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Feeding Practices, Nutritional Status and Diarrhoea Diseases among Children Aged 6 - 59 Months in the Yaounde 6 Subdivision Health Districts: Centre-Cameroon

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Abstract

Background and Aim: Malnutrition and diarrhoea diseases remain a major source of morbidity and mortality in young children aged 6 to 59 months in developing countries. In Cameroon, many strategies are being implemented to protect the mother-child pair through antenatal sensitization. However, these interventions are still limited. Therefore, this study aimed to explore the association between feeding practices, nutritional status and diarrhoea diseases among young children aged under five years in the Yaounde 6 subdivision health districts. **Subjects and Method:** This was a descriptive cross-sectional and analytical study targeting mother-child pair attending consultations, selected by convenience sampling, from May to July 2023 in three major health districts in the Yaounde 6 subdivision. Data were collected on feeding practices. The prevalence of diarrhoea disease and nutritional status was determined. **Results**: A total of 217 mother-child pairs were included in this study. Very few children (21.75 and 7.55%) consumed animal source foods and fruits respectively. The prevalence of stunting, underweight, and diarrhoea disease was 23.96% (18.28% - 29.64%), 15.66% (10.82% - 20.49%) and 23.04% (17.04% - 28.59%) respectively. Multivariate analysis revealed that there was no statistical association between the person who fed the child in the mother's absence (nanny or neighbors) [odds ratio (95% CI): 0.285 (0.126 - 0.626), $p < 0.01$], the young age of mother: 25 - 30 years [odds ratio (95% CI):

0.464 (0.233 - 0.915), p < 0.027] or the family size (>6 members) [0.836 (0.710 - 0.962), p < 0.01] despite an apparent trend towards increased risk. Microbiological analysis revealed that 23% of diarrhoea diseases were caused by yeasts (18.3%) followed by *Entamoeba histolytica* (2.7%). **Conclusion:** Unappropriate complementary feeding practices of mothers were associated with the nutritional status and diarrhoea diseases of children aged under five years. Improving the nutritional and hygiene knowledge of all the people in contact with children could help to reduce childhood diarrhoea and malnutrition outcomes in Yaounde.

Keywords

Complementary Foods, Stunting, Diarrhoea, Under Five Children, Yaounde 6 Subdivision

1. Introduction

Malnutrition and diarrhoea diseases form a vicious circle. According to World Health Organization (WHO), diarrhoea is the passage of three or more loose or liquid stools per day because of abnormally high fluid content of stool or an abnormal increase in daily stool frequency [1]. Diarrhoea diseases are infectious illnesses caused by germs such as bacteria, protozoa, viruses and fungi that enter in the body, multiply and can cause an infection [2]. These diseases are commonly transmitted by contaminated water or food especially fruits and vegetables [3]. Diarrhoea diseases remain a serious health problem which can be prevented and treated. However, it can cause dehydration, malnutrition and death among all age and especially in children under five years [1] [3]. An estimated 1.7 billion of people suffer from diarrhoea each year resulting in half a million deaths. It is the second leading cause of morbidity and mortality among children aged under five resulting in approximately 525,000 children deaths each year in the global population [1]. In low and lower middle-income countries, diarrhoea is responsible for the death of more than 90% of children under five years of age [3].

Several studies have revealed that children with diarrhoea face many problems such as appetite loss, electrolyte deficit, delay in physical growth and cognitive development and malnutrition [4]. Malnutrition is estimated to contribute to more than one third of all children's deaths, although it is rarely listed as the direct cause [5]. Malnutrition in preschool aged children is a global public health problem with 38.9 million children being overweight, 149.2 million being stunted and 45.4 million being wasted. About 45% of deaths in children aged under 5 years in developing countries are due to malnutrition, according to UNICEF in 2020 [6].

In Cameroon, about 29% of children aged under five years are stunted [7]. The latest demographic surveys revealed that 15% of children under 59 months suffered and died from diarrhoea [8]. It is one of the major and most common child-

hood diseases of public health concern. [9]. Generally, inappropriate maternal feeding practices were found to potentially cause diarrhoea and malnutrition in children under 59 months [10]. Maternal age, wealth index, maternal education, maternal occupation, age of child, time of initiation of breast feeding and time to get to the water source were associated with diarrhoea [4]. The feeding practice is generally influenced by the mother as the main caregiver for the child [11] [12]. Children infected with diarrhoea can be treated in numerous ways (such as oral rehydration solutions, antibiotic treatments, immunization, and feeding practices) to prevent morbidities and high mortality rate [13]. Although limited research has explored knowledge, prevalence and associated factors of diarrhoea diseases in urban areas, several studies have highlighted the impact of knowledge, attitude, feeding practices and nutritional status of young children in rural and peri urban areas [14]-[16]. Global reports showed that significant progress has been made in reducing child mortality between 1991 and 2018. However, focused efforts are still needed to prevent deaths, of which diarrhoea and/or malnutrition diseases are the leading cause [8]. Therefore, the present study aimed to explore feeding practices, nutritional status and prevalence of diarrhoea among children aged 6 - 59 months in the Yaounde 6 subdivision health districts to allow the implementation of the appropriate interventions.

