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Nutritional status of Households using Anthropometric Measurements in North West region, Cameroon.

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ABSTRACT

This study examined the nutritional status of rural households using anthropometric measurements in North West Region of Cameroon. Twenty –two rural and 106 urban households were randomly selected for anthropometric studies... Anthropometric indices of respondents 6 months - 60 years from urban and rural households were obtained using standard procedures. Descriptive and inferential statistics were used to analyze collected data and significance at $p<0.05$ accepted. Data obtained and analyzed showed that stunting was the most prevalent form of malnutrition in the study, followed by underweight and wasting. Overweight and obesity in the urban households was 6.32% and 2.37% respectively while overweight and obesity in the rural households was 7.69% and 4.48% respectively. Mild (12.59% and 12.50%) and severe (8.66% and 8.33%) malnutrition were similar in urban and rural households respectively. Increased Risk of Metabolic Complication was 28.68% in the urban and 23.63% in rural households while Substantially Increased Risk of Metabolic Complication was 31.78% in the urban and 28.07% in the rural households.

Keywords: Nutritional status, anthropometric measurements, household

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INTRODUCTION

Hunger is on the rise in almost all African sub regions, making African the region with the highest prevalence of undernourishment. Significant challenges remain in the fight against food insecurity and malnutrition. A greater focus on child overweight and adult obesity is needed to better understand the different dimensions of these nutrition challenges (Nutrition initiative, 2018)[1]. The number of malnourished people in sub-Saharan Africa has increased mainly children have moderate malnutrition while 13 million have severe acute malnutrition. Worldwide reports show that among the under-five 21.9%, 13.4% and 7.3% are stunted, underweight and wasted respectively (Nutrition initiatives, 2019)[2]. Malnutrition is unacceptably high and affects every country in the world, but there is a need to end it. The world's most comprehensive report on nutrition highlights the worrying prevalence and universality of malnutrition in all its forms. Malnutrition is responsible for about 300,000 deaths per year in developing countries (Souganidis, 2012)[3]. More than half (53%) of all deaths in children under 5 are attributable to under nutrition. The interaction between under nutrition and infection can create a potentially lethal cycle of worsening illness and deteriorating nutritional status (UNICEF, WHO/World Bank, 2019)[4]. According to Africa 2018 Global Nutrition Report malnutrition is unacceptably high in about 41 countries that struggle with three forms of malnutrition- childhood stunting, anaemia in women of reproductive age and overweight among women. Thirty of these countries (73%) are in Africa.

The health consequences of overweight and obesity contribute to an estimated four million deaths globally. Significant steps are adopted to address malnutrition globally. Stunting among children under five years has fallen from 32.6% in 2000 to 22.2% in 2017 (Nutrition initiatives, 2017)[5]. Yet, while stunting in children under five years of age is declining at a global level, the numbers in Africa are increasing. The number of stunted children has steadily increased from 50.6 million in 2000 to 38.7million in 2017. The economic impact of malnutrition (particularly stunting) cannot be under estimated, its costs several developing countries about 2-3% of the GDP each year, thus impeding economic growth (Nutrition initiatives, 2017)[5]. Most developing countries are faced with the double burden of persisting under nutrition as well as the growing epidemic of obesity, diabetes and non-communicable diseases, and Cameroon is no exception (Kanasop *et al*.,2011; Nolla *et al*., 2014)[6,7]. Cameroon has a diversity of food resources sufficient to feed its population but malnutrition still remains a public health problem affecting all age groups: infants, pre-school and school children, adolescents, pregnant and lactating mothers and the aged. Food is physically available in the rural and urban markets (Kanasop *et al*., 2011; Nolla *et al*., 2014)[6,7]; however, it has often been lacking in the qualitative and quantitative point of view in some communities resulting in the occurrence of malnutrition.

UNICEF/WHO/WB (2017)[4] report indicates that 35.4 percent of children in Cameroon are suffering from malnutrition resulting to serious growth stunting among them. It also stated that global acute malnutrition stands at 2.5%.Data from various surveys showed that Cameroon is experiencing a double burden; a rising prevalence of over nutrition, alongside a high incidence of under nutrition (Ponka, Fokou, Leke, Fotso, Souopgui, AchuandMbiapo, 2015)[21]. Approximately 45,000 children die each year in Cameroon due to malnutrition (UNICEF Cameroon, 2017). The Development initiatives report of the nutrition profile of Cameroon in line with UNICEF/WHO/WB (2017)[4] showed that in children below five, 33% are stunted, 15% are underweight, 6 % are affected by wasting and 7 % are overweight. With regards to the nutritional status of adolescents and adults the report indicated that amongst women of reproductive age 8% had thinness (wasting) and 1% had stunting (chronic malnutrition). The report also indicated that 42 % of females and 33 % of males were overweight (BMI ≥ 25); 15 % of females and 7 % of males had obesity (BMI ≥ 30). In relation to the micro nutrient status of the population the report stated that 42 % of women of reproductive age had anaemia and 39 % of pre-school children had vitamin A deficiency (VAD). It also indicated risk factors for metabolic diseases in Cameroon to be same in both sexes; 43 % of the population had raised blood pressures, 10 % had raised blood glucose levels, and 22 % had raised blood cholesterol. These diet-related diseases are on the rise in Cameroon (Nolla, Kana, Djeukeu, Tetanye and Gouado, 2013)[7]. According to Nutrition initiatives (2019) Cameroon adult population is also facing malnutrition burden. Forty –one percent (41.4%) of women of reproductive age have anaemia, and 6.9% of adult women have diabetes, compared to 6.5% of men. Meanwhile, 16.4% of women and 6.1% of men have obesity.

