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Factors Associated with Unfavorable Nutritional Knowledge, Attitudes, and Practices among Mothers of Children Aged 6-59 Months Regarding the Fight Against Chronic Malnutrition in Kayanza Health District in Burundi

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Abstract

Nutrition is an essential pillar for the social and economic development of communities and a country, as well as for the growth and cognitive development of children. However, malnutrition is a major global public health issue, particularly concerning for children under 5 years of age. The objective of our research was to identify factors related to mothers' unfavorable nutritional knowledge, attitudes, and practices (KAP) with the aim of combating chronic malnutrition in Kayanza Health District (KHD) in Burundi.

A cross-sectional research study was conducted, with data collection in KHD households, on a sample of 227 mothers with children aged 6 to 59 months. Study was carried out using a systematic stratified sampling technique with proportional allocation. Descriptive analysis of sample by calculating Chi2 and its p-value, bivariate and multivariate analysis by calculating the Odds Ratio and their 95% confidence interval were carried out in Stata 15.1 Variables, whose p-value was < 0.05, were retained as significantly associated with the unfavorable nutritional (KAP) of mothers of children aged 6 to 59 months in terms of the fight against chronic malnutrition in KHD.

Results show that maternal age >= 35 years (p = 0.001), low maternal education (p = 0.000), lack of food accessibility (p = 0.007), lack of food availability (p = 0.000), non-participation in nutrition education sessions (p = 0.001) and knowledge of key moments of hand washing (p=0.000) were identified as factors significantly associated with adverse nutritional KAP of mothers of children aged 6 to 59 months in KHD.

Keywords: Knowledge, Attitudes, Practices, Chronic Malnutrition, Kayanza Health District

Introduction

Nutrition constitutes a crucial foundation for the social and economic progress of communities and a country [1]. It is also a determining factor in the outcome of a child's cognitive development and growth. During the early childhood period, appropriate nutrition is essential for the full development of every child [1, 2].

Food is a fundamental right for every child and young person, as it is essential for healthy nutrition and proper physical and mental development. Unfortunately, children around the world struggle to receive the food they need, which undermines their

ability to grow [1]. The State of Food Security and Nutrition in the World 2024 report highlighted the slow progress in combating malnutrition in all its manifestations [3].

Globally, particularly in low- and middle-income countries, malnutrition is characterized by excessive, inadequate, or disproportionate consumption of energy and/or nutrients [4]. This includes overweight, obesity, undernutrition, stunting, and micronutrient deficiencies [5].

Additional evidence indicates that, although there are partial successes, the current pace of change will not achieve nutrition targets (such as: reducing the number of stunted children under 5 by 40%; reducing anemia among women of reproductive age by 50%; reducing low birth weight by 30%; no increase in the percentage of overweight children; increasing exclusive breastfeeding rates in the first 6 months of life to at least 50%; reducing and maintaining child wasting below 5%) by 2025 in most countries [6]. In 2021, more than 3.1 million children under the age of 5 died as a result of malnutrition, primarily in low- and middle-income countries in sub-Saharan Africa and parts of South Asia [7].

In Africa, malnutrition is most often the result of a complex interaction of insufficient dietary intake and frequent episodes of illness. It is also linked to a lack of knowledge of good nutritional practices and low income among populations [8].

It constitutes a major global public health problem, particularly concerning among children under the age of five [9]. Inadequate and inappropriate feeding practices, as well as a poor sanitation environment, play a crucial role in the occurrence of this condition.

In developing countries, nutritional practices are frequently inappropriate and do not correspond to World Health Organization (WHO) guidelines and are the main factors hindering the physical and mental growth of children [10, 11]. Children suffering from severe acute malnutrition are nine times more likely to die from illness than well-nourished children due to a weakened immune system. Malnutrition makes children more vulnerable to disease, weakens their intellectual capacity, decreases their motivation, and impacts their productivity [4].