2. Material and Methods

2.1. Study Setting, Period and Design

This study was a descriptive cross-sectional study among women or caregivers having children under five years old attending selected health districts. This study was conducted in the paediatrics and vaccinology care of Saint Martin de Porres Hospital of Mvog-Betsi, the District Medical Center of Mendong and the District Medical Center of Obili, Yaounde 6 subdivision from May to July 2023. Samples were collected in the laboratories of these health facilities and analyzed at the Saint Martin de Porres Hospital of Mvog-Betsi and the District Medical Center of Mendong.

2.2. Subjects and Eligibility Criteria

Mothers or caregivers or guardians older than 18 years having children aged under 59 months were interviewed. The investigators administered the questionnaire orally to mothers after obtaining their consent, in order to evaluate their knowledge of and practical skills related to malnutrition and diarrhoea diseases.

Case selection: this study included children aged between 6 and 59 months who were hospitalised or attending consultations at Obili Hospital, Mendong Hospital, or Saint Martin de Porres Dominican Hospital in Mvog-Beti. To be included in the study, the children had to have been residing in the Yaounde 6 subdivision district for at least six months. Children having deformities, chronic diseases, fever, birth defects or other illnesses than diarrhoea at the time of the study were not included.

2.3. Sample and Sampling

The sample size was determined using OPEN EPI with the assumption of a 15% prevalence of diarrhoea among children under 59 months of age as reported in previous studies in Cameroon, with a 5% of margin error, 95% confidence interval and expected odds ratio (OR) of 1. Therefore, the minimum estimated sample size was 196. Adding 10% for incomplete data or biases observed in this study. We had 196 + 20 = 216 mother-children pair. Ultimately, the sample should be ±216 subjects. For the biochemical and microbial analysis, the minimum sample size was estimated at 20% of the total number of children investigated. In the analytical component, every child present during the consultation was included independent of the presence of diarrhoea disease.

2.4. Data Collection Procedures

The questionnaire was validated in a preliminary pilot survey. The questionnaire contained 43 questions aiming to assess socio-demographic and environmental determinants (sex, age, occupation, marital status, educational level) of the mothers and children (part 1), feeding practices (part 2), food survey (part 3), knowledge and practical skills regarding diarrhoea and malnutrition (part 4) and anthropometric characteristics (part 5). Subsequently, a blood sample was taken for biochemical analyses. For microbiological analysis the stools were collected. The results of all analyses were communicated to the participants to ensure the medical follow up for those who needed it and advice on good eating habits was given to all the mothers.

2.5. Clinical Analyses

Biochemical analyses, that is the determination of serum albumin, blood ionogram and C-reactive protein (CRP) which were performed according to the protocol described in the various kits used. Microbial analyses, that is microscopic tests which were done as developed by Mariani-Kurkdjian *et al.* (2016) [17]. Microscopic analysis was done to look for different parasites, yeasts and certain blood elements.

2.6. Nutritional Status

The children's weight, height and Mid-Upper Arm Circumferences (MUAC) were measured. Nutritional status indicators used were weight for age, height for age and weight for height z-scores. According to a previous study of Mananga *et al.* (2022) [14], malnourished children were reported when one of their anthropometric indices were abnormal than 2 z-scores below the average reference. The MUAC was used as a nutritional indicator, forming part of the health screening.

2.7. Data Analyses

Data collected on hard copies or google sheets were analyzed into Excel 2016. Anthropometric data were standardized for age using Emergency Nutrition Assess-

ment (ENA) for Smart version 2007. The nutritional status indicators, weight for height (WHZ), height for age (HAZ) and weight for age (WAZ) were compared with the reference data from the World Health Organization (WHO) standards. Data analyses were done using R studio software version 4.4.0. for Windows. Qualitative variables were represented in the form of proportion. Continuous variables were expressed as mean [standard deviation (SD)] when the distribution was normal or as median (25^{th}-75^{th} percentiles) when non normally distributed presented in Tables and graphs. Bivariate analysis was done using Chi square test to analyze the association between the children's characteristics, the mother's socio-demographic and environmental characteristics complementary feeding practices and nutritional status and diarrhoea. Multivariate logistic regression analysis was performed using variables found to be significantly associated with malnutrition and diarrhoea in the bivariate analysis in order to identify those that were independently associated with it. A $p < 0.05$ was used to declare statistical significance.

