



## **Assessment of Feeding Habits and Nutritional Status of Infants Admitted in Kumba Hospitals (South-West Region, Cameroon)**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. Authors GKK and WB designed the study, performed the statistical analysis and wrote the first draft of the manuscript. Authors JEK and GNA managed the data generation of the study. All authors read and approved the final manuscript.*

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### **ABSTRACT**

**Aims:** Malnutrition remains an issue of public health concern in Cameroon. Optimal infant feeding habits and maternal risk factors influence the prevalence of malnutrition. This work aimed to evaluate the influence of feeding habits and risk factors on the nutritional status of infants in Kumba hospitals.

**Study design:** A descriptive cross-sectional study was carried out for a period of 3 months at the

Maternal and Child Protection (PMI) and Kumba District hospitals.

**Methodology:** The age of the children were recorded from their immunization cards. The measurements of length and weight of children were recorded. Questionnaires were administered through simple random sampling to care givers of 227 infants at the welfare clinics from which information on feeding habits, anthropometric parameters and socio-demographic status was obtained. The Z-score classifications for malnutrition was used to estimate the deterioration in weight and height of children in reference to the children of same age and sex.

**Results:** There was a low prevalence (14%) of exclusive breast feeding. A high prevalence of early initiation of breast feeding within the first hour of birth at 85% was observed. Early introduction to energy dense complementary food at 67.2% was observed in infants between 0-5 months accounting for the high prevalence of overweight, and possible risk obesity. Furthermore, it was found that 17% of children were stunted, 14.60% were wasted, and 11.70% were underweight. Among them, stunting was highest in children 0-3 months who were on breast milk. Moreover, a significant relationship was observed between marital status and stunting ( $P<0.05$ ), and underweight and unemployment ( $P<0.05$ ).

**Conclusion:** This study revealed that exclusive breast feeding from 0 to 6 months was poorly practiced. Thus leading to a high prevalence of wasting, overweight and obesity among admitted children in Kumba hospitals. This was also found to be linked to malnutrition, marital and professional status.

*Keywords: Infants; feeding habit; breast feeding pattern; stunting prevalence; nutritional status.*

## 1. INTRODUCTION

Under-five child malnutrition is normally determined by a large number of factors such as birth interval, size at birth, mother's body mass index at birth and parent's education to the extent that it sometimes becomes difficult to predict the risk factors in developing countries and particularly in Sub-Saharan Africa [1,2,3]. Such factors act through a number of interrelated proximate determinants to bring about under-five malnutrition that is stunting, underweight and wasting. The demographic (child factors) and socio-economic factors (maternal factors) such as; age of child, birth order, mothers age at birth, mothers education, marital status as well as maternal occupation work through proximate/variables like the duration of breast feeding, sanitation and mothers health seeking behaviors to determine under-five malnutrition (UNICEF, 2019) [4]. A good nutrition, in addition to ensuring health promotion and disease prevention improves performance and productivity and it is an antidote against nutritional related health problems such as eating disorders, obesity, high blood pressure, and cancer [5]. The practice of good eating habit among health person could go a long way in making them effective advocates of healthy eating.

Malnutrition remains a serious public health problem in Cameroon. It is a major contributor to the disease and death burden of the population. The overall under- five mortality rate in

Cameroon is 74.8 deaths per 1,000 live births, which is higher in the northern regions where a total of 105,000 child deaths occur each year [6]. The cause of this child mortality has been attributed largely to under nutrition. Chronic under-nutrition (stunting) which is characterized by a deficit of height for age among under-five is widespread and severe. The World Bank report in 2009, reported even though Cameroon income is 50% higher than that of Kenya, they have the same stunting percentage (36%). As a result, the World Bank concluded that food access is not the only major cause of malnutrition but poor caring practices and diseases. Although there is a gradual overall reduction in the prevalence of childhood malnutrition in some Regions of Cameroon, it is important to note that the prevalence is also disproportionate according to region and socio-economic status. The Eastern and Northern Regions of the country still have a higher prevalence of childhood malnutrition in general; according to 2014 nationwide survey which indicated that the Far North, North and Adamawa have a global acute malnutrition prevalence (GAM) of 9.0%, 6.7% and 5.2% respectively. The Far North region has a prevalence of severe acute malnutrition (SAM) at the emergency threshold of 2.0%. In 2015, 1,289 children with SAM have been admitted in therapeutic care [7]. There exist a series of causative factors that contribute to childhood malnutrition with environmental, socio-demographic as well as hygienic habits the most important risk factors associated to the nutritional

status. Previous studies [8,9,10,11,12,13] have linked childhood malnutrition with maternal education and employment, family support and social network.

As a global public health recommendation, infants should be exclusively breastfed for the first six months of life to achieve optimal growth, development and health. Thereafter, to meet their evolving nutritional needs, infants should receive safe and nutritionally adequate complementary foods while breastfeeding continues up to two years or beyond. As specified by WHO and UNICEF [14] exclusive breastfeeding from birth is required for every child, except for a few rare medical conditions. Optimal infant and Young Child Feeding are essential for child growth. The period during pregnancy and child's first two years of life are considered as "critical window of opportunity" for prevention of growth faltering. Recent anthropometric data from low-income countries (Cameroon inclusive) confirms that the levels of under nutrition increase markedly from 3 months to 18-24 months of age. After birth, a child's ability to achieve the standards in growth is determined by the adequacy of dietary intake and on infant and young child feeding as well as care practices and food security [15].

Inadequate food intake is a consequence of both insufficient food available at the household level, and improper feeding practices. (Cameroon Demographic Health Survey, 2006). There is a high rate and increasing prevalence of stunting (33%), underweight (15%) and wasting (6%) in children under 5 years in Cameroon (Cameroon Demographic Health Survey, 2011). Studies carried out in the Bangang community of the west region of Cameroon showed a high prevalence of stunting in children 6 months old of 42.22% [16]. UNICEF 2011, reported the prevalence of chronic malnutrition (stunting) in Cameroon stands at 35.8%. Malnutrition is particularly pronounced in the Northern and Eastern regions. Given the above statistics, it was therefore evident that malnutrition still remains a health problem in Cameroon and its prevalence varies from region to region. At the limit of how knowledge, there are few data available on the prevalence of infants malnutrition status in South-West region of Cameroon in general and specifically in Kumba town.

The aim of this study was therefore to assess the influence of feeding habits and associated risk

factors of malnutrition on the nutritional status of infants in Kumba.

## 2. METHODOLOGY

### 2.1 Study Area

The study was carried out in Kumba municipality. Kumba is the Divisional headquarters of Meme division of the South west region of Cameroon. Commonly called K-town, Kumba is located between latitude 4° 38' Nord and longitude 9° 27' East with an estimated population of about 400.000 inhabitants with about  $\frac{3}{4}$  of this population falling within the youthful age group [17].

### 2.2 Study Design

A descriptive cross-sectional study was carried out over a period of 3 months, from April to June 2018 at the Maternal and Child Protection (PMI) and Kumba District hospitals.

### 2.3 Data Collection

A questionnaire was administered through simple random sampling to care givers of children 0-12 months at the child welfare clinic. The questionnaire was designed to obtain information on the anthropometric parameters, feeding practices and socio-demographic/economic status of mothers or care givers. The vaccination cards were used to collect information on the sex, age and date of birth of the children".