The Nutrition Improvement Program of the Cameroon Baptist Convention Health Board (CBCHB, 2017), for theNorth West Region reported that of all the clients received in their health sectors 25 % were obese/hypertensive, 30 % diabetic and 10 % of the under fives had chronic undernutrition (CBCHB, 2017). There is no clear data on over-nutrition in children (Nolla *et al*., 2014)[7]. Despite the abundance of various foodstuffs in the North-West region of Cameroon, under nutrition rates among children under 5 years and the other vulnerable groupsstill persist and are on the rise (Demographic and Health Survey - Multiple Indicator Cluster Survey, 2016).Information to link food consumption patterns and nutritional status is necessary in a population for healthier food choices. People are becoming more health conscious and are increasingly focusing on food safety as well as their eating habits and nutrient intake. Studies determining associations between food consumption patterns and health are limited, partly because of lack of knowledge of the dietary habits. Most researches on nutrition have focused mainly on epidemiologic surveys, showing the poor nutritional situation and food composition of some commonly consumed foods. Research work carried out by Djeukeu, Nolla, Kanasop, William, Tetanyeand Gouado (2013); Nolla *et al.* (2014), in some cities of Cameroon showed that the prevalence of malnutrition was high in population aged 15 to 65 years in these cities.

Literature review

Assessment of nutritional status

Progressive changes characterize a nutrient deficiency in the body, so there is no simple procedure for establishing nutritional status (Srilakshmi, 2016)[8]. Nutritional status can be assessed by direct and indirect methods. The direct methods deal with the individual and measure objective criteria. Anthropometric parameters, clinical assessments, dietary evaluation and biochemical analyses are considered direct methods (Shubhangini, 2012)[9]. Indirect methods use indices that reflect the community nutritional status. These include agricultural crop production, household income, per capita income, population density, food prices and availability, and socio-cultural factors. Others include morbidity and mortality rates, availability and utilization of health care services, provision of water, toilets and sanitary services.

Anthropometry

Anthropometric indicators assess the physical dimensions and the gross composition of the body. It measures many variables of nutritional significance. Anthropometric measurements body includes height, weight, skinfold thickness, head, arm, BMI, waist and chest circumferences. These indicators are used throughout the world as the basis for assessing growth and nutritional status of individuals (Srilakshmi, 2016)[8]. Anthropometric is most frequently used to assess nutritional status of individuals or population groups based on child growth and body weight changes in adults. Anthropometric measurements taken periodically and compared with perverse measurements reveal patterns and indicate trends in a person's overall nutritional status, but they provide little information about specific nutrients. Anthropometric values outside the reference ranges reveal abnormal nutritional status. This may be reflected in growth failure in children, swelling of body tissues in adults and obesity conditions (Whitney and Sharon, 2006)[10].

Weight-for-age, Height-for-age and Mid upper arm circumference (MUAC), Body Mass Index, Head circumference of under five children can be assessed by either lying (recumbent) for infants less than 24 months or by standing and compared with a reference population recommended by WHO/Multi-center Growth Reference Group (2006) and the indices expressed as standard deviation from the mean (Z-score) centile or percentages of the median. Depending on the sensitivity of the indicator one or more of them could be used for nutritional screening or surveillance to detect changes in nutritional status during crisis. The WHO/Multi-center Growth Reference Study Group (2006)[11] growth chart can reflect the physical health and nutritional status of infant and young children (IYC). Length/height can reflect prolonged under-nutrition in an infant (stunting or too short for age). The growth chart used in assessing nutritional status of infant and young children has a median weight for healthy infant which is at the 50thpercentile. Children whose weights are far above the 50th percentile curve are likely to be overweight. Children with weight far below the bottom line are not healthy and need urgent attention (WHO/Multi-center Growth Reference Study Group, 2006)[11]. Anthropometric indicators are used effectively to identify individuals at risk of under-nutrition or over-nutrition and the severity (mild, moderate, severe) within a population as well as identify vulnerable groups based on age and gender, region, rural/urban and other socio demographic characteristics of the population (Gibson, 1990)[12].

In screening for malnourished infants, the MUAC is preferred to weight-for-height because it is simple and easier to operate. MUAC often times has been used as a pre-screening tool while weight-for-height confirms diagnosis made (Laillou, Prakand de Groot, 2014; Mogendi, De SteurandGellynck, 2015)[13,14]. MUAC measurement requires using a tape with strips and a fixed cut off with weight -for-height the infants' height and weight must be measured and compared with a reference table (Goossens, Bekeleand Yun, 2012)[15]. In their study on MUAC versus weight-for-height performance, Dukhi, Sartorius and Taylor (2017)[16] reported that weight-for-height appeared to be more sensitive in measuring children below 12 months while MUAC was more sensitive in measuring children 3-5 years of age than weight-for-height indicating that careful monitoring is required when both weight-for-height and MUAC are used in detecting malnutrition rates.

Weight for age

Underweights, as the term implies represents depleted body fat and/or lean tissue stores. It is a major public health problem in developing countries and is a main contributor to the disease burden in low income countries (Ezzati, 2005). Malnutrition is the most common cause of underweight and is caused by the unavailability of adequate food over along period of time. Underweight causes growth failure and is linked to increased morbidity and mortality among children (Savy and Martin-Prevel, 2005)[17].

Height for age

This is an indicator for stunting which reflects linear growth retardation accumulated before and after birth. Stunting affects nearly one-third of children under 5 years of age Worldwide. Its prevalence is higher in low-resource countries in sub-Saharan Africa and South Asia (Bezerra and Sichieri, 2011)[18]. Irreversible growth failure may occur during infancy and early childhood, resulting in short stature. Stunting causes high rates of child mortality, increased susceptibility to infection and poor cognitive and psychomotor development. Deficits in school achievement, reduced work capacity and adverse pregnancy outcomes are some of the long-term consequences of stunting. The pathogenesis of stunting is very complex. However, chronic intake of a low-quality diet lacking in macro- and micronutrients, as well as to frequent infections may be contributory factors (Martorell, Khanand Schroeder, 1994). Height is influenced both by genetic and environmental factors. Environmental factors like nutrition and morbidity further determine the extent of expression of the genetic potentials. Height is affected only by long–term nutritional depreviation, and considered an index of chronic or long duration malnutrition (Srilakshmi, 2016).