2.8. Ethical Statements

The protocol for this study was approved by the Regional Ethics Committee for Research in Human Health (N˚: CE N˚0069/CRERSHC/2023) and the Joint Institutional Review Board for Human and Animal Bioethics of the University of Yaounde 1 (N˚: BTC-JIRB2023-095). Informed consent was obtained from all women/caregiver/guardian prior to their inclusion in the study.

3. Results

3.1. Socio-Demographic, Environmental, Maternal and Child Characteristics

Table 1 presents the socio-demographic, environmental, maternal and child characteristics. A total of 217 mothers-children pair were included in the study. Most of the mothers involved in the study were aged above 30 years old (36.40%). The median age (25^{th}-75^{th} percentiles) was 28 (24.0 - 32.5) years. The mothers were predominantly housewives 75 (34.56%). A total of 122 (56.22%) mothers had completed secondary level of education. The majority [124 (56.68%)] of the children had a family size comprised of at least 6 people and most of the mothers had more than three children 78 (35.95%). The market or shopping bag was the main container reported to be used for the collection of household waste 104 (47.92%). More than half of the mothers used latrine 124 (57.14%). The majority of the children fell within the age range of 6 - 12 months (50.23%). The median age (25^{th}-75^{th} percentiles) was 12.8 (9 - 20) months. Most of the children were the firstborn to the mothers 88 (40.55%).

3.2. Complementary Feeding (CF) Practices of Mothers and Feeding Indicators

The complementary feeding practices of the children under 59 months are illustrated in Table 2. Only 29% of the mothers knew about appropriate complementary

Table 1. Socio-demographic, environmental, maternal and child characteristics.

Characteristics	N	(%)
Mother's age (years)		
[18 - 24]	62	28.57
[25 - 30]	76	35.02
>30	79	36.4
Mother's level of education		
None	6	2.76
Primary	12	5.53
Secondary	122	56.22
University	77	35.48
Mothers occupation		
Housewives/Unemployed	75	34.56
Informal sector	62	28.57
Public sector	56	25.81
Private sector	24	11.06
Marital status		
Married	94	43.32
Single	123	56.68
Parity		
1	72	33.18
2	67	30.88
≥3	78	35.94
Sanitation		
Modern WC	113	52.07
Latrine	104	47.93
Vessels use for fetching water		
Bathing bucket	98	45.16
Vessel for that purpose	103	47.46
Washing basing	16	7.37
Household waste		
Bathing bucket	44	20.27
Market, shopping bag	104	47.92
Closed trash can	53	24.41
Age of child (months)		
[6 - 12[	109	50.23

Continued

[12 - 24[	83	38.25
]24 - 59]	25	11.52
Sex		
Male	106	48.85
Female	111	51.15
Birth order		
1st	88	40.55
2nd	68	31.34
≥3rd	61	28.11
Completion of age appropriate vaccination		
Complete	77	35.48
Incomplete	140	64.51
Family size (person)		
[1 - 3]	42	19.35
[4 - 6]	51	23.5
>6	124	57.14
Water source for drinking of children		
Tap	14	6.45
Borehole	27	12.44
Mineral	125	57.6
Well	51	23.5

Table 2. Complementary feeding (CF) indicators and feeding practices.

Characteristics	N=217	(%)
Knowledge about appropriate complementary feeding		
No knowledge	154	70.97
Have knowledge	63	29.03
Age of introducing complementary foods		
<6 months	135	62.21
6 months	75	34.56
>6 months	7	3.23
Reasons for starting complementary foods		
Breast milk was not enough milk	92	42.40
Hospital instructions	6	2.76
Always crying	19	8.75

Continued

Taboo or ancestral beliefs	37	17.05
Others	63	29.03
Introduction of soft, semi-solid or solid foods		
Met	97	88.99
Not met	12	11.00
Food diversity score		
Low score	136	62.67
Average Score	54	34.09
High score	20	3.22
Separate preparation of child's food		
Yes	94	43.32
No	123	56.68
First complementary food offered to child		
Infant formula	58	26.73
Local pap (fermented maize)	136	62.67
Others	23	10.60
Hand washing with soap before feeding child		
Yes	32	14.74
No	185	85.25
How complementary food is fed to child		
Spoon	161	74.19
Hand	36	16.58
Bottle with nipple	20	9.21
Who feeds the child		
Mother or other family members (father, grand-mother, sisters, aunty)	121	55.76
Nanny, neighbors	35	16.12
Autonomous	61	28.12

feeding. Results showed that 62.21% of the mothers started complementary foods before 6 months while only 34.56% began complementary feeding at the age of 6 months. Most (42.40%) of the mothers justified it by the fact that breast milk was not enough to satisfy the babies. The majority [97 (88.99%)] of children aged 6 - 8 months received soft, semi-solid or solid foods. Furthermore, 136 (62.67%) children had a low food diversity score. The proportion of children aged 6 - 59 months who had minimum acceptable diet was 13 (5.99%). Local pap was the most common first complementary local food that 136 (62.67%) mothers gave to their children. Only 58 (26.73%) mothers offered infant flour as first complementary food to

their child. Few mothers practiced hand washing with soap before feeding their children 32 (14.74%). Most mothers fed their children with a spoon [161 (74.19%)] while [36 (16.58)] did it by hand. One hundred and twenty one (55.76%) were fed by family members, 61 (28.11%) were autonomous and 35 (16.13%) by neighbors.

