% in the age groups (11-20) month, (21-30) month, (31-40) month, and (41-50) month, respectively. On the other hand, the prevalence of wasting in the severe form for girls in the same age groups are about 33.3%, 46.2%, 22.2% and 41.7%, respectively. It emerges that the numbers of severe under nutrition is considerably higher among the boys relative to girls in these age groups.

How to cite this article: Samar A, Abdelmoneim T, Eltighani E. Assessment of the Nutritional Status for the Children Under-Five in Khartoum State: A Policy Making Perspective. Agri Res & Tech: Open Access J. 2016; 1(3): 555564.

Table 8: Nutritional Status for the children under five years according to weight for height/ length in Khartoum State, 2015.

Remarks: the sample size is about 396 children- Numbers between brackets are the percentage- weight for height or length are statistically significant with age groups at level 10% (χ2=26.09)- sex (boys and girls) are significantly differences with the weight for height /length, χ^2 = 7.05 at level 10%.

Age categories	Sex	Severe (< -3 Z-score)	Moderate (<-2 Z-score)	Mild (<1 Z-score)	Normal	Total
2-10	Boys	3(37.5)	2(66.7)	6(85.7)	9(37.5)	20(47.6)
	Girls	5(62.5)	1(33.3)	1(14.3)	15(62.5)	22(52.4)
	Total	8(100)	3(100)	7(100)	24(100)	42(100)
11-20	Boys	12(66.7)	2(66.7)	11(47.8)	21(50)	46(53.5)
	Girls	6(33.3)	1(33.3)	12(52.2)	21(50)	40(46.5)
	Total	18(100)	3(100)	23(100)	42(100)	86(100)
21-30	Boys	7(53.8)	2(40)	8(50)	16(33.3)	33(40.2)
	Girls	6(46.2)	3(60)	8(50)	32(66.7)	49(59.8)
	Total	13(100)	5(100)	16(100)	48(100)	82(100)
31-40	Boys	7(77.8)	4(40)	6(66.7)	17(50)	34(54.8)
	Girls	2(22.2)	6(60)	3(33.3)	17(50)	28(45.2)
	Total	9(100)	10(100)	9(100)	34(100)	62(100)
41-50	Boys	7(58.3)	8(53.3)	16(59.3)	18(47.4)	49(53.3)
	Girls	5(41.7)	7(46.7)	11(40.7)	20(52.6)	43(46.7)
	Total	12(100)	15(100)	27(100)	38(100)	92(100)
51-59	Boys	2(40)	2(50)	6(50)	4(36.4)	14(43.8)
	Girls	3(60)	2(50)	6(50)	7(63.6)	18(56.3)
	Total	5(100)	4(100)	12(100)	11(100)	32(100)
Total	Boys	38(58.5)	20(50)	53(56.4)	85(43.1)	196(49.5)
	Girls	27(41.5)	20(50)	41(43.6)	112(56.9)	200(50.5)
	Total	65(100)	40(100)	94(100)	197(100)	396(100)

In addition, Table 8 reveals that the percentages of normal or adequate prevalence of weight for height/length for under-five population in Khartoum State i.e., (mild plus normal forms). The adequate weight for height/length in the case of boys under the mild form (<-1 Z-score) in the age groups (11-20) month, (21-30) month, (31-40) month, and (41-50) month are about 47.8%, 50%, 66.7%, and 59.3%, correspondingly. Conversely, the prevalence of the adequate weight for height/length for age under the mild form for the girls in the same age groups are about 52.2%, 50%, 33.3% and 40.7%, respectively. Nevertheless, the differences in the distribution for weight for height/length for the individuals between age groups are statistically significant at level 10% for both boys and girls (chi-square =26.09). The findings also present that there are statistically significantly differences between the sex and the distribution of weight for height/length as indicated by chi-square equal 7.05 at level 10%. Other outcomes in India by Maken et al. [16] showed the prevalence of wasting is slightly higher in boys than in girls, despite the absence of statistical difference. They also add that the prevalence of wasting is higher in girls than in boys in the age group 6-10 years, although it is not statistically significant.