Weight for height

Wasting indicates deficit in tissue and fat mass compared with amount expected in a child of the same height or length and may result also from failure to gain weight (Ekesa *et al.*, 2008)[19]. The body weight is a composite of all body constituents like water, minerals, fat, protein and bone. It is a better indicator of recent malnutrition. Serial measurements of weight as in growth monitoring are more sensitive indicators of changes in nutritionals status. This can also help to detect deviation from an established normal growth pattern. Rapid loss of body weight in children should be considered as an indicating malnutrtion (Srilakshmi, 2016).

Mid-upper arm circumference

Mid-Upper Arm Circumference (MUAC) is the circumference of the left upper arm, measured at the mid-point between the tip of the shoulder and the tip of the elbow (the acromium and olecranon process) using a measuring or MUAC tape. Arm muscle and sub-cutaneous fatare the main determinants of the MUAC (WHO, 2014). It is relatively independent of height, body-shape and even pregnancy. It is less affected than weight and height-based indices and by the localized accumulation of fluid common in famine (WHO, 2014). It is useful in identifying malnutrition and the mortality risk in children (Srilakshmi, 2016). In many studies, MUAC predicted death in children better than any other anthropometric indicator. MUAC is recommended for use in children between six and fifty-nine months of age, and for assessing acute energy deficiency in adults during famine (WHO, 2014).

The use of MUAC in adults may be affected by the redistribution of subcutaneous fat towards central areas of the body during ageing. In older children and adolescents, the rapidly changing patterns of skeletal muscle and subcutaneous fat are also likely to be a problem. Age specific MUAC cut-off points may be required for older children, adolescents, and the elderly (WHO, 2014).

Waist circumference

Waist circumference indicates the level of subcutaneous fat and hence estimates the amount of total fat of the body. It is positively correlated with abdominal fat and is an indicator for underweight, normal, overweight and android obesity. Two levels of risk have been identified with waist circumference (Nolla *et al*., 2014) [7]. Level one, is the maximum acceptable waist circumference irrespective of the adult age and requires no further weight gain. Level two, denotes obesity and requires weight management to reduce the risk of type 2 diabetes and CVS complications. Waist circumference predicts mortality better than any other anthropometric measurement (Nolla *et al*., 2014)[7].

The waist circumference (WC) expresses strong correlation with visceral fat (VAT) and subcutaneous fat (SAT) (Spolidoro *et al.*, 2012)[9]. Body fat located at the abdominal region is associated with greater health risk than the peripheral fat. It is recognized that, VAT more than SAT, exerts a greater influence on the hepatic release of free fatty acids. This has a greater effect in increasing cholesterol, triglycerides, and blood glucose, all of which increase the risk of high blood pressure, type 2 diabetes, dyslipidaemia, heart disease and stroke (Després and Lemieux, 2006)[22]. There is a relationship between the WC and abdominal fat distribution. An excess body fat especially abdominal fat is directly related to changes in lipids profile (Spolidoro *et al.*, 2012) [9].

Most definitions for the metabolic syndrome recommend higher waist circumference (wc) for the males. This gender pattern may be accounted for by the fact that men tend to deposit fat in the abdomen (upper body or android obesity) while women deposit fat more on the hips. These patterns of body fat deposition are thought to be influenced by sex hormones which not only influence the pattern of body fat distribution, but also the burden of obesity in women (Clement, Netto, Carvalho-Ferreira, Campos, Piano and Tock, 2016). Hormonal changes are responsible for the appearance of secondary elements and physical changes that takes place in puberty. Therefore, the degree of physical development of adolescents cannot be solely determined by chronological age, since it is influenced by other environmental and intrinsic factors. Adolescents can be considered a critical time for the onset of obesity. Studies have shown that adolescents have inadequate food preferences with high consumption of processed and ultra-processed foods, which may favour diseases such as obesity, diabetes, hypertension and metabolic syndrome. Obesity is explained as an inflammatory disease of multifactorial etiology resulting from imbalance of energy and promoting accumulation of adipose tissue. WC can be considered an efficient indicator of abdominal obesity and consequently of cardiovascular risk among children and adolescent. Fat accumulation in the abdominal region implies increase in inflammatory adiopokines, which in turn intensifies the risk of insulin resistance and the frequency of cardiovascular disease. Increase in children and adolescent's waist circumference in some studies showed a good correlation with dyslipidemia, hypertension, insulin resistance and metabolic syndrome. A longitudinal study reported an increase in body percentage of post-pubertal girls with strong correlation between the weight gain and waist circumference at the age of menarche (Clement, Netto, Carvalho-Ferreira, Campos, Piano and Tock, 2016)[20].

MATERIALS AND METHOD

A portable Salter scale (Mode 180-England), Stadiometer, and flexible non- elastic tape were used in the collection of anthropometric measurements,.The study was carried out using a cross-sectional descriptive research design. The population of study comprises of households from the North West region. having subjects between the age ranges of 6 months to 60 years. Twenty –two rural and 106 urban households were randomly selected for anthropometric studies... Measurements of the weight, height, mid upper arm and waist circumferences were carried out on subjects from 106 households in the urban and 22 households in the rural areas. Measurements of 600 subjects comprising infants, children and adolescents, women of reproductive age and adult women and men randomly selected from both milieus were taken. Two readings were taken in each case and the average calculated (WHO, 2006). The measurements were recorded on a separate form attached to the questionnaire.

The consent of participants was freely obtained by asking them to read and sign an informed consent form which contained adequate information like the title, objective of the study, methods used, and participants' role in the study and expected benefits of the study. The forms were signed by mothers of the households with the consent of their husbands. The reason being that the mothers were available at almost all times. Those who could not read and write were assisted by the research assistants. The information obtained was strictly confidential as code numbers instead of names were used in the study.