3.3. Frequency of Food Consumption

The frequency of intake of complementary food is shown in Table 3. The findings suggested that 198 (91.24%) of the children (6 - 59 months) were mainly fed with cereals, tubers and roots and 128 (58.99%) by legumes, nuts and seed. The proportion of children fed with meat, fish, eggs [48 (22.12%)] and fruits and vegetables [50 (23.04%)] was very low.

Table 3. Frequency of food consumption of children.

Food groups	Types of food	N	Frequency (%)
Cereals, roots and tubers	Rice, pasta	198	91.24
Meat, fish, egg	Eggs, dried fish	48	22.12
Legumes, nuts and seed	Peanut, soybean, bean	128	58.99
Milk and dairy products	Fermented milk	31	14.28
Fruits and vegetables	Orange, Banana	50	23.04
Sweet products	Soft drinks, candy	74	34.10
Fats	Butter, mayonnaise	22	10.14

3.4. Prevalence of Malnutrition among Children by Sex and Age

The study revealed that the median weight-for-height, weight-for-age, height-for-age z-scores and MUAC were −0.15 (−0.87; 1.48), −0.34 (−1.45; 0.27), −1.07 (−1.98; −0.22) and 14.80 (14; 15.70) respectively. Table 4 presents the overall

Table 4. Prevalence of malnutrition among children by sex and age.

Nutritional status indicators	Sex		Total % (95% CI)	Age (months)		
	Male %	Female %		[6 - 12[%	[12 - 24[%	[24 - 59] %
Stunting (height for age < −2 z-score)	16.12	7.82	23.96 (18.28 - 29.64)	6.9	13.82	3.23
Wasting (weight for height < −2-z-score)	4.14	5.06	9.21 (7.25 - 11.17)	4.61	3.68	0.92
Underweight (weight for age < −2 z-score)	10.13	5.52	15.66 (10.82 - 20.49)	3.23	8.26	4.14
Overweight and obesity (weight for height > 2-z-score)	4.6	3.22	7.82 (4.25 - 11.39)	4.14	3.22	0.46

p-value significant at 0.05.

prevalence of stunting, wasting underweight and overweight. The results revealed that nearly 56.69% of the children showed at least one indicator of malnutrition. More than 23% of the children were stunted, 9% were wasted, 15% were underweight and 7% were overweight/obese. The prevalence of stunting, underweight and overweight were higher in males than females. Similarly, the prevalence of stunting and underweight were higher among children aged 12 - 24 months.

3.5. Prevalence of Diarrhoea among Children

Diarrhoea episodes were detected among 23.04%, (95% CI; 17.40% - 28.59%) of the children (Figure 1). According to age groups, children aged 6 to 11 months were the most affected (13%) by diarrhoea. However, the different pathogens observed during microbial analyses of stools were mainly yeast (18.3%) (Figure 2).

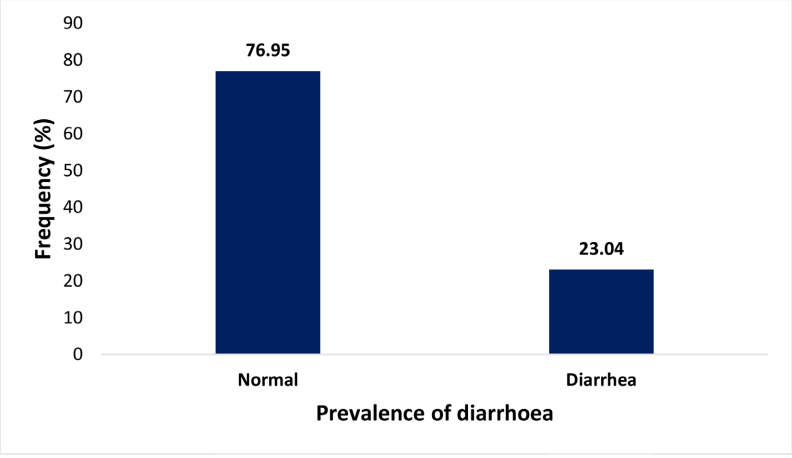

Figure 1. Prevalence of diarrhoea among children.