### 2.4 Inclusion and Exclusion Criteria of the Study

All children from 0-12 months attending welfare clinic in Kumba district hospital and PMI were included in this study whether sick or not. Children's whose questionnaire were not completed were not included in the study.

#### 2.4.1 Determination of sample size

Using the national average of the prevalence of the different forms of malnutrition, i.e., stunting (33%), underweight (15%) and wasting (6%) from statistics of the Cameroon Demographic Health Survey (2011). The sample size (N) was determined by using the Laurence Koppers equation [18]

$$N = \frac{Z^2 PQ}{D^2}$$

Where:

N = sample size,  
 Z = linked to 95% confidence interval (1.96),  
 P = % prevalence of malnutrition (18%),  
 Q = (1-P) expected non-prevalence,  
 D = relative desired precision (5%),  
 This gave a sample size, N = 227.

#### 2.4.2 Anthropometric measurement

Measurements were performed using a mechanical table top baby weighing scale (Vogel and Hake model) for babies unable to stand, and an electronic health scale mic balance for children aged of 12 months old. Children had to lie down or stand on the scale, without shoes and heavy clothing. Weight measurements were recorded in the survey form. Measurements were taken to the nearest 0.1 kg. [19]. Height measurements were taken using a non-stretch tape for younger children. The measurements for children lower than 12 months were taken, while lying on the scale whereas, for children aged to 12 months old, the measurements were recorded by standing up on a stadiometer. The children were made to stand or lie down erect without shoes, on the scale platform. Measurements were taken to the nearest 0.1 cm [20]. The ages were recorded from the children's health care cards or immunization card. The record was added in the questionnaire.

#### 2.4.3 Evaluation of the nutritional status of infants

Anthropometric indices were expressed in relationship to the reference population in terms of standard deviations from the median. The recently adopted Z-score malnutrition classification (WHO, 2007) was used as the reference population as opposed to the NCHS/WHO growth reference percentiles, which had been recommended for international use since the late 1970s. The values are obtained by plotting on the growth charts as shown in the WHO 2007.

### 2.5 Statistical Analysis

Descriptive and inferential statistics computed with SPSS (Version 20.1), were carried out to

achieve the objectives of the study. The level of significant was assessed at  $P < 0.05$ .

## 3. RESULTS AND DISCUSSIONS

### 3.1 Socio-demographic Information

The socio-demographic outcomes presented in Table 1 shown that. Among the nursing mothers 224 (99.1%) were the mothers of the children, while 2 (0.9%) were the guardians of the children. Moreover, 137 (60.6%) women were married, whilst 89 (39.4%) were single. It is noteworthy that only 2 (0.9%) of women were not educated. Furthermore, the socio-demographic results revealed that 51.7% (comprising of 26.5% of housewives and 25.2% unemployed single care givers) of women were jobless. Amongst workers, 19.0% were into business, and 15.9% were civil servants. The descriptive analysis also shown that 109 (48.2%) of babies were male, and 117 (51.8%) were female. The eldest baby was aged of 12 months while the youngest was aged less than a month old (3 weeks old). Less than half of the babies were aged less than 3 months old.

The results of anthropometric parameters are presented in Table 2. From these results, the mean weight and height of the infant's sampled increased with age. Babies from 0-3 months had the smallest weight and height compared to babies aged 4-6 months which were smaller compared to those aged >6 months who weighed the highest and were consequently the tallest. These results showed that there was an increase in growth with age. Growth is faster in the first two years of life and increases with age. During the first decades of life there is an increase height, weight and head which continue to develop after birth and during infancy growth is faster than any other time after birth [12].

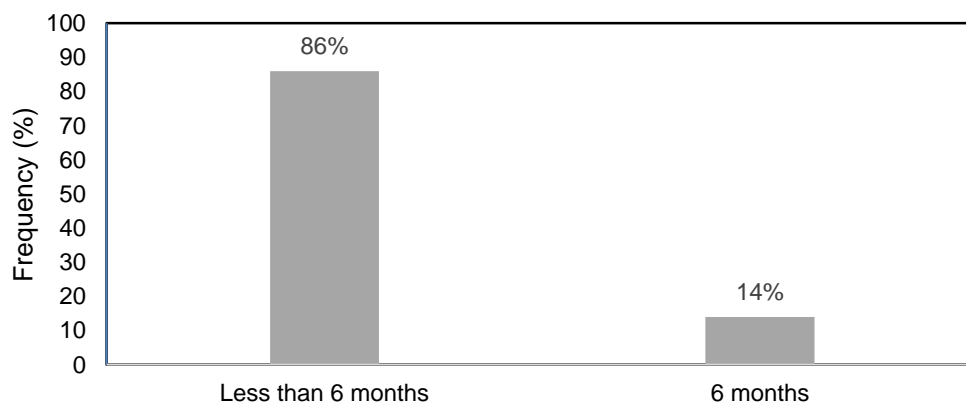
Fig. 1 presents the frequency of exclusive breast feeding. From the results, only 14% of the children were placed on exclusive breastfeeding from 0-6 months and 86% of them on mixed feeding or infant formula. This could be explained by the fact that the care givers are still not convinced on the nutritional quality of breast milk for their babies. This trend found in this study, is similar to those obtained in the Bangang community in Cameroon and Riyadh and Dammam city in Kingdom of Saudi Arabia [16, 21] and in West and Central Africa [14].

**Table 1. Socio-demographic information**

Socio-demographic characteristics	Status	Frequency	Percentage
Marital status (n= 226)	Married	137	60.6%
	Single	89	39.4%
Level of education (n=226)	Primary	70	31.0%
	Secondary	103	45.6%
	Tertiary	51	22.6%
Occupation (n=226)	Civil servant	36	15.9%
	Farmer	15	6.6%
	Seamstress	15	6.6%
	Business	43	19.0%
	Unemployed	117	51.2%
Gender (n=226)	Male	109	48.9%
	Female	117	51.8%
Age (n=226)	0-3 months	135	59.7%
	4-6 months	36	15.9%
	> 6 months	55	24. 3%

**Table 2. Values of anthropometric parameters**

Age (Months)	Growth parameters	Mean±SE	Median	Min.	Max.
0-3	Weight (kg)	5.6±0.1	5.5	2.9	8.3
	Height (cm)	57.8±0.5	58	4.9	71
4-6	Weight (kg)	7.5±0.2	7.5	5.9	9.6
	Height (cm)	64.0±0.8	64	55	72
> 6	Weight (kg)	8.6±0.2	8.8	6.6	11
	Height (cm)	71.6±0.6	71	63	82