Descriptive statistics (frequencies and percentage), standard deviation (SD), student t-test, one-way analysis of variance using statistical package for social sciences version 20.0

Data analysis

Anthropometric indices of respondents in North-West region

Age and gender of respondents used for anthropometry are presented in Table 1. A total of six hundred (600) male and female respondents from the 128 households in urban and rural communities were measured. More than half (59.00 %) were from urban household while (41.00%) were from rural households. Males and females from urban households were 6.66% and 32.33% while females were 18.00% and 23.00% respectively. The age range of the respondents was 6 months to 60 years. Some were within 6-23 months, 24-59 months, 6-9 years, 10-19 years and 20-60 years. Table 1 shows the prevalence of malnutrition within age groups in North-West Region of Cameroon. Significant ($p<0.05$) differences were observed between different age groups. Underweight across different age groups ranged from 22.94% - 36.9.00% being highest among pre-school children 24-59 months old. Underweight among school age children 6-9 years old was significantly lower than ages 6-23 and 24-53 months old. Stunting ranged from 28.00% - 46.46% being the highest among infants and young children 6-23 months old and significantly ($p<0.05$) higher than the pre-school, school age children and adolescents. Wasting across different age groups ranged from 16.51% - 36.00% being highest among pre-school children 24-59 months and significantly ($p<0.05$) higher than other age groups. Overweight ranged from 2.79% - 11.11% being highest among infants and young children 6-23 months old. Overweight was significantly ($p<0.05$) among adolescents 10-19 years while obesity among infants (5.05%) 6-23 months and school age children (7.33 %) 6-9 years old was similar. Mild-moderate and severe malnutrition were found in infants and young children 6-23 months and pre-school children 24-59 months old. Mild-moderate malnutrition was similar among the different age groups while severe malnutrition was significantly ($p<0.05$) higher among children 24-59 months old than infants and young children. Furthermore, waist circumference leading to increased risk of metabolic complication across adolescents (30.76%) 15-19 years and adults (25.13%) 20 years and above was similar while waist circumference leading to substantially increased risk of metabolic complication was significantly ($p<0.05$) higher in adults 20 years and above than adolescents.

Anthropometric indices of urban and rural respondents in North-West Region

Tables 2 and 3 present anthropometric indices of urban and rural respondents. From table 24, underweight across different categories of children in urban and rural households ranged from 18.00% - 60.00% being highest among urban children 6-9 years old. Underweight was significantly ($0<0.05$) higher among urban children (22.20%) 6-23 months and children (60.00%) 6-9 years old than their rural counterparts. Stunting ranged from 9.17% - 31.30 % across the different age groups being highest among urban infants and young children 6-23 months old. Significant differences were observed between urban and rural children. Urban children (31.30 %) 6-23 months and children (19.13 %) 6- 9 years old had significantly ($p<0.05$) high stunting rate compared to rural children. Wasting ranged from 3.66% - 22.00% being highest among urban pre-school children 24-59 months old. Urban children (22.00%) 24-59 months and children (12.80%) 6-9 years old had significantly ($p<0.05$) higher wasting than rural children of similar age group. Overweight ranged from 2.75% - 8.08% being highest in urban children 6-23 months old and obesity 1.01% -5.50% being highest in rural children 6-9 years old.

No significant (p>0.05) differences were found in the overweight and obesity rate between urban and rural respondents. Similarly, significant differences were not found in the prevalence of malnutrition between urban and rural children 6-59 months (Table 4). Mild to moderate and severe malnutrition appears to decrease with increase in age, 4.04% - 9.09% among children 6-23 months and 2.00% - 6.00% among children 24-59 months in urban and rural respondents respectively. Waist circumference leading to increased risk of metabolic complication across the different age groups ranged from 10.50% - 17.30% being highest among urban adolescents 15-19 years while substantially increased risk of metabolic complication ranged from 3.84% - 19.90% being highest among urban adults 20 years and above. No significant (p>0.05) differences were found between urban and rural respondents.

Table 1: Gender and age of respondents in urban and rural households

Variable/Age	Frequency (%)	Frequency (%)	Total
	Urban	Rural	
6-23 months	67(18.92%)	32(13.00%)	99
24-59 months	60(16.94%)	40(16.26%)	100
6-9 years	73(20.62%)	36(14.63%)	109
10-19 years	53(14.91%)	48(19.51%)	101
20-60 years	101(28.53%)	90(36.58%)	191
Total	354(100%)	246(100%)	600
Gender			
Male	160(26.66%)	108(18.00%)	268
Female	194(32.33%)	138(23.00%)	332
Total	354(58.99%)	246(41.00%)	600

Table 2: Anthropometric indices of respondents in North West region

Indices/Age	6-23mth	24-59mth	6-9yrs	10-19yrs	15-19yrs	>19 yrs
underweight	36(36.66%)	39(39.00%	25(22.94%)*	-	-	-
Normal	63(63.63%)	61(61.00%)	84(77/06%)	-	-	-
Total	99	100	109	-	-	-
	$X^2 = 2.113$	*Df=3*	*P=0.023*			
Stunting	46(46.46%)*	28(28.00%)	31(28.44%)	34(33.66%)	-	-
Normal	53(53.53%)	72(72.00%)	78(71.55%)	67(66.33%)	-	-
Total	99	100	109	101	-	-
	$X^2 = 0.236$	*Df=4*	*P=0.040*			
Wasting	20(20.20%)	36(36.00%)*	18(16.51%)	17(16.83%)	-	-
Normal	63(63.63%)	57(57.00%)	76(69.72%)	81(80.19%)	-	-
Overweight	11(11.11%)*	7(7.00%)	7(6.42%)	3(2.97%)*		
Obesity	5(5.05%)	-	8(7.33%)	-		
Total	99	100	109	101		
	$X^2 = 0.542$	*Df=3*	*P=0.041*			
MUAC						
MAM	15(15.15%)	9(9.00%)	-	-	-	-
SAM	13(13.13%)*	4(4.00%)	-	--	-	-
Normal	71(71.71%)	87(87.00%)				
Total	99	100				
WC						
	$X^2 = 3.32$	*Df=4*	*P=0.013*			
IRMC	-	-	-	-	16(30.76%)	48(25.13%)

SIRMC	-	-	-	-	5(9.61%)	68(35.60%)*
Normal	-	-	-	-	31(59.61%)	75(39.26%)
Total	-	-	-	-	52	191
	$X^2 = 1.004$	*Df=4*	*P=0.03*			

MUAC= mid upper arm circumference, WC= waist circumference, MAM= mild-moderate malnutrition, SAM= severe malnutrition, IRMC= increased risk of metabolic complications, SIRMC= substantially increased risk of metabolic complications.