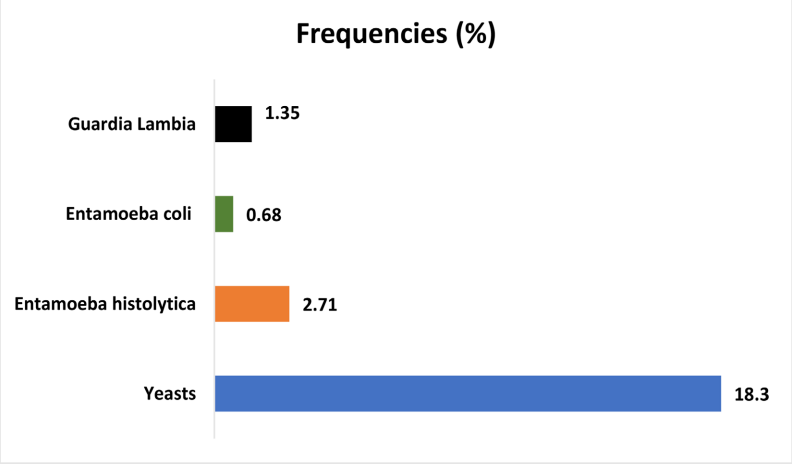

Figure 2. Pathogens involved in diarrhoea in children.

3.6. Biochemical Status of Children

Results show that the majority of children had a low level of natremia (56%), calcemia (52%), carbonic acid (100%) and higher level of C-reactive Protein (68%).

Additionally 60%, 84% and 100% of the infants and young children had normal chloruremia, albuminemia and magnesemia respectively (Table 5).

Table 5. Biochemical status.

Characteristics	Avg ± SD	Deficient (%)	Normal (%)	Above (%)	Reference
Natremia (mmol/L)	134.39 ± 1.58	28 (56)	18 (36)	4 (8)	135 - 147
Chloruremia (mmol/L)	100.05 ± 1.36	18 (36)	30 (60)	2 (4)	99.0 - 112.0
Kaliemia (mmol/L)	4.10 ± 0.69	24 (48)	16 (32)	10 (20)	3.40 - 5.30
Calcemia (mg/L)	84.33 ± 4.81	26 (52)	20 (40)	4 (8)	80.0 - 103.20
Phosphatidemia (mmol/L)	1.16 ± 0.36	22 (44)	12 (24)	16 (32)	0.85 - 1.51
Carbonic acid (mmol/L)	21.33 ± 1.06	50 (100)	0 (0)	0 (0)	22.0 - 29.0
Magnesemia (mmol/L)	23.06 ± 2.89	0 (0)	50 (100)	0 (0)	15.73 - 30.25
Albuminemia (mmol/L)	44.02 ± 3.30	08(16)	42 (84)	0 (0)	38 - 58
C-Reactive Protein (mg/L)	11.54 ± 0.53	Positive (%) 34 (68)	Normal (%) 0 (0)	Negative (%) 16 (32)	<6 Negative ≥6 positive

3.7. Association between Nutritional Status and Related Factors

In the present finding, there was a significant positive correlation between albuminemia and stunting ($p = 0.01$), albuminemia and underweight ($p = 0.005$), magnesemia and underweight ($p = 0.048$) and calcemia and stunting ($p = 0.018$). However, there was no significant correlation between albuminemia and stunting ($p > 0.05$), magnesemia and stunting ($p > 0.05$) and magnesemia and wasting ($p > 0.05$) (Table 6).

Table 6. Association nutritional status and albumin, magnesium and calcium levels.

Variables	Correlation coefficient	P-value
Albuminemia and wasting	0.447	0.01
Albuminemia and stunting	0.090	0.534
Albuminemia and underweight	0.387	0.005
Magnesemia and underweight	0.281	0.048
Magnesemia and stunting	0.222	0.121
Magnesemia and wasting	0.173	0.230
Calcemia and stunting	0.335	0.018

3.8. Association of Socio-Demographic, Complementary Feeding, Maternal and Child Characteristics with Nutritional Status

The analysis of the findings (Table 7) showed that the mother's level of education ($p = 0.001$), parity ($p = 0.032$), family size ($p = 0.034$), knowledge about appropriate complementary feeding ($p = 0.027$), food diversity score ($p = 0.018$), separate preparation of child's food ($p = 0.047$), hand washing with soap before feeding

child (p = 0.022), who feeds the child (p = 0.015) were significantly associated with underweight. The factors associated with wasting were the mother's level of education (p = 0.027), the parity (0.005) and the family size (0.016). The results from binary logistic regression analysis revealed that the age of children (p<0.001), the sex (p = 0.045), the knowledge about appropriate complementary feeding (p = 0.035), the age of introducing complementary foods (p = 0.026) and food diversity score (p = 0.012) were positively associated with stunting.

Table 7. Bivariate analysis of nutritional status with socio-demographic, complementary feeding and maternal and child indicators.