Morbidity in Children Under-Five

Table 9: Morbidity (Diarrhea, Fever and difficult breathing, Malaria and Other diseases) affected the children under five in Khartoum State, 2015.

Remark: the sample size is about 396 children- Numbers between brackets are the percentage.

Morbidity	Girls (n=200)	Boys (n=196)	Total (N=396)
Diarrhea	34 (17)	29 (14.8)	63 (15.9)
Fever and difficult breathing	48 (24)	50 (25.5)	98 (24.7)
Malaria	15 (7.5)	12 (6.1)	27 (6.8)
Other diseases	61 (30.5)	64 (32.7)	125 (31.6)

Table 9 presents the morbidity such as Diarrhoea, fever and difficult breathing, as well as malaria and other diseases that affected both boys and girls under-five in Khartoum State. It's shown from the table that 17% and 14.8% from the total girls and boys are suffering from Diarrhoea during the time of the survey, respectively. On the other hand, fever and difficult breathing disturbing about 24% from total girls group and 25.5% from the total boys group. Infection by malaria is considerably low

How to cite this article: Samar A, Abdelmoneim T, Eltighani E. Assessment of the Nutritional Status for the Children Under-Five in Khartoum State: A Policy Making Perspective. Agri Res & Tech: Open Access J. 2016; 1(3): 555564.

in compared to other diseases. Malaria affects about 6.8% from the whole sample of the children under-five in Khartoum State. Furthermore, 31.6% of the total children under-five are affected by other diseases.

Vaccination against diseases

Table 10 shows the vaccination against diseases such as (Paralysis, Diphtheria and Measles) for children under-five years. Vaccination against the basic diseases is depending mostly on the ages of the children. It's clearly appears that the total girls and 98.5% from the total boys sampled are taking the doses vaccination of paralysis. Alternatively, the vaccination from Diphtheria for the children under-five in Khartoum State is about 99.5% for girls and for about 97.4% for boys. The outcomes also shown that approximately, 90.7% of the children under-five are taking the vaccination against measles.

Table 10: Vaccination against diseases (Paralysis, Diphtheria and Measles) for children under the five year in Khartoum State, 2015.

Remark: the sample size is about 396 children- Numbers between brackets are the percentage.

Vaccination	Girls (n=200)	Boys (n=196)	Total (N=396)
Paralysis	200 (100)	193(98.5)	393 (99.2)
Diphtheria	199 (99.5)	191(97.4)	390 (98.5)
Measles	182(91.0)	177 (90.3)	359 (90.7)

Summary, Conclusion and Recommendations

Assessment of the nutrition status for the population under-five provides the essential indicators for nutrition and food security at the household's level and hence informed policy making. The well-nourished children indicate a better sign for food intake, stability of food, food distribution and good quality and quantity of food intake. Therefore, this paper is focused on assessment of the nutrition status for the children under-five in Khartoum State. The data was collected through the household's survey from three localities namely; Bahari, Khartoum and Umbada. About 396 children were chosen to measure their nutritional status using anthropometric measurements i.e. weight-for-age, height/length-for-age and weight-for-height/length. In view of that, the results show that the weight, height or lengths are increasing rapidly with age groups for individuals under-five years in Khartoum State. This generally implies the healthy growth condition for the under-five years; nevertheless, it cannot reflect the good nutritional status. Therefore, the nutrition indicators such as weight-for-age, height/length-for-age, and weight for height/length are used to measure the nutritional status for the under-five.

The finding shows the prevalence of underweight (low weight-for-age) under the moderate form is considerably higher for girls in comparison to boys in the higher age groups. The prevalence of underweight in the severe form is higher in boys relative to girls indicating the existing of the sex variations. However, these differences in the distribution of underweight between age groups for the individuals under five are not statistically significant for both boys and girls. This implies that the policy makers have to emphasize on nutritious foods for the under-five years in adequate amounts for different sex and age categories in order to ensure the healthy growth. On the other hand, the prevalence of stunting (low height/length for age) under moderate form is considerably higher for boys compared to girls. Additionally, the findings also indicate that there are differences between the sex and age groups with respect to the percentage distribution of stunting children. The outcomes indicate that the policy makers have to give attention to the adequate foods in term of both quality and quantity of foods intake and food diversity.