Table 3: Anthropometric indices of urban and rural households in North-west region

Variable/ Age	Under Weight	Normal	Stunting	Normal	Wasting	Over weight	Obesity	Normal
6-23mth								
Urban	22(22.2%)*	45(45.4%)	31(31.3%)*	36(36.4%)	11(11.1%)	8(8.08%)	4(4.04%)	44(44.4%)
Rural	14(14.5%)	18(18.2%)	15(15.2%)	17(17.2%)	9(9.09%)	3(3.03%)	1(1.01%)	19(19.2%)
Total	36	63	46	53	20	11	5	63
		$X^2 = 2.242$	*Df=3*	*P= 0.021*				
24-59th								
Urban	21(21.0%)	39(39.0%)	15(15.0%)	45(45.0%)	22(22.0%)*	4(4.00%)	-	34(34.0%)
Rural	18(18.0%)	22(22.0%)	13(13.0%)	27(27.0%)	14(14.0%)	3(3.00%)	-	23(23.0%)
Total	39	61	28	72	36	7	-	57
		$X^2 = 1.142$	*Df=3*	*P= 0.032*				
6-9yrs								
Urban	15(60.0%)*	58(52.2%)	21(19.3%)*	52(47.7%)	14(12.8%)*	4(3.66%)	2(1.83%)	23(21.1%)
Rural	10(40.0%)	26(23.9%)	10(9.17%)	26(23.9%)	4(3.66%)	3(2.75%)	6(5.50%)	53(48.6%)
Total	25	84	31	78	18	7	8	76
		$X^2 = 0.545$	*Df=4*	*P= 0.041*				
10-19yrs								
Urban	-	-	16(15.8%)	37(36.4%)	9(8.91%)	-	-	44(43.6%)
Rural	-	-	18(17.8%)	30(29.7%)	8(7.92%)	3(2.97%)	-	37(36.4%)
Total	-	-	34	67	17	3	-	81
		$X^2 = 5.212$	*Df=4*	*P= 1.033*				

Table 4: Mid upper arm and waist circumference of urban and rural household in North-West region

Variable/Age	MUAC	MAM	SAM	Normal	WC	IRMC	SIRMC	Normal
6-23mth								
Urban		9(9.09%)	9(9.09%)	49(49.5%)		-	-	-
Rural		6(6.06%)	4(4.04%)	22(22.2%)		-	-	-
Total		15	13	71		-	-	-
		$X^2 = 1.12$	*Df=4*	*P= 1.033*				
24-59th								
Urban		6(6.00%)	2(2.00%)	52(52.0%)		-	-	-
Rural		3(3.00%)	2(2.00%)	35(32.0%)		-	-	-
Total		9	4	87		-	-	-
		$X^2 = 5.11$	*Df=4*	*P= 0.412*				
15-19yrs								
Urban		-	-	-		9(17.3%)	3(5.76%)	16(30.8%)
Rural		-	-	-		7(13.5%)	2(3.84%)	15(28.8%)
Total		-	-	-		16	8	31
		$X^2=6.31$	*Df=4*	*P=0.417*				
20-60yrs								
Urban		-	-	-		28(14.7%)	38(19.9%)	35(18.3%)

Rural	-	-	-	20(10.5%)	30(15.7%)	40(20.9%)
Total	-	-	-	48	68	75
	$X^2 = 2.43$	*Df=3*	*P= 0.213*			

MUAC= mid upper arm circumference, WC= waist circumference, MAM= mild-moderate malnutrition, SAM= severe malnutrition, IRMC= increased risk of metabolic complications, SIRMC= substantially increased risk of metabolic complications,

Anthropometric indices of urban and rural respondents by age and gender

From table 5, the rate of underweight ranged from 0% - 38.90 % for different categories of children 6 months to 9 years old. Moderate underweight ranged from 10.81% - 38.90% while severe underweight ranged from 0% - 25.00% among children 6 months to 9 years old. No significant difference (p>0.05) was found in the underweight rate between urban and rural females, while significant (p<0.05) differences were observed between rural and urban males 6-23months and 24-59 months. Moderate underweight was significantly higher among rural male (38.90%) 6-23 months than their urban (20.00%) counterpart. Similarly, severe underweight was higher among rural males (25.00%) 24-59 months old compared to urban (14.28%) males. Moderate to severe underweight was higher among males than females in the age group 6-23 months and 24-59 months while among 6-9 years old, moderate to severe underweight was higher among females.

Table 6 shows the prevalence of moderate and severe stunting in the different age groups. Moderate stunting among females ranged from 22.00 % - 49.00%, being the highest among rural females 10-19years old and significantly (p<0.05) different from their rural (29.40%) counterparts. Significant differences were observed between rural and urban male infants and young children 6 - 23 month with severe stunting significantly (p<0.05) higher among urban male children (26.66%) 6-23 months than their rural counterparts (16.66%). Furthermore, across all age groups moderate stunting was high among rural female children (30.00% - 41.90 %) while severe stunting was much higher among children 6-23 months irrespective of gender (13.51% - 26.66%) compared to other age groups (0-11.11%).