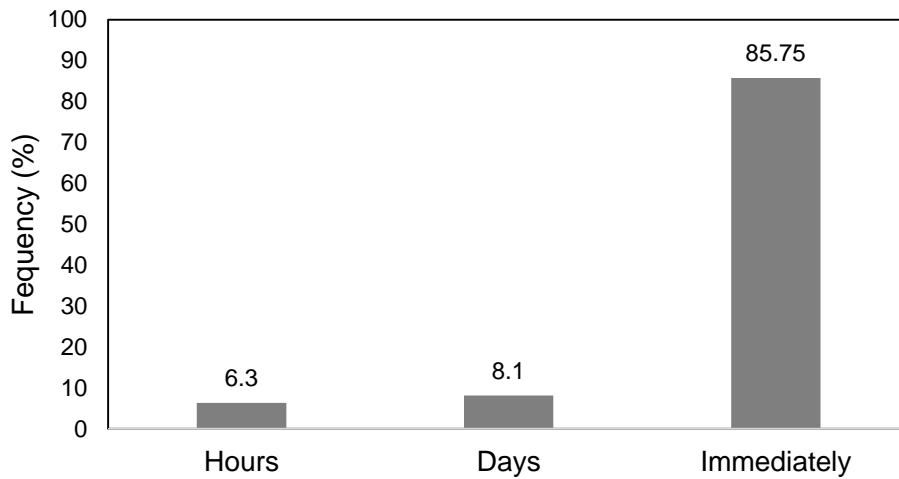


**Fig. 1. Frequency of exclusive breast feeding**

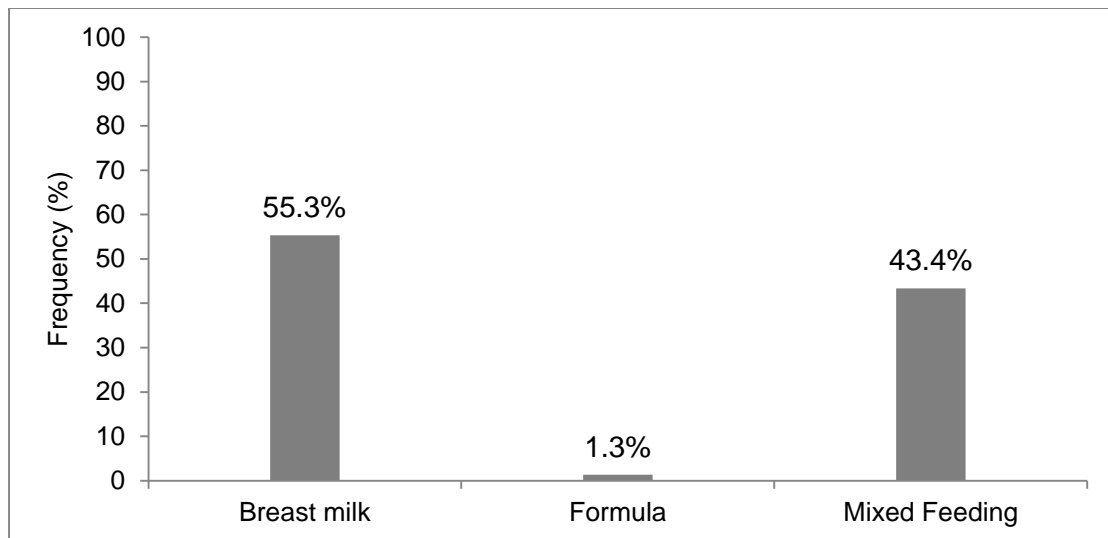
Fig. 2 represents the timely initiation of breast feeding. According to these results, 85.7% of care givers admitted to introducing their babies to breast milk immediately after birth.

Whereas, 14.3% of care givers admitted that they introduced their children to breast milk hours (6.3%) or days after birth (7.1%). This could be because mothers were aware of the importance of colostrum while, the cesarean section or the fact that breast did not flow accounted to the not

breast feeding after childbirth. These results are contrary to those obtained in Cameroon in the Bangang community of the west region of Cameroon [11] where the prevalence of early initiation of breast milk was quite low. According to studies, the prevalence of early initiation of breastfeeding places Ghana above some low- and middle-income countries such as Nepal where a recent national survey reported 41.8% breastfeeding initiation within the first 1 hour of delivery [22,23].



**Fig. 2. Frequency of timely introduction to breast**



**Fig. 3. Frequency of type of feeding**

The type of feeding before 6 months illustrated in Fig. 3 shown that the prevalence of breast feeding was 55.3% with 14% exclusive breast feeding and 41.3% on mixed breast feeding. The prevalence of mixed feeding was relatively high due to early introduction to complementary feeding. Mothers who did not breastfeed gave reasons such as; they give birth by cesarean, breast milk didn't flowing or they believed that their milk wasn't sufficient enough. These results were quite similar to those found by Mananga et al. [16 and 22], in which the low consumption of infant formula was linked to high cost. Table 3 represents the percentage and frequency of breast milk consumption in a day. According to these results, 89.1 % of care givers gave their children breast milk on demand, while 8.9 %

gave breast milk 10-12 times a day, and 2.1 % gave breast milk less than 10 times a day.

Fig. 4 gives the age of introduction to complementary foods. The results show that the

**Table 3. Frequency and percentage of daily intake of breast milk**

Number of times	Frequency	Valid percent (%)
Less than 10 times	4	2.1
10 -12 times	17	8.9
On demand	171	89.1
Total	192	100.0

WHO/UNICEF message of introducing complementary feeding at 6 months of age is not being followed. Only 32.9% of caregivers admitted giving complementary feeding at 6 months. In addition, more than half of the caregivers reported giving their children aged 1 to 4 months infant formula, water with breast milk, and traditional infant meal made from maize and Soy bean gruel. This finding was similar to results obtained in Bangang community of the west region of Cameroon [16], Douala, Cameroon [11], and Malawi [24], where mothers gave water to their children the first hours after post-partum.

The sources of drinking water are presented in Fig. 5. According to these results, majority of care givers (91.0%) gave mineral water to their children with 7% of them providing boiled tap water and 2% giving boiled well water (water from bore holes). This trend in results of source of drinking water is similar to those reported by Hasanian et al. [25]. However, contrary finding was reported by Mengistus et al. [26], where the main source of drinking water was spring water and public tap. The data also provided evidence that most babies (55.9%) drunk water at least 5 times but not more than 10 times on a normal day, whilst 7.6% of babies drunk water more than 10 times a day, and whereas. Moreover, 36.5% of women admitted they do not know how many times their babies drink water a day. Amongst women which gave water to their children, 6.7% added at least one substance to the water, whilst 93.3% only give water without any additions.

Although most caregivers could not estimate how much milk their children drunk on a daily basis, 4% of mothers reported that their children drank about one cup of milk per day. Poor drinking water quality is one of the main causes of diarrhea and infection caused by parasitic intestinal helminths which can lead to malnutrition through anorexia [27]. Children who suffer from reported episodes of diarrhea are most likely to suffer from malnutrition.

The results of some commonly consumed complementary foods are presented in Fig. 6. From these results, it is evident that there was an almost equal rate of consumption of food in all the food groups. The consumption of foods rich in protein such as meat and fish, milk and milk products and eggs was very high cumulatively compared to cereals and vegetables. These results are however not similar to those reported by Kana et al. [11]. Table 4 represents the frequency of consumption of various complementary foods. According to these results apart from eggs which less than half of the sampled babies take on a daily basis, all other food substances are eaten everyday by most of the sampled children. Cereal, vegetables, fruits, fish/meat, potatoes/cocoyam/yam are eaten every day. From these results, the frequency of intake of protein and energy dense food was very high. Studies carried out this decade in South Africa also reported a high increase in obesity and overweight in infants as a result of the consumption of high energy foods, fatty foods [28].