Further, the prevalence of under-nutrition or wasting (low weight for height/length) reveals that boys are highly under-nutrition compared to girls under the severe form. Overall, the prevalence of wasting is high in the severe form compared to the moderate form. Thus, to reduce the prevalence of wasting among the under-five years some requirements are needed such as appropriate feeding practices, control the infection by diseases as well as provide adequate foods.

The paper also covered the morbidity and the vaccination against diseases for the population under-five years. The outcome exposes that children are highly suffering from Diarrhoea relative to other diseases. Thus, this entails to protect the children in stage through health control services and environmental preservation to avoid the infection by diseases.

The study recommends the importance of periodic monitoring of the nutrition status for the under-five years in order to capture and treat those who are severe or at high risk. Enlighten the mothers through special nutrition program that help them to understand the ways of feeding practices, food diversity, and important of food distribution among the households members are another recommendation for the Ministry of Health. The policy makers and nutritionists have to routinely review/revise the factors that lead to malnutrition among under-five population (i.e. food losses, intra-household food distribution, individual health).

References

1. Bruce C (2001) Anthropometric indicators Measurement guide. Food and nutrition technical assistant project, Academy for education development, Washington DC, USA.
2. Simmons KP, Istook CL (2003) Body Measurement Techniques: Comparing 3D Body-Scanning and Anthropometric Methods for Apparel Applications. Journal of Fashion Marketing and Management 7(3): 306-332.
3. Lu JM, Wang MJJ (2008) Automated Anthropometric Data Collection Using 3D Whole Body Scanners. Expert Systems with Applications

How to cite this article: Samar A, Abdelmoneim T, Eltighani E. Assessment of the Nutritional Status for the Children Under-Five in Khartoum State: A Policy Making Perspective. Agri Res & Tech: Open Access J. 2016; 1(3): 555564.

35(1-2): 407-414.

4. Shu C, Wuhrer S, Xi P (2011) Geometric and Statistical Methods for Processing 3D Anthropometric Data. In International Symposium on Digital Human Modeling, Canada, pp. 1-5.
5. de Haen H, Klasen S, Qaim M (2011) What Do we Really Know? Metrics for Food Insecurity and Under-nutrition. Food Policy 36(6): 760-769.
6. Svedberg P (2011) How Many People Are Malnourished? Annual Review of Nutrition 31: 263-283.
7. Deaton A, Dreze J (2009) Food and Nutrition in India: facts and interpretations. Economics and Political Weekly 44(7): 42-65.
8. Walker SP, Wachs TD, Gardner JM, Lozoff B, Wasserman GA, et al. (2007) Child Development: risk factors for adverse outcomes in developing countries. The Lancet 369(9556): 145-157.
9. Olusanya BO (2005) State of the World's Children: life beyond survival. Arch Dis Child 90(3): 317-318.
10. Bryce J, Boschi-Pinto C, Shibuya K, Black RE (2005) WHO Estimates of the Causes of Death in Children. The Lancet 365(9465): 1147-1152.
11. Wikipedia (2014) Information about Khartoum State.
12. CBS (2009) 5th Sudan population and housing census- Priority results, Central Bureau of Statistics.
13. UNICEF (2001) "How to Use the UNISCALE" prepared by the Nutrition Section Program Division/UNICEF New York, USA.
14. WHO (2006) Child growth standards: length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: methods and development. Geneva: WHO.
15. Bruce C (2003) Anthropometric Indicators Measurement Guide-Washington, DC: Food and Nutrition Technical Assistance (FANTA) Project, FHI 360.
16. Maken T, Varte LR (2012) Nutritional status of children as indicated by z-scores of the Hmars: A tribe of N.E. India. Antrocom Online Journal of Anthropology 8(1): 213-227.

How to cite this article: Samar A, Abdelmoneim T, Eltighani E. Assessment of the Nutritional Status for the Children Under-Five in Khartoum State: A Policy Making Perspective. Agri Res & Tech: Open Access J. 2016; 1(3): 555564.