From Table 7, severe wasting across all age group ranges from (0- 21.42%) with rural female children 6-23 months having the highest rate of severe wasting. Moderate wasting range from 5.26% and 5.70% in urban males 10 – 19 years and 6 – 9 years, respectively to 10.00% - 28.12% among the other age groups irrespective of gender. Severe wasting appeared to decrease with increase in age among children (5.40% - 11.11%) 6-19 years and among children (5.55 % - 21.42 %) 6-59 months. On the contrary, moderate wasting (10.00 % -28.12 %) was higher among children 6-59 month compared to the 5.70% - 17.60% for children 6-19years. Overweight ranged from 4.16% - 14-28% across infants and pre-school children 6-59 months old and appears to increase with age among this age group in the urban. Male children 24-59 months in the urban had the highest overweight rate (14.28%) than their rural counterparts. On the contrary, overweight decreases with age in older children 6-19 years old. Overweight among school age children 6-9 years and adolescents 10-19 years irrespective of gender and location ranged from 2.70 % - 12.50 % being highest among rural males 6-9 years. Obesity among infants and young children ranged from 3.33 % - 8.10% being the highest among urban female 6-23months old. Significant ($p<0.05$) difference was observed between rural (5.55%) and urban females (15.00%) 6-9 years. There was more obesity among rural males (18.75%) 6-9 years old than the other age groups.

Table 5: Weight for age indices of rural and urban respondents by age and gender

Gender/Age	Number of Subjects		Severe underweight	Moderate underweight	Normal
6-23mnth					
Male	Rural	18	2(11.11%)	7(38.88%)*	9(50.00%)
	Urban	30	4(13.30%)	6(20.00%)	20(66.66%)
Total		48	6	13	29
			Chi =5.960	*Df = 3;*	*P =0.030*
Female	Rural	14	0(0.00%)	5(35.71%)	9(64.28%)
	Urban	37	2(5.41%)	10(27.02%)	25(67.56%)
Total		51	2	15	34
			Chi =4.308;	*Df =3;*	*P =0.30*
24-59mth					
Male	Rural	16	4(25.00%)*	5(31.30%)*	7(42.80%)
	Urban	28	4(14.30%)	6(21.42%)	18(64.30%)
Total		44	8	11	25
			Chi =2.144	*Df = 3;*	*P =0.04*
Female	Rural	24	3(12.50%)	6(25.00%)	15(62.50%)
	Urban	32	2(6.25%)	9(28.12%)	21(65.60%)
Total		56	5	15	36
			Chi =2.674;	*Df =3;*	*P =0.544*
6-9yrs					
Male	Rural	16	0(0.00%)	3(18.75%)	13(81.65%)
	Urban	37	0(0.00%)	4(10.81%)	33(89.18%)
Total		53	0	7	46
			Chi =0.591	*Df =2;*	*P = 0.46*
Female	Rural	20	2(10.00%)	5(25.00%)	13(65.00%)
	Urban	36	2(5.55%)	9(25.00%)	25(69.44%)
Total		56	4	14	38
			Chi =2.674;	*Df =3*	*P=0.43*

Cut-offs = Severe underweight = < −3SD, Moderate underweight = ≥ −3SD to < −2SD, Normal = ≥ −2SD to ≤ 1SD, Overweight = >1SD to 2SD, obese = > 2SD (WHO, 2007). * =Significant at $p<0.05$

Table 6: Height for age (stunting) of rural and urban respondents by age and gender

Gender/Age	Subjects	Severe stunting	Moderate stunting	Normal
6-23mnth				
Male	Rural- 18	3(16.66%)	5(27.77%)	10(55.55%)
	Urban-30	8(26.66%)*	7(23.33%)	15(50.00%)
Total	48	11	12	25
		Chi =4.640	*Df =3;*	*P=0.04*
Female	Rural 14	2(14.28%)	5(35.71%)	7(50.00%)
	Urban 37	5(13.51%)	11(29.72%)	21(56.75%)
Total	51	7	16	28
		Chi =10.323	*Df =4;*	*P =0.56*
24-59mth				
Male	Rural 16	0(0.00%)	4(25.00%)	12(75.00%)
	Urban 28	0(0.00%)	7(25.00%)	21(75.00%)
Total	44	0	11	33
		Chi =4.400	*Df =4;*	*P =0.301*
Female	Rural 24	0(0.00%)	9(37.50%)	15(62.50%)
	Urban 32	0(0.00%)	8(25.00%)	24(75.00%)
Total	56	0	17	39
		Chi =10.936	*Df =3;*	*P =0.15*
6-9yrs				
Male	Rural 16	0(0.00%)	4(25.00%)	12(75.00%)
	Urban 37	3(8.10%)	6(16.21%)	28(75.67%)
Total	53	3	10	40
		Chi =3.872	*Df =3;*	*P =0.276*
Female	Rural 20	0(0.00%)	6(30.00%)	14(70.00%)
	Urban 36	4(11.11%)	8(22.22%)	24(66.66%)
Total	56	4	14	38
		Chi =4.192	*Df = 4;*	*P =0.334*
10-19 years				
Male	Rural 17	0(0.00%)	4(23.5%)	13(76.47%)
	Urban 19	(0.00%)	5(26.31%)	14(73.68%)
Total	36	0	9	27
		Chi =6.180	*Df =3*	*P =0.30*
Female	Rural 31	1(3.2%)	13(41.90%)*	17(54.80%)
	Urban 34	1(2.90%)	10(29.40%)	23(67.70%)
Total	65	2	23	40
		Chi =4.675	*Df =3*	*P =0.023*

Cut-offs = Severe stunting = < −3SD, Moderate stunting = ≥ −3SD to < −2SD, Normal =≥ −2SD to ≤ 1SD, (WHO, 2007). *= Significant at p<0.05

Table 7: Weight for height indices of rural and urban by age and gender

Gender/Age	Subjects	Severe wasting	Mod. Wasting	Normal	Overweight	Obese
6-23mnth						
Male	Rural 18	1(5.55%)	5(27.77%)	10(55.55%)	2(11.11%)	-
	Urban 30	3(10.00%)	3(10.0%)*	20(66.66%	3(10.00%)	1(3.33%)
Total	48	4	8	30	5	1
			Chi =	*2.783;df=*	*3; p=0.02*	
Female	Rural 14	3(21.42%)	-	9(64.28%)	1(7.14%)	1(7.14%)
	Urban 37	5(13.51%)	-	24(64.86%)	5(13.51%)	3(8.10%)
Total	51	8	-	35	6	4
			Chi =	*3.288; df=*	*4; p=0.65*	