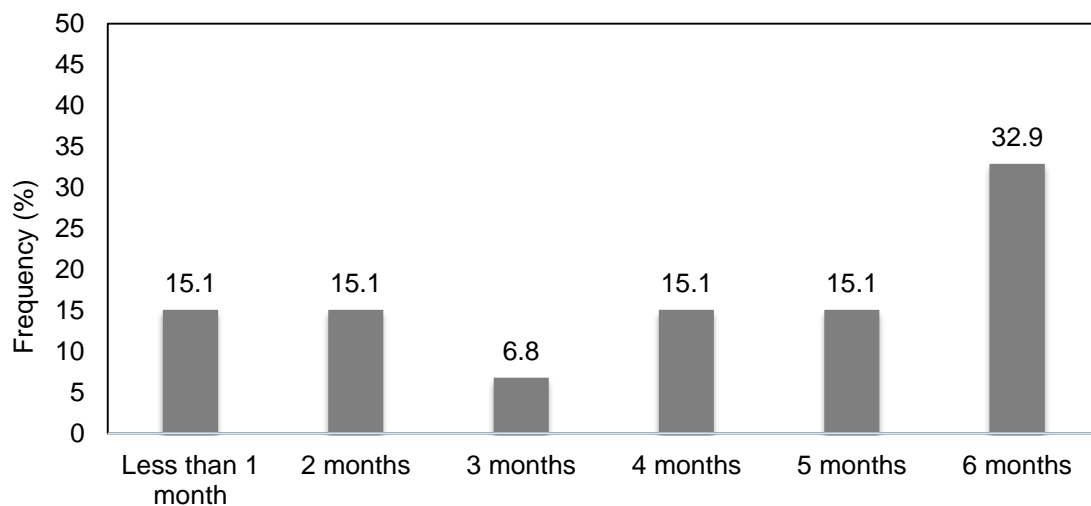
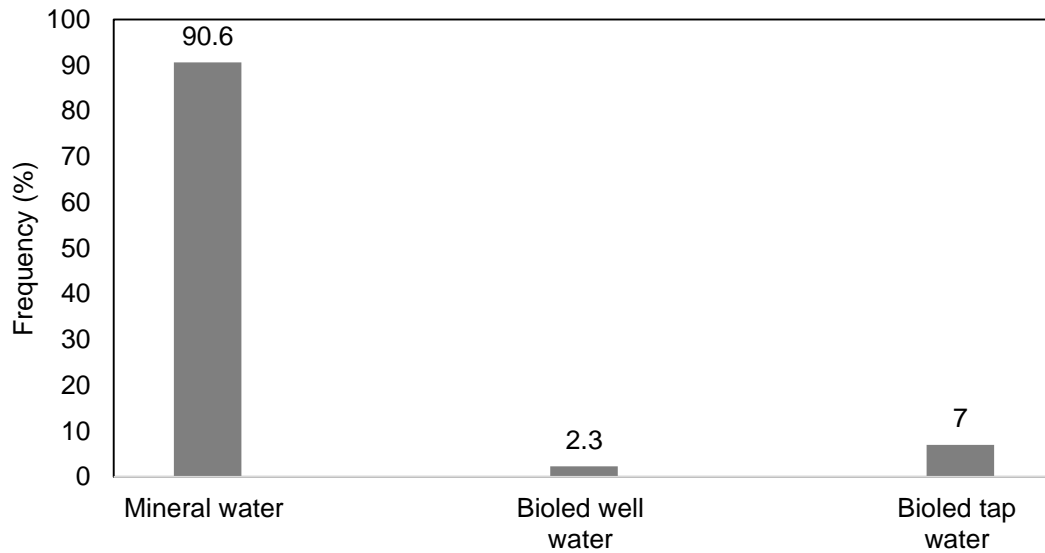


Fig. 4. Age of introduction to complementary feeding



**Fig. 5. Distribution of the source of drinking water**

**Table 3. Frequency intake of complementary food consumed**

Food substance	Less than once a week	At least once a week	Everyday	2-3 times a day
Egg	21 (40.4%)	16 (30.8%)	14 (26.9%)	1 (1.9%)
Cereal	7 (11.7%)	21 (35.0%)	31 (51.7%)	1 (1.7%)
Vegetable	8 (14.5%)	10 (18.2%)	33 (60.0%)	2 (3.6%)
Fruits	7 (12.5%)	9 (16.1%)	40 (71.4%)	-
Fish/Meat	4 (7.4%)	9 (16.7%)	40 (74.1%)	1 (1.9%)
Potatoes/cocoyam/yam	4 (7.7%)	17 (32.7%)	29 (55.8%)	2 (3.8%)
Milk/milk product	4 (8.0%)	5 (10.0%)	39 (78.0%)	2 (4.0%)

The results of Fig. 7 represent the percentage of stunted and severely stunted children. According to these results, there were 82.9% babies with normal HAZ contrary to 17.1 % of those who were stunted (9.00 % and 8.10 % stunted and severely stunted respectively). This could be related to the improving of feeding, sanitation and health care practices of the care givers or to less intrauterine growth retardation. The prevalence of stunting is relatively low compared to results reported in Africa 31% [27], and Cameroon which was 33% (Cameroon Demographic Health Survey, 2011) with 41.26% for Bangang, West region of Cameroon [19].

The results illustrated in Fig. 8 representing the percentage of stunting with respect to gender

shown that males children (57.1%) were more stunted than females (46.7%). Nevertheless females were severely stunted (53.3%) than males (42.9%). This difference in stunting could be explained by the fact that most male children under-five spend time running around while females are always closer to their parents. The difference in severely stunted between males and females could be as a result of morbid state due to poor hygienic practices. Thurstans et al. [30] shown that Boys are more likely to be undernourished than girls. These results are similar to those found in Nigeria [31], Northern Uganda [32] and Cameroon [33,34].



Fig. 9 represents the percentage distribution of stunting according to age group. There was an irregular trend in stunting i.e., 65%, 20% and 45.5% for 0-3 months, 4-6 months and greater

than 6 months, respectively, with the highest prevalence found amongst children aged from 0-3 months. This might be ascribed to the early weaning with food that didn't meet the nutritional