Variables	Underweight N (%)	p	Wasting N (%)	p	Stunting N (%)	p
Mother's level of education						
None	1 (0.46)		0 (0)		03 (1.38)	
Primary	3 (1.38)	0.001	04 (1.84)	0.027	0 (0)	0.385
Secondary	25 (11.52)		14 (6.45)		31 (14.28)	
University	05 (2.30)		02 (0.92)		18 (8.29)	
Mother's occupation						
Private sector	0 (0)		0 (0)		04 (1.84)	
Public sector	8 (3.68)	0.135	03 (1.38)	0.129	10 (4.60)	0.152
Housewives /Unemployed	10 (4.60)		6 (2.76)		23 (10.59)	
Informal sector	16 (7.37)		11 (5.06)		15 (6.91)	
Mother's age (years)						
[18 - 25]	11 (5.06)	0.660	10 (4.60)	0.403	25 (11.52)	0.106
]25 - 34]	18 (8.29)		9 (4.14)		21 (9.67)	
Marital status						
Married	12 (5.52)	0.385	8 (3.68)	0.238	20 (9,21)	0.154
Single	22 (10.13)		11 (5.06)		32 (14.74)	
Age of the children						
[6 - 11]	13 (5.99)		10 (4.60)		15 (6.91)	
[12 - 23]	15 (6.91)	0.075	08 (3.68)	0.157	30 (13.82)	<0.001
[24 - 59]	06 (2.76)		02 (0.92)		07 (3.22)	
Parity						
1	10 (4.60)		03 (1.38)		22 (10,13)	
2	15 (6.91)	0.032	11 (5.06)	0.005	14 (6.45)	0.192
≥3	9 (4,14)		06 (2.76)		16 (7.37)	
Sex						
Male	22 (10.13)	0.132	9 (4.14)	0.738	35 (16.12)	0.045

Continued

Female	12 (5.52)		11 (5.07)		17 (7.83)	
Family size (person)						
[1 - 3]	4 (1.84)		0 (0)		10 (4.61)	
[4 - 6]	9 (4.15)	0.034	7 (3.23)	0.016	19 (8.76)	0.611
>6	21 (9.67)		17 (7.83)		25 (11.52)	
Knowledge about appropriate complementary feeding						
No knowledge	26 (11.98)	0.027	13 (5.99)	0.076	36 (16.59)	0.035
Have knowledge	8 (3.69)		11 (5.07)		16 (7.37)	
Age of introducing complementary foods						
<6 months	22 (10.13)		13 (5.99)		27 (12.44)	
6 months	03 (1.38)	0.54	5 (2.30)	0.452	13 (5.99)	0.026
>6 months	9 (4.15)		6 (2.76)		14 (6.45)	
Food diversity score						
Low score	25 (11.52)		12 (5.52)		33 (15.20)	
Average Score	7 (3.22)	0.018	8 (3.68)	0.376	13 (5.99)	0.012
High score	2 (0.921)		4 (1.84)		6 (2.76)	
Separate preparation of child's food						
Yes	4 (1.84)	0.047	2 (0.92)	0.107	15 (6.91)	0.993
No	30 (13.82)		18 (8.29)		37 (17.05)	
Hand washing with soap before feeding child						
Yes	9 (4.14)	0.022	10 (4.61)	0.34	28 (12.90)	0.87
No	25 (11.52)		14 (6.45)		24 (11.06)	
Who feeds the child						
Mother or other family members (father, grand-mother, sisters, aunty)	6 (2.76)	0.015	13 (5.99)	0.96	26 (11.98)	0.056
Nanny, neighbors	16 (7.37)		9 (4.15)		17 (7.83)	
Autonomous	12 (5.53)		2 (0.92)		9 (4.15)	

3.9. Factors Associated with Diarrhoea and Malnutrition among Children

After multivariate analysis (Table 8 and Table 9), it appeared that the person who fed the child (nanny, neighbors) in the absence of the parents was associated with a significant reduction in the odds of diarrhoea (adjusted OR = 0.285; 95% CI [0.126 - 0.626]). In the same idea, the mother's age ≥ 25 and ≤30 years [0.464 (0.233 - 0.915), $p < 0.027$] and the family size: > 6 members [0.836 (0.710 - 0.962), $p < 0.01$ were found to have an important protective effect against the children malnutrition.

Table 8. Multivariate analysis of factors associated with diarrhoea among the children.

Characteristics	OR adjusted	95% CI	p
Mother's age (years)			
[18 - 24]	0.710	[0.326 - 1.52]	0.38
[25 - 30]	1	1	1
>30	1.31	[0.658 - 2.77]	0.43
Marital status			
Married	1	1	1
Single	0.886	[0.448 - 1.75]	0.73
Who feeds the child			
Mother or other family members (father, grand-mother, sisters, aunty)	1	1	1
Nanny, neighbors	0.285	[0.126 - 0.626]	<0.01
Autonomous	1.32	[0.658 - 2.77]	0.44

Table 9. Multivariate analysis of factors associated with malnutrition among the children.