In 2022, it was estimated that globally, 149 million children aged zero to 59 months were stunted (too short for their age), 45 million were wasted (low weight for their height), and 37 million were overweight or obese [4]. Nearly half of deaths in children under 5 years of age are attributable to undernutrition [12].

Despite a significant global decrease in the number of children suffering from stunting, more than 150 million children are still affected [13]. In Asia, despite significant progress towards achieving global targets, gaps persist. This region recorded a stunting rate higher than the global average, reaching 22.7% [13].

For the past thirty years, leaders in the Latin American region have worked hard to combat malnutrition, but in some parts of the region, significant progress has yet to be seen [1].

According to a 2019 UNICEF report, approximately 20% of children under 5 years of age in Latin America and the Caribbean were affected by malnutrition or showed signs of both types of malnutrition [1].

In 2018, although child stunting declined globally, the African region recorded an increase in the number of affected children, from 50.3 million to 58.8 million [14].

In Benin, 4.7% of children aged 6 to 59 months suffer from acute malnutrition, of which 0.7% have a severe form. Furthermore, more than 37% of these children have stunted growth, which puts them at higher risk of death [15].

Approximately 34% of children under five years of age in Mali are short for their age, while approximately 13% are thin and approximately 27% are underweight [16]. A recent study conducted in Côte d'Ivoire highlighted that 35% of deaths among young children are linked to malnutrition [17].

According to the Burundi Demographic and Health Survey (DHS III), stunting is an indicator of chronic undernutrition, resulting from inadequate nutrition over a long period of time. It can also be influenced by recurrent and chronic diseases [18, 19]. In Burundi, 56% of children under 5 years of age are stunted or suffer from chronic malnutrition, which translates to being too short for their age, and 25% of them are affected by severe stunting [20]. In 2018, the prevalence of chronic malnutrition among children under 5 years of age was 54.2%, according to the 2018 National Survey on Nutrition and Food Security in Burundi (ENSNSAB, 2018) [21].

Our research aims to identify factors associated with unfavorable nutritional knowledge, attitudes, and practices (KAP) among mothers of children aged 6 to 59 months that are responsible for chronic malnutrition.

Study Method

Study Framework

Burundi is a country straddling East and Central Africa. According to projections from the 2008 General Population and Housing Census, the total population is estimated at 11,215,578 inhabitants, including 5,500,949 men and 5,714,629 women, and the estimated number of households is 2,484,613 [22]. This population is distributed across 18 provinces, 119 communes, and 2,911 collines. Burundi is bordered to the east and south by Tanzania, to the north by Rwanda, and to the west by the Democratic Republic of Congo (DRC). The Kayanza District, where our research was conducted, is located in Kayanza Province and consists of 17 health center responsibility areas (HC) spread across three communes: Kabarore Commune, Kayanza Commune, and Muruta Commune. This District has 43,591 children aged 0-59 months and 38,360 children aged 6-59 months, according to the National Nutritional Situation and Mortality Survey (ENSNMB, 2018) [21].

We chose to work in the Kayanza Health District because this District has a very high prevalence of stunting in children under 5 years of age, at 60.4% [21], compared to the WHO alert threshold (40%) [4].

Study Type

This is a cross-sectional study with analytical purposes.

Study Period

The study was conducted in sampled households in the Kayanza Health District. Data collection covered a one-month period from October 1 to 31, 2024.

Study Population

This population consisted of mothers or guardians of children from households with a child aged 6 to 59 months during the survey period. In cases where the mother was unavailable or no longer alive, the primary caregiver

participated in the study.

Sampling

Sample Size

In Burundi, according to projections from the 2008 General Population and Housing Census, in Kayanza province, 58% of children under 5 years of age are stunted [22].