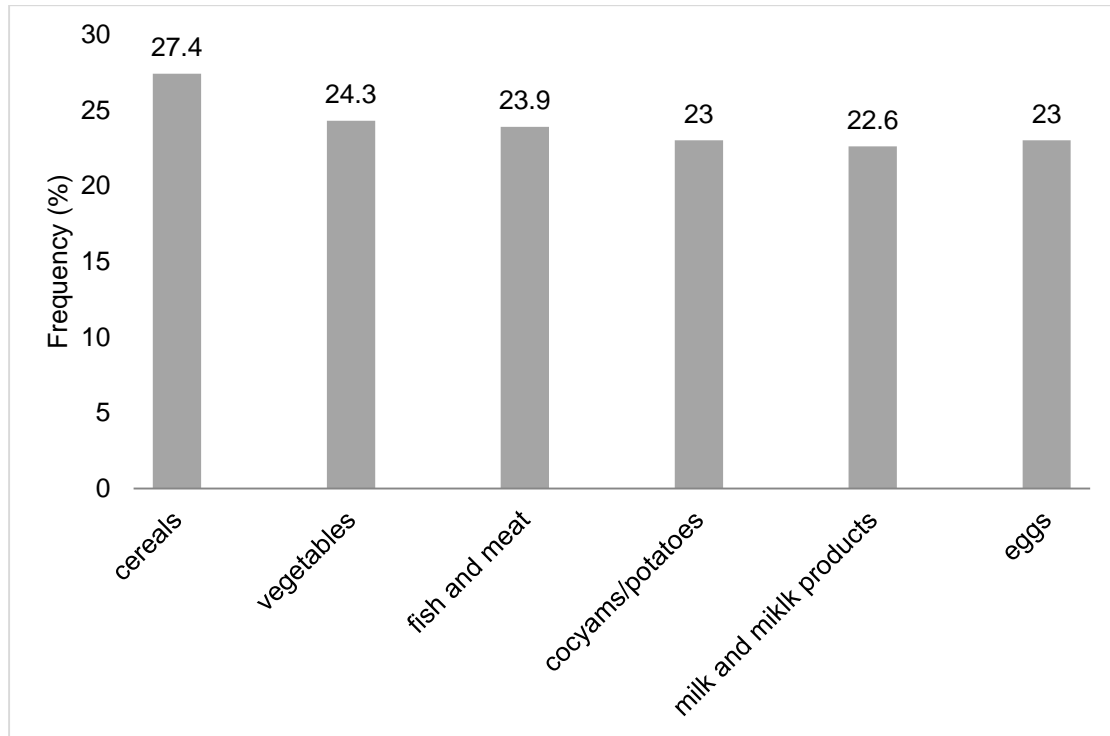


Fig. 6. Frequently consumed complementary food

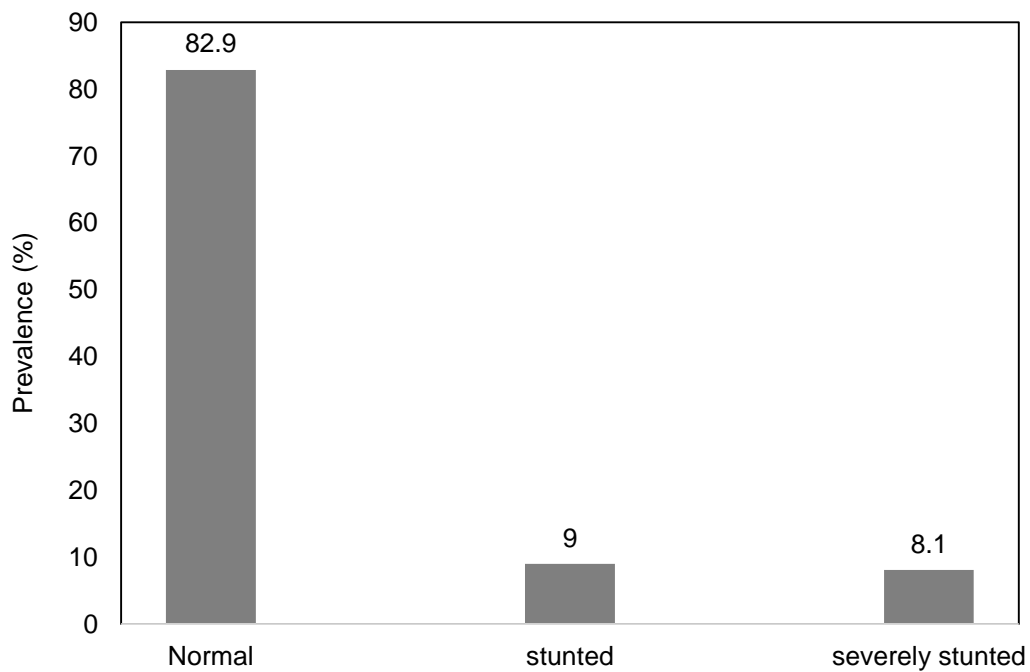
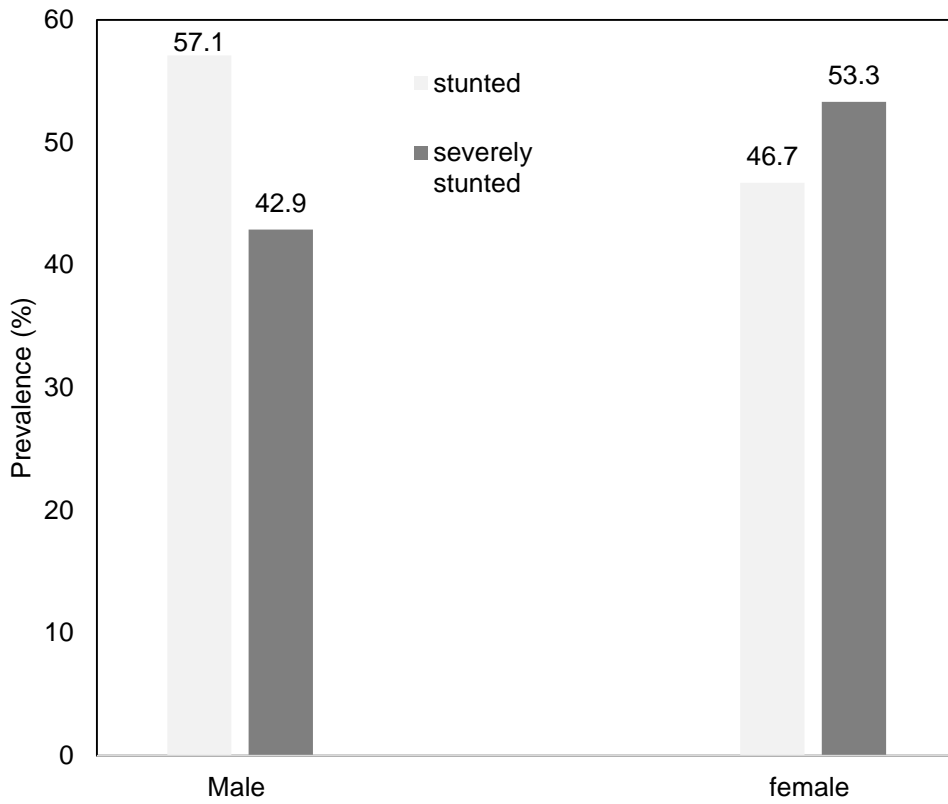
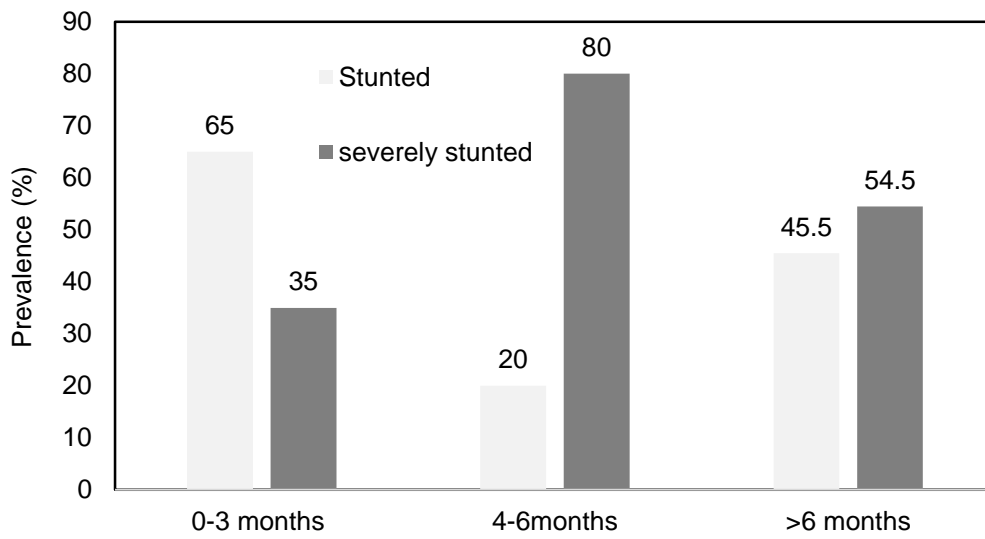