Characteristics	OR adjusted	95% CI	p
Mother's age			
[18 - 24]	1	1	1
[25 - 30]	0.464	[0.233 - 0.915]	0.027
>30	0.342	[0.116 - 0.879]	0.055
Mother's occupation			
Private sector	1	1	1
Public sector	0.920	[0.231 - 3.12]	0.9
Housewives/Unemployed	2.03	[0.896 - 4.89]	0.098
Informal sector	1.47	[0.604 - 3.69]	0.4
Family size (person)			
[1 - 3]	1	1	1
[4 - 6]	0.95	[0.785 - 1.04]	0.22
>6	0.836	[0.710 - 0.962]	<0.01
Marital status			
Married	1	1	1
Single	1.53	[0.760 - 3.20]	0.24
Presence of diarrhoea			
Yes	0.511	[0.268; 0.983]	0.043
No	1	1	1

4. Discussion

The present study aimed to explore feeding practices, nutritional status and prevalence of diarrhoea and determinants of children aged under five years in the Yaounde 6 subdivision health districts. The study highlighted inappropriate feeding practices, low food diversity score, no knowledge about appropriate complementary feeding, high prevalence of acute and chronic malnutrition and diarrhoea. Diarrhoea was mainly caused by yeast in children aged 6 to 59 months. Electrolyte disorders were frequently observed in children suffering from diarrhoea. Sixty-two percent (62.21%) of the children started their food diversification before 6 months (0 - 3 months). This high frequency of early initiation of complementary foods could be explained by the fact that in this study, the majority of mothers (more than 65%) have a job, which would reduce the time to take care of the baby, including the practice of exclusive breastfeeding according to WHO recommendations. Most of the mothers were forced to entrust the feeding of their children to someone else. However, multivariate analysis indicated a protective odds ratio (OR = 0.285, 0.464, 0.836) in favor of the person who fed the children (nanny or neighbors) in the mother's absence, the mother's age and a family size at 6 persons respectively. These data suggested that, the choice of the person to look after the children in the parents' absence is a very important factor in the care of young children. On the other hand, the larger of the family, the more support and help there is for the mother when she is unavailable. The present findings are consistent with the results from the studies conducted in Eastern Algeria [18] and the mother and infant and young child in Kumbotso local Government area, Kano state, Nigeria [19]. However, the percentage of good feeding practices observed in this study were lower than those of the mothers in the Buea, Tiko and Limbe health Districts in Cameroon [9] as well as the percentage reported in the rural Bangladesh [20]and Western Rwanda [21]. Furthermore, at this age (0 - 6 months), the infants have an immature digestive system, therefore early dietary diversification would expose them to nutritional deficiencies due to nutrient absorption disorders and hydro-electrolytic disorders or diarrhoea [22]. Findings from this study indicate that there is still a lack of awareness about good complementary feeding practices among mothers. The children's diets were mainly composed of staple foods, root and tuber cereals (91.24%) and legumes (58.99%) and are low in meat and dairy products (22.12%), fruits and vegetables (23.04%). This could be justified by the fact that most of the mothers bought infant formulas for the nutrition of their children, which are generally made up of cereals such as rice, pasta, corn, millet and sorghum. In addition, most of the mothers revealed that they didn't cook particular meals for their children as they preferred ready to eat food. This aligns with the findings of Sobze *et al.* (2019) [23] in the Mayo-Danay department of Cameroon, who found that children under five years were fed at 98.9%, with cereals, roots and tubers, 51.6% had a non-diversified diet and 48.8% received three meals during the past 24 hours. Regarding the food diversity score of the children, it was characterized by a low score (62.67%). These results can likely to

be attributed to several factors, such as the fact that the majority of mothers were workers (65%) so as a result, they don't have enough time to prepare balanced meals. On the other hand, most mothers still lacked adequate knowledge (70.97%) about complementary food. Additionally, the high cost of living does not always allow mothers to provide balanced meals for their children. Likely, previous studies demonstrated unhealthy feeding practices among young children aged 6 - 23 months in five sub-Saharan African regions [24], the main food consumed were cereals. Furthermore, a low food diversity score could predispose children to risks of nutritional deficiencies that can affect physical growth, cognitive development and overall health of children [25].