24-59mth							
Male	Rural	16	2(12.5%)	3(18.75%)	9(56.25%)	2(12.50%)	-
	Urban	28	4(14.28%)	6(21.42%)	14(50.00%)	4(14.28%)	-
Total		44	6	9	23	6	
				Chi =	*13.281; df*	*=4; p =*	*0.40*
Female	Rural	24	4(16.66%)	5(20.83%)	14(58.33%)	1(4.16%)	-
	Urban	32	3(9.37%)	9(28.12%)	20(62.5%)	-	-
Total		56	7	14	34	1	-
				Chi =	*8.866; df=*	*5; p =*	*0.115*
6-9yrs							
Male	Rural	16	1(6.25%)	-	10(62.50%)	2(12.50%)	3(18.75%)
	Urban	37	2(5.40%)	2(5.70%)	32(86.40%)	1(2.70%)	-
Total		53	3	2	42	3	3
				Chi =	*4.284; df=*	*5; p =*	*0.509*
Female	Rural	20	-	3(15.00%)	13(65.00%)	1(5.00%)	3(15.00%)
	Urban	36	4(11.11%)	6(16.66%)	21(58.33%)	3(8.33%)	2(5.55%)*
Total		56	4	9	33	4	5
				Chi =	*5.526; df =*	*5; p =*	*0.355*
10-19yrs							
Male	Rural	17	1(5.88%)	3(17.6%)*	12(70.58%)	1(5.88%)	-
	Urban	19	-	1(5.26%)	18(94.73%)	-	-
Total		36	1	4	30	1	
				Chi =	*4.290; df =*	*4; p =*	*0.038*
Female	Rural	31	-	4(12.90%)	25(80.64%)	2(6.45%)	-
	Urban	34	2(5.88%)	6(17.64%)	26(76.47%)	-	-
Total		65	2	10	51	2	-
				Chi =	*5.395; df =*	*3; p =*	*0.145*

Cut-offs for IYC 0-59 months = Severe wasting = < −3SD =, Moderate wasting = ≥ −3SD to < −2SD, Normal = ≥ −2SD to ≤ 1SD, Overweight = > 2SD, Obese = > 3SD = (WHO, 2007). Cut-offs for ages 6-19years using BMI for age; Severe wasting = −3SD, Moderate wasting = −2SD, Normal = - 1 SD to 1SD, Overweight= 2SD, Obese = 3SD. * Significant at p<0.05

Mid upper arm and waist circumference of urban and rural respondents by age and gender

Tables 8 and 9 present mid upper arm circumference (MUAC) and waist circumference (WC) of respondents. Using MUAC, the rate of mild-moderate and severe malnutrition in infants and young children 6-59 months ranged from 4.16% - 21.40% being highest among rural females 6-23 months old and significantly (p<0.05) different with their urban counterparts (8.10%). Mild-moderate and severe malnutrition appeared to be high in urban males 6-23 months compared to their rural counterparts and rural females compared to their urban counterparts while mild-moderate malnutrition was high in urban males (14.28%) and females (6.25%) 24-59 months old compared to their rural counterparts (12.50%; 4.16%) respectively. Severe malnutrition was observed among females (6.25% - 8.33%) 24-59 months old. The rate of increased risk of metabolic complications and substantially increased risk of metabolic complication ranged from 8.33% -56.46% for adolescents and adults 15-60 years old as seen in Table 30. No significant (p>0.05) differences were found in waist circumference between urban and rural males and females while significant (p<0.05) difference was found between rural and urban males 20 years and above. Waist circumference leading to increased risk of metabolic complication appears to be high in male and female (25.00% - 33.33%) adolescents 15-19 years old compared to adults (21.95% - 30.00%) 20 years and above. On the contrary, substantially increased risk of metabolic complication was high in adults (12.19% - 56.40%) 20 years and above compared to adolescents (8.33% - 11.11%) 15-19years old. Furthermore, across all age groups, waist circumference leading to substantially increased risk of metabolic complication was high among rural and urban females (51.02% - 56.40 %) 20 years and above.

Table 8: Mid upper arm circumference (MUAC) of respondents by age and gender

Gender/Age	Number of subjects		Severe malnutrition	Mild-moderate malnutrition	Normal
6-23months					
Male	Rural	18	2(11.11%)	3(16.66%)	13(72.22%)
	Urban	30	4(13.30%)	6(20.00%)	20(66.70%)
Total		48	6	9	33
Total	*Chi cal =*		*11.693; df*	*= 3; p =*	*1.05*
Female	Rural	14	2(14.30%)	3(21.40%)*	9(64.30%)
	Urban	37	5(13.50%)	3(8.10%)	29(78.40%)
Total		51	7	6	38
	Chi cal =		*10.936; df*	*= 3; p <*	*0. 0 5*
24-59months					
Male	Rural	16	-	2(12.50%)	14(87.50%)
	Urban	28	-	4(14.28%)	24(85.71%)
Total		44	-	6	38
	Chi cal =		*9.946; df*	*= 3; p =*	*0.21*
Female	Rural	24	2(8.33%)	1(4.16%)	21(87.50%)
	Urban	32	2(6.25%)	2(6.25%)	28(87.50%)
Total		56	4	3	49
	Chi cal =		*9.946; df*	*= 3; p =*	*1.05*

The measurements for mid upper arm circumference were interpreted as follows :<11.0 cm (Red) = Severe malnutrition; 11.0 cm – 12.5 cm, Mild-moderate moderate malnutrition; 12.5 cm – 13.5 cm, Normal ≥13.5.0 cm (WHO, 2006). *= Significant at p<0.05

Table 9: Waist circumference (WC) of urban and rural respondents by age and gender