Fig. 7. Prevalence of stunting



**Fig. 8. Prevalence of stunting with respect to gender**



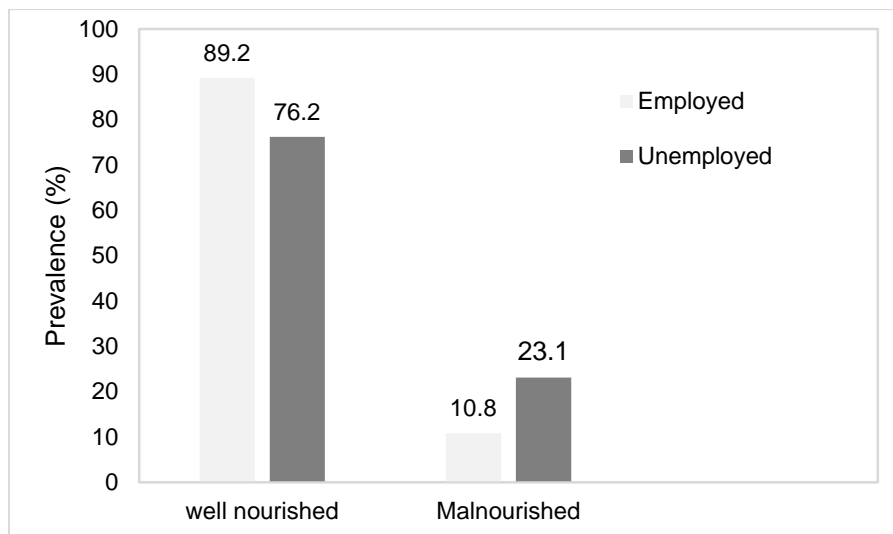
**Fig. 9. Prevalence of stunting with respect to age group**

requirement of the children. The drop of stunting from 4-6 months is due to aged appropriate introduction of complementary food and increased of stunting from greater than 6 months suggest neglect on the part of care givers as children got older. Moreover, 35.5%, 80% and 54.5% in sever stunting was observed for 0-3 months, 4-6 months and >6 months respectively. These results show that severe stunting was highest in the age group of 4-6 months. This irregular trend however is similar to those obtained in Gombe Nigeria by Danjin and Dawud, [35]. The high prevalence of stunting form 0-3 months suggest intrauterine growth retardation [13].

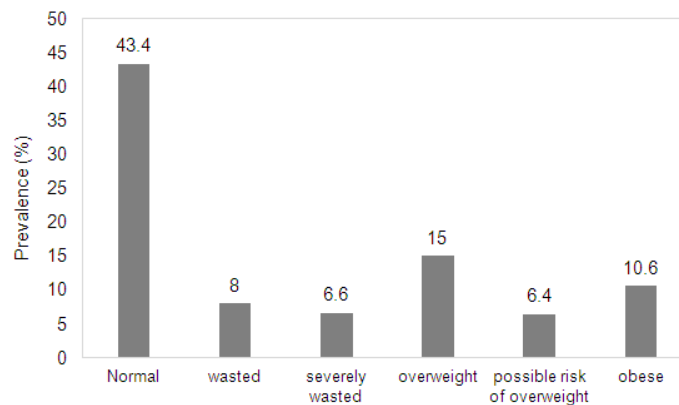
Fig. 10 provide information's on the relationship between socio-economic status and stunting. A significant relationship ( $P=0.014$ ) was found

between employment status and stunting. The prevalence of stunting was higher in unemployed guardians. This can be explained by the fact that employed mothers had money to provide health care and quality food to their children compared to unemployed mothers who despite having time to take care of their children, did not have the financial support necessary to provide good health care and quality food. This trend in results is not similar to those obtained in Vietnam [34] which showed a decrease in prevalence of malnutrition with unemployed mothers.

Fig. 11 represents the percentage of weight for height. From the outcomes, it can be seen that, the percentage of wasting in Kumba was high as compared to those observed in the Bangang rural community of west region of Cameroon



**Fig. 10. Prevalence of stunting with respect to employment status**

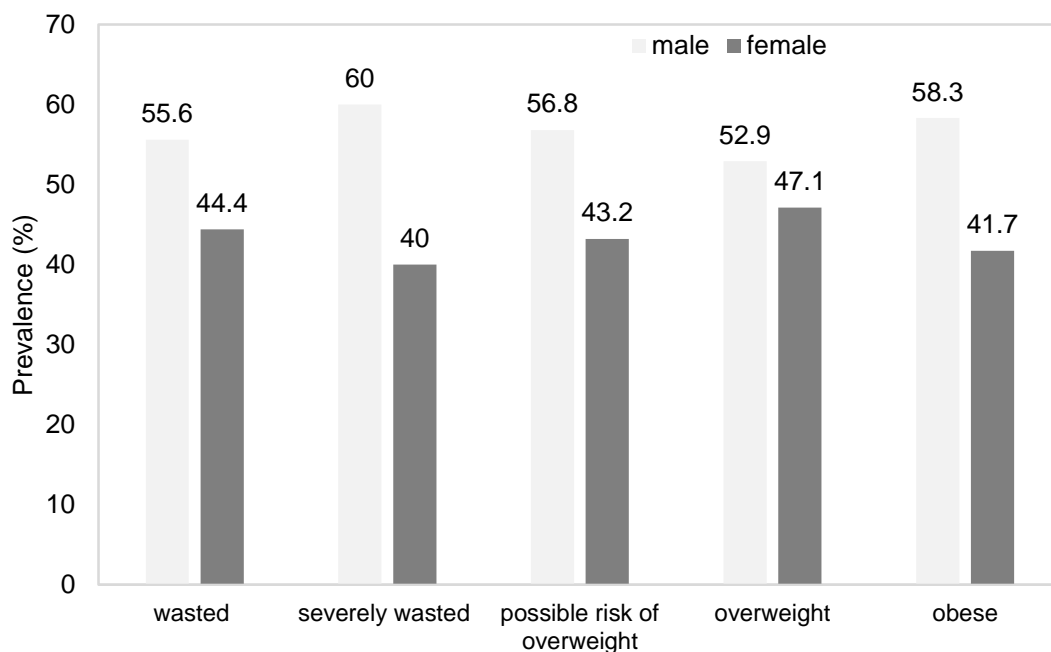


**Fig. 11. Prevalence of wasting, overweight and obesity**

(3.3%) [16], and Cameroon (6%) (*Cameroon Demographic Health Survey, 2011*). However, the percentage of wasting in Kumba remain lower than that of Ethiopia which has been reported to be 12 % [36]. Wasting which represents the acute Protein Energy Malnutrition indicates recent weight loss which could be related to recent state of morbidity associated with poor hygienic practices or poor feeding habits. This high prevalence of overweight (15.0%) and obesity (10.60%) and could be due to the early introduction of high energy dense complementary foods and low rates of exclusive breast feeding. Indeed, although the percentage of obesity observed in this study was similar to that of the North West region of Cameroon [37], it still remain higher