The study of complementary feeding indicators and feeding practices revealed that the mothers had inappropriate feeding practices leading to increased risk of child malnutrition. Food frequency and food diversity score both in children are key indicators of optimum feeding practices [26]. The results revealed that the prevalence of stunting was critical, affecting approximately 23.96% of children. Stunting rates were higher in boys (16.1%) than in girls (7.8%) and higher in children aged 12 to 23 months (13.82%). These findings are closed to the 23.6% prevalence of stunting obtained by Kojom *et al.* (2021) [27] on the prevalence, patterns and determinants of malaria and malnutrition in children under 5 years of age in the city of Douala (Cameroon). Regarding sex and age, the prevalence of stunting found in this study is lower than that obtained by Tchapda *et al.* (2022) [28] in a study conducted in Ayos (Eastern Cameroon) among children in the same age group. Stunting is a form of malnutrition that results in a height below normal in relation to the child's age. When it occurs in children under 24 months, it can have adverse consequences on their health, such as cognitive disorders that can persist into adulthood. This high rate of stunting would be linked to an early or too late introduction of complementary foods that are not well assimilated by children [12]. Additionally, there is strong evidence that infants under 6 months of age who consume foods other than breast milk tend to have diarrhoea problems, which could reduce the absorption of nutrients, including some minerals from breast milk [29]. The overall prevalence of underweight reflected acute malnutrition among infants and young children. However, severe underweight was low (4.14%). Underweight is associated with insufficient nutrition due to the large family size or to irregular food intake attributable to the mother's occupation. Higher prevalence of underweight (25.8%) among young children have been previously reported in the city of Douala in Cameroon [11]. Wasting which reflects acute malnutrition among children was low (9.2%) according to WHO criteria [3]. Conversely, a study in the Tole Health district in the South West region of Cameroon [30] reported a low prevalence of wasting due to household size. Household with 2 - 4 people had 7.8% for wasting while those with 5 - 7 people had 5.3%. Those with more than 8 members in the house, had zero prevalence of wasting and the difference in wasting with respect to household size was statistically significant. Overweight and obesity were less prevalent among males (4.6%)

compared with females (3.2%) among the children under five years. Comparable findings were reported by Hossain *et al.* (2020) [31] in their study. Additionally, it was previously observed a high prevalence of overweight among females (2.86%) compared with males (2.09%) in peri-urban area in Cameroon [14]. The prevalence of stunting, underweight and wasting weakens children's immune systems. This exposes them to diarrhoea diseases [32].

Accordingly, the study revealed that the prevalence of diarrhoea was 23.04% with those aged 6 to 11 months being the most affceted age group (13.01%). This high rate could be explained by the poor hygiene rules and feeding practices among children under five years old. Most of the children ate the family meal and there were no age appropriate foods. In addition, mothers did not wash their hands with soap before feeding their children. Interestingly, this study showed that over 40% of the children drank water not safe for consumption and most mothers had access to latrines. Latrine is a hole in the ground and a toilet is a modern toilet that uses a pour-flush system [16]. This result was lower compared to the results obtained from Efoulan Health district, Yaounde-Cameroon (26.1%) [33], but higher compared to a study carried out in Eastern Ethiopia where the prevalence of diarrhoea among children was 7.4% [34]. This is supported by the fact that diarrhoea leads to hydro electrolytic imbalance between different ions in the body. Additionally, these findings could be attributed to water and electrolyte losses due to vomiting, stools, urine, and sweating during diarrhoea [35]. Microscopic examination of the different pathogens revealed that diarrhoea in children was mainly caused by yeasts followed by *Entamoeba histolytica*, *Entamoeba coli* and *Guardia lambia*. Several hypotheses can be put forward to explain the presence of yeast in children's stools: diarrhoea may be caused by infant porridges, which is mostly made from fermented maize, which may contain high levels of yeast and other micro-organisms if the fermentation is not controlled. On the other hand, inappropriate complementary feeding and poor hygiene may also explain this result. Consequently, according to many authors, high levels of yeast or other bacteria lead to general intestinal inflammation, chronic intestinal or extra-intestinal amoebiasis, an inflammatory reaction of the liver (liver abscess) and respiratory failures that can lead to death [17]. Nearly 60% of children with diarrhoea had a positive CRP (greater than 6 mg/L). C-reactive protein is an early, sensitive and specific marker of the inflammatory reaction released by the liver, and proportional to its intensity. Thus, the predominant positive C-reactive protein in the study population would indicate the presence of an infection, particularly by yeasts or other pathogens responsible for diarrhoea in children [36]. In the same line, the family size (>6) and the age of mother (25 - 30 years) were independent factors associated with childhood malnutrition onset.

5. Conclusion

The present finding demonstrated that stunting, wasting, underweight and diarrhoea remained public health problem. The nutritional problems observed in chil-

dren under five years were mainly due to poor knowledge and inappropriate complementary feeding practices of mothers/caregivers. It would be necessary, and indeed advisable, to set up nutritional intervention programmes focusing on hygiene training for those responsible for children in the absence of their parents, as well as practical nutritional advice for working mothers.

Limitation of This Study

Even though this study has some strengths, it is not without limitations. The weaknesses of the study were essentially due to the cross-sectional design being unable to establish the temporal relationship between diarrhoea and its determinants. Additionally, the data were collected only once from each mother child pair, which made it difficult to assess a direct link between the quality of the food served to the children and occurrence of diarrhoea. It is necessary to perform a PCR test on the children's stools in order to determine the characteristics of the bacteria involved.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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