In our study, 60.4% was taken as a reference proportion for calculating our sample size. To determine the sample size, we used the Schwartz formula:

$$\mathbf{n} = \frac{z^2 X\, p(1-p)}{e^2}$$

n = sample size

z = 95% z-score (1.96)

p = prevalence of chronic malnutrition in the Kayanza HD (0.604)

e = margin of error (0.05). Given the research constraints, the precision was reduced to 0.08.

$$\mathbf{n} = \frac{1.96^2 X\ 0.604\ (1-0.604)}{0.08^2} = \mathbf{143.57\ or\ 144}$$

Considering the cluster effect, the sample size was multiplied by the cluster effect d=1.5. The sample size then becomes 144 x 1.5=216.

Applying the 5% non-response, the sample size becomes:

$$\mathbf{n} = \frac{216X105}{100} = 226,8.\ \textbf{Or 227 households}$$

Sampling Technique

The method used was a two-stage cluster sampling. In the first stage, 17 areas of responsibility were selected: a list of the 17 areas of responsibility of the Kayanza Health District and a list of all the hills constituting these 17 areas of responsibility were established.

In each area of responsibility, we selected a single hill by simple random sampling:

For each area of responsibility, the Randomiser.org function was used to find the hills surveyed in that area of responsibility. A total of 17 hills were selected.

In the second stage, 227 households were selected: The number of households to be surveyed per selected hill was calculated by proportional allocation based on the population of the area of responsibility of the HC it represents, using the following formula:

$$n_i = \frac{nxN_i}{N}$$

Where:

n_i = sample size for each hill;

n = total sample size for our study;

N_i= target population size for each hill;

N = total target population size for our study.

To determine the households to survey within each hill, the surveyor used the systematic sampling technique within the study population for that hill and then calculated the sampling interval (Ni/ni). To find the first household to survey on that hill, they used the Randomizer.org function.

For the remaining households to be surveyed, the surveyor continued down the list, respecting the sampling interval, until the number of households that constituted the sample size for that hill was totaled.

Table 1: Distribution of households to be surveyed by hill and area of responsibility

N°	Area of responsibility of HC	Name of hill	Number of children aged 6 to 59 months for each HC	Number of households to survey per hill
1	Gahahe	Cukiro	3014	11
2	Jene	Ruhinga	4296	16
3	Kabarore	Caguka	3135	12
4	Kabuye	Mpanda	6690	26
5	Karunyinya	Manini	2772	11
6	Kavoga	Kaserege	2554	10
7	Kayanza	Kinga	7692	29
8	Manga	Manga	1232	5
9	Mubuga	Nyamiyogoro	4439	17
10	Murima	Kibingo	3815	15
11	Nyabihogo	Ruhande	2440	9
12	Remera	Buziraguhindwa	2893	11
13	Rubura	Randa	2247	9
14	Rugazi	Buvumo	3939	15
15	Rwegura	Mpfunda	3074	12
16	Ryamukona	Kivuvu	2083	8
17	Siloe	Musave	2775	11
Total			**59090**	**227**

Inclusion Criteria

Any household with a child aged 6 to 59 months during the survey period and whose mother or guardian agreed to participate in the survey through verbal informed consent.

Exclusion Criteria

Any household with a child aged 6 to 59 months during the survey period who is not from this district.

Data Collection Tools

The data collection tool used was a pre-designed questionnaire sent to a mother or guardian of a child between 6 and 59 months old who agreed to participate in the study.

The questionnaire, which included dimensions and questions addressing the various variables derived from the conceptual framework at the level of each dimension, was translated into the national language to facilitate the interviewee's understanding and encoded. It was then deployed in the Kobocollect format on a smartphone, sent to the respondent, and completed by the interviewer themselves.

Instrument Validation: Pre-test

To test comprehension of the questionnaire (pre-test), the survey form was first sent to 23 mothers of children aged 6 to 59 months from households in the Ngozi Health District, and then some questions were adapted and reworded. The pre-test also made it possible to estimate the time required to complete the survey.

Data Collection Proper

The data collection was conducted by ourselves, the author of this thesis, and took place from October 1st to 31st, 2024.