health care practices. While obesity, overweight and possible risk of overweight were could be as a result of an early introduction to high quantity consumption energy dense complementary food. According to the results shown in table 5, the majority of the infants aged of 0-3 months (20.8%) were wasted compared to that of other age groups. Furthermore, 18.5% of children between 0-3 months, 40.0% of children between 4-6 months, and 51.9% of children above 6 months faced possible risk of overweight. This high percentage of obesity can be associated to the consumption of high energy dense complementary food [38]. The results in Table 6, presented the percentage distribution of weight for height with regards to the socio-economic status of the care givers (Table 5). According to these results, there wasn't any significant relationship between socio-economic parameters and weight for height. This is similar to reports of World Bank for Cameroon in 2009 which linked malnutrition attributed malnutrition to poor feeding habits instead of poverty. However, these results are contrary to that of other researchers [34,39] who found a significant relation between malnutrition and socio-economic parameters.

Fig. 12 shows the percentage of weight for height with respect to gender. According to these results obtain, there was an irregular pattern in malnutrition. Males were severely wasted, faced higher risk of overweight and were more overweight compared to the male infants. The males where in turn more wasted and obese than female infants. Wasting could be linked to morbid state caused by poor feeding, hygiene or



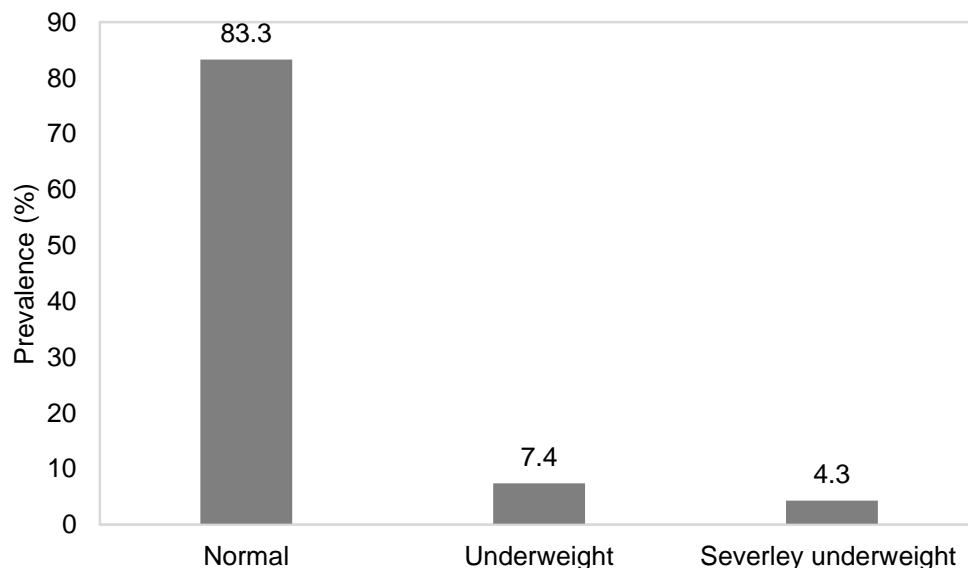
**Fig. 12. Prevalence of wasting, overweight and obesity with respect to gender**

**Table 4. Distribution of weight for height with respect to age group**

Age (months)	Weight for height					Total
	Wasted	Severely wasted	Possible risk of overweight	Overweight	Obese	
0-3	13 (16.0%)	12 (14.8%)	15 (18.5%)	23 (28.4%)	18 (22.2%)	81
4-6	1 (5.0%)	1 (5.0%)	8 (40.0%)	5 (25.0%)	5 (25.0%)	20
>6	4 (14.8%)	2 (7.4%)	14 (51.9%)	6 (22.2%)	1 (3.7%)	27
Total	18 (14.1%)	15 (11.7%)	37 (28.9%)	34 (26.6%)	24 (18.8%)	128

**Table 5. Percentage distribution of weight for height with respect to socio-economic status of care givers**

Socio-economic factors	Prevalence of weight for height		$\chi^2$ -test
	Well nourished	Malnourished	
<b>Marital status</b>	Married	53 (38.7%)	$\chi^2=3.10$ df=1 p=0.8
	Single	45 (50.6%)	
<b>Employment status</b>	Employed	46 (42.2%)	$\chi^2=0.12$ df=1 p=0.73
	Unemployed	52 (44.4%)	
<b>Level of education</b>	Primary education	48 (66.7%)	$\chi^2=1.91$ df=2 p=0.38
	Secondary education	68 (66.0%)	
	Tertiary education	39 (76.5%)	



**Fig. 13. Prevalence of underweight**

According to Fig. 13, the representing percentages of weight for age show that more than the half babies (83.3%) had a normal weight for age Z-score. However, 7.4% were assessed to be underweight, and 4.3% were severely underweight. The prevalence of malnourished babies evaluated by 'Weight for age' was found

to be 11.7%. This prevalence of underweight was lower than those found in Africa (WHO; UNICEF and World Bank, 2011) [29], Cameroon, 15% (Cameroon Demographic Health Survey, 2011). This trend in underweight and severely underweight was similar to those obtained in the Bangang community by Nolla et al. [19] where

the prevalence of underweight was a higher compared to that of severely underweight.

Fig. 14 shows the prevalence of underweight infants by age. According to these results, the percentage of underweight and severely underweight for the age group of 4-6 months was 0% implying that infants within this age had a normal growth similar to those recommended by WHO. This could be as a result of an increased in health care, nutritional awareness and good health practices. The percentages of severely underweight according to sex (Fig. 15) was higher in females (49%) than male infants (22%). This could be explained by the fact that females as at the time of the study might be in a morbid state. This trend in results is similar to those reported in Vietnam [34], where the highest malnourished children were those above six months old. This could be explained by the fact that as children get older, the level of care in terms of nutrition and hygiene isn't adequate

especially in families where the birth interval is short or where they are many children to look after. However, this trend contrary to that reported by others researchers (Salah and Nnyepi, 2006) [34,32,40]. The prevalence of malnutrition in infants based on weight for height Z score (Fig. 15) shown that males were more underweight compared to females. This can be explained by the fact that men are less brooding than girls, therefore spending a lot of their time running with friends, which in turn leads them to have less meals than girls [33,34]. Furthermore, the difference in prevalence of malnourished infants which are underweight was found to be significant ( $\chi^2=6.077$ ,  $P=0.024$ ) between single and married women. It can be inferred that children of married caregivers had less likely to have abnormal WA compared to children of single caregivers. This might be due to the availability of more resources. Indeed, single parents are at a higher risk of poverty than married parents.