Gender/age	No of subjects		Normal	IRMC	SIRMC
15-19years					
Male	Rural	12	7(58.33%)	4(33.33%)	1(8.33%)
	Urban	10	6(60.00%)	3(30.00%)	1(10.00%)
Total		22	13	7	2
	Chi cal =		*8.436; df*	*= 2; p =*	*0.46*
Female	Rural	12	8(66.67%)	3(25.00%)	1(8.33%)
	Urban	18	10(55.56%)	6(33.33%)	2(11.11%)
Total		30	18	9	3

	Chi cal =		*9.943; df*	*= 3; p =*	*0.55*
20 and above					
Male	Rural	41	27 (65.85 %)	9(21.95 %)	5(12.19%)
	Urban	46	24 (56.00%)	15(30.00%)*	7(14.00%)
Total		87	51	22	12
	Chi cal =		*4.436; df*	*= 3; p =*	*0.030*
Female	Rural	49	13 (26.53%)	11(22.40 %)	25(51.02 %)
	Urban	55	11 (20.00%)	13(23.6 0%)	31(56.40 %)
Total		104	24	24	56
	Chi cal =		*11.443; df*	*= 2; p =*	*0.10*

Cut-offs for adults: Men >94cm and Women > 80cm for IRMC= Increased risk of metabolic complication. Men 102 cm and Women 88cm for SIRMC= substantially increased risk of metabolic complication. Cut-offs for adolescents: Normal (Male>84cm, Female >83cm); IRMC (Male ≥84cm Female ≥83cm); SIRMC (Male ≥96cm, Female ≥95cm)

Source: WHO (2006; Okafor et al (2016)

DISCUSSION OF FINDINGS

The values for underweight in urban and rural respondents 6 – 59 months and female 6-9 year was higher than the national values of 11.00% for children under five years of age (UNICEF,WB,WHO, joint child malnutrition estimates, 2018). Underweight reflects depleted body fat, usually the result of inadequate food intake over a long period of time. It is an indication of under nutrition that incorporates elements of Stunting, small stature and wasting (Black, 2008; Ezzati*et al*., 2008). Stunting among IYC 6-23 months was above the WHO critical value (≥40 %). Generally, the prevalence of stunting in IYC 6-23 months and stunted children in 24 -59 months, 6-9 years and 10 - 19 years were above the global prevalence of 22.2 % (Nutrition Initiatives, 2018). Stunting reflects the failure to grow in stature and often times is a result of insufficient nutrient intake over time or chronic illness. It is linear growth retardation and cumulative growth deficits in children, indicating chronic malnutrition. For this reason stunting, especially stunting of children under five years of age is a stronger indicator of hunger and endemic poverty than underweight (UNDP, 2012; Popoola *et al*., 2016). The high prevalence of stunting and underweight in IYC 6-23months old in urban and rural households could be attributed to inappropriate infant feeding practices. In older children, it is as a result of the prolonged nutrient deficit affected by recurrent and chronic illnesses during infancy which increases with age (FMOH, 2010; UNICEF/WHO/WBG, 2017).

Stunting is usually caused by past history of malnutrition. It usually results from prolonged inadequate intake of food as well as diseases making infants to have low height for their age. During the periods of growth (childhood and adolescence), inadequate food intake and/or debilitating diseases such as chronic parasitic infestations may seriously affect lying down of tissues which may result in stunted growth. Chronic malnutrition observed in this study among IYC 6-23 months and older children especially in rural females, is of public health importance and must be given immediate attention. Wasting in IYC 6-59 months especially in rural females was almost 30.00% although it was as higher than 5.00 % in other age groups.

Using MUAC, mild-moderate and severe malnutrition were observed in about 20.00 % of IYC 6-59 months of age. Mild-moderate malnutrition was significantly ($p<0.05$) higher in females 6-23months of age in rural compared to urban households. This finding is similar to previous reports that malnutrition rates of under-five children are higher in the rural (38.1 %) areas than in the urban (20.5 %) areas (WFP and FAO, (2011). The number of children affected by retarded growth was more in rural areas. Increased malnutrition rate in rural areas in this study could be attributed to mothers not giving adequate care to their young due to their engagement in activities outside the home. The occupation of household heads and mothers appears to be the major factor influencing the level of wasting in most studies. Cameroon municipalities of Douala and Yaoundé recorded 4.1% retarded growth. Children of mothers who leave home to farm or undertake other economic activities are often left in the care of older siblings, neighbours or relatives who often do not provide optimal childcare. These children are more likely to be wasted than children whose mothers spend time with them. Care has become increasingly recognized as an important determinant of child nutritional status (Adeladza, 2009).Also, it was observed that preference was given to fathers in terms of portion sizes and choice foods like flesh foods especially during food shortage as is the case now in Cameroon. This could be the reason for the high prevalence of underweight and wasting observed in children and adolescents especially in rural households. Children often become very active as they grow and this sometimes results in the burning down of some carbohydrates. Adequate nutrient intake is therefore important in ensuring child health and normal growth. Carbohydrate availability was uniformly high in both communities but the percentage coverage of protein was lower in the rural communities. The prevalence of overweight and obesity were up to 14.28% and 18.75% respectively in males and females 6-59 months, 6-9 years and 10-19 years in both communities. For adults 20 years and above, overweight and obesity were as high as 47.82% and 29.10% respectively although overweight was high in males and obesity in female. Adult males and females in urban households had significantly ($p<0.05$) higher values for obesity and overweight compared to rural households

CONCLUSION

The study was conducted to determine the nutritional status of urban and rural households in the North West region of Cameroon using anthropometric measurements. . Anthropometric indices were taken and acceptable cut-off values were used to determine nutritional status. Both over nutrition (obesity and overweight) and under-nutrition problems are present in the communities . Wasting was the most prevalent form of malnutrition observed amongst infants and young children 6-23 months while overweight and obesity were most prevalent in children (10-19 years) and in adults 20 years and above. The following recommendations may help food policy makers to determine the areas of priority: To parents of the households Men, as well as women, should be educated on the perculiar nutritional needs of the family members . The women should be taught the foods needed for good health, and nutritional values of various locally-produced foods. They need to attend and participate in nutrition seminars and other nutrition education programs put at their locality by either the government or NGOs.

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