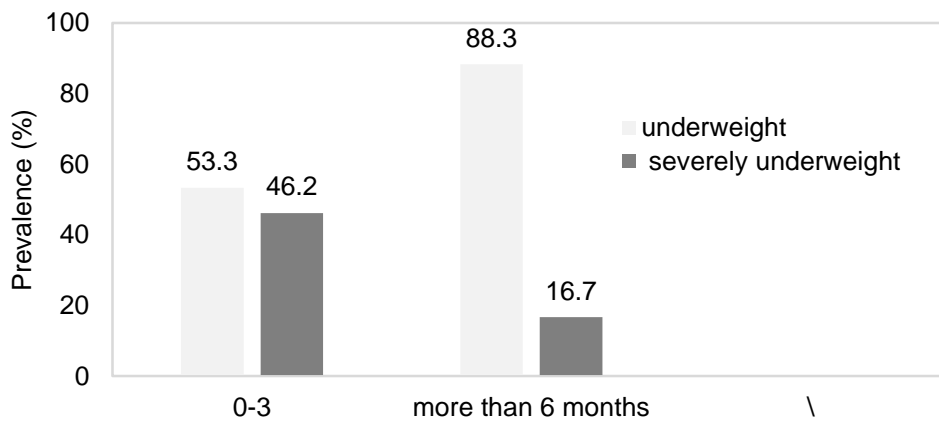


Fig. 14. Prevalence of underweight with respect to age

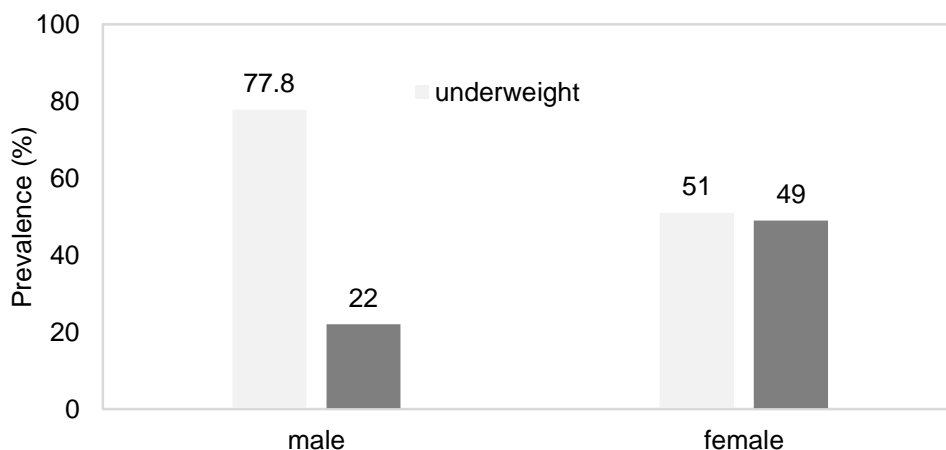


Fig. 15. Prevalence of underweight with respect to gender

The results in Fig. 16 depicted the distribution of malnutrition infants based on weight for height with respect to age and food type. According to these results, it can be suggested that infants fed with formula ingests more food as compared to those feed with breast, thus tanking more weight due to the high concentration of nutrients [41]. Furthermore, the high prevalence of overweight in mixed fed infants was as a result of the consumption of high fat and energy dense foods as reported in Table 5. Similar findings have

been reported by Lim et al. [42]; Foote and Marriott, [43]. The prevalence of wasting and severe wasting was highest in infants aged of 0-3 months who were on breast milk. That be due to the fact that the majority of the mother's feed these groups of infant with breast on demand as presented in Table 7. Besides, infants only while feed less than 10 times a day which were not getting enough breast milk or wasting led to a morbid state.

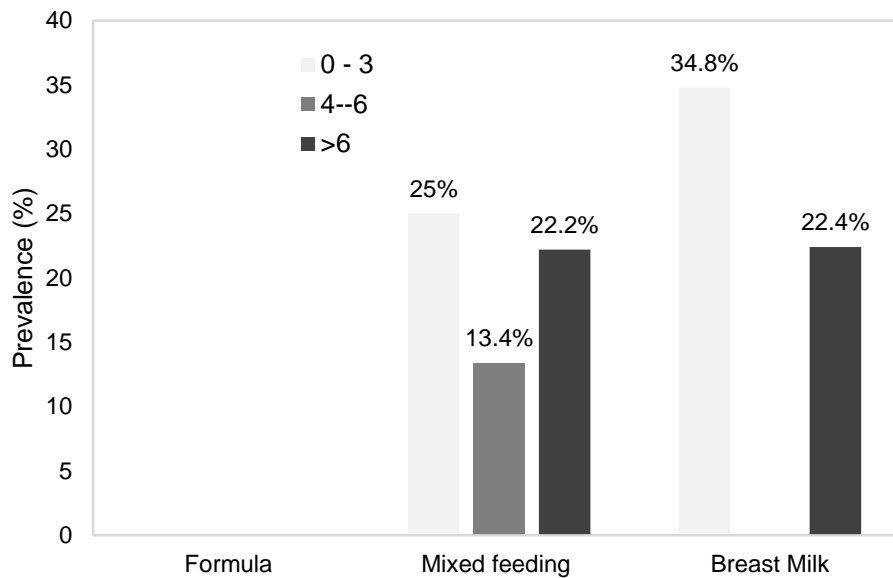


Fig. 16. Prevalence of wasting with respect to food type

Table 6. Percentage of stunting with respect to age and food type

Food type	Age (% months)	Height for age		Total
		Stunted	Severely stunted	
Breast milk	0-3	10	5	15
		66.7%	33.3%	
	4-6	1	3	4
		25.0%	75.0%	
	> 6	3	2	5
		60.0%	40.0%	
	Total	14	10	24
		58.3%	41.7%	
Mixed Feeding	0-3	3	2	5
		60.0%	40.0%	
	4-6	0	1	1
		0.0%	100.0%	
	> 6	2	4	6
		33.3%	66.7%	
	Total	5	7	12
		41.7%	58.3%	

## 5. CONCLUSION

At the end of this study, it is evident that poor feeding practices are carried out during the early introduction of complementary food. In addition, a low prevalence of exclusive breastfeeding has been reported. As a result, most infants were overweight due to the early introduction of complementary foods high in energy and fat even before the age of 6 months, leading to significant weight gain. According to the results, the prevalence of overweight was very high. It should be noted that all infants 0 to 3 months receiving infant formula were overweight, while those fed breast milk with a lower weight. In addition, more than half of mothers introduced their children to breast milk immediately after birth. The prevalence of Stunting was low compared to the overall prevalence of the country and other regions of the country but higher than the WHO threshold value. Marital status and unemployment significantly were found to be significant risk factors associated to the nutritional status. The stunting and severe stunting results from a complex interaction of factors. Hence at the individual level, interventions to prevent stunting and severe stunting should focus on improving women's nutrition to reduce low birth size, improving household hygiene to reduce diarrhea and on promotion of appropriate complementary food and feeding practices. It's therefore important that mothers and care givers should make efforts to improve on the feeding habits and child care practices of children. Exclusive breast feeding should be encouraged with complimentary feeding introduced only at aged of 6 months. Mothers and guardians should be educated on the importance of taking regular measurements and keeping records of height, weight and head circumference of their children in order to monitor the growth of their children.

## ETHICAL APPROVAL AND CONSENT

Ethical approval and permission were obtained from the national ethics committee of Cameroon and the regional delegation of public health of South West, Cameroon. The approval of the mothers or guardian was obtained before proceeding to collect information from the children.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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