Administrative Considerations

A request for access to research data from the East African

Nutritional Sciences Institute (EANSI) was submitted to the Kayanza Health District. This request was granted, allowing us to collect the data.

Ethical Considerations

The research protocol was submitted and defended before a panel of EANSI professors, who granted authorization to conduct the study.

Informed Consent and Confidentiality

The purpose and significance of the study, the anonymity and confidentiality of the data collected, the voluntary nature of participation in the study, and the right to discontinue participation at any time were explained to the respondents, and free, verbal, and informed consent was obtained from each mother of a child aged 6 to 59 months.

Data Protection

To ensure data security, a database will be kept for 5 years.

Data Entry and Analysis

A database was created by exporting the collected data from Kobotoolbox to Excel 13 for editing, then exported to Stata 15.1 for analysis. A description of the sample was provided based on the various variables selected for the study. For quantitative variables, the mean +/- standard deviation was calculated when the distribution was normal; otherwise, the median +/- interquartile range was used.

For qualitative variables, we calculated the sample size and frequency (%) of the different modalities. The descriptive analysis of the relationship between the dependent variable and various independent variables was performed using the Chi-square homogeneity test at a 95% confidence level. The results were presented in tables and graphs, made in Word 2010. After the descriptive analysis, a bivariate analysis was done by simple logistic regression, with a risk of error α of 5% (p-value = 0.05) to analyze the relationship between the dependent variable and the different independent variables, by calculating the Odds ratio (OR) with its 95% confidence interval. Were considered significantly associated with the dependent variable of our study which is: "unfavorable nutritional knowledge, attitudes and practices of mothers of children aged 6-59 months in the fight against chronic malnutrition", all variables whose confidence interval of the OR does not contain the value 1, that is to say with a p-value < 0.05. Finally, a multivariate analysis was performed using multiple logistic regression, calculating the adjusted OR and its 95% confidence interval between the dependent variable "unfavorable nutritional KAP of mothers of children aged 6 to 59 months in terms of combating malnutrition" and the various independent variables whose p-value was < 0.20 in bivariate analysis, to identify the factors associated with the dependent variable in our study. The saturated model, containing only variables significantly associated with the dependent variable, was obtained by automatically eliminating variables backward, one by one, starting with the variables with the highest p-value until remaining with only variables with a p-value < 0.05. The discriminatory power of the final model was tested to determine the reliability of the model using the ROC curve.

Internal Validity

To eliminate the influence of biases that could affect the quality of our study, various strategies were used:

- Definition of inclusion and exclusion criteria;
- The list of areas of responsibility of the HC and the hills of the Kayanza health district was found in the Kayanza Health District Register;
- Sampling of cases;
- Interview with the mother, who was familiar with the objectives and purpose of the study;
- The questionnaire consisted of short and clear questions;
- Interview with the respondents in the Kayanza Health District Register;
- Consideration of the α error of 5% in data analysis;
- Conducting a bivariate and multivariate analysis by calculating the OR and its 95% CI;
- Calculating the discriminatory power of the final model by constructing the ROC curve.

External Validity

Our sample included all mothers of children aged 6 to 59 months in the Kayanza Health District who were available, met the inclusion and exclusion criteria, and who gave their consent to participate in the study. Our results will be generalizable to all children aged 6 to 59 months in the Kayanza Health District.

Results

Sample Description

Our total sample size was 227 mothers of children aged 6 to 59 months.

The median age of the mothers was 28 years, with an interquartile range of 15 years.

The median household size was 5 people, with an interquartile range of 3 people.

Table 2: Distribution of the sample (n=227) of mothers of children aged 6-59 months from Kayanza HD, according to sociodemographic characteristics, Burundi 2024

		Mothers' Unfavorable Nutritional KAP			
Variables	**N**	**Yes n (%)**	**No n (%)**	**Chi-square**	**P-value**
Mother's Age				7.50	**0.023**
20-35 years	131	93(53.45)	38(71.70)		
< 20 years	22	21(12.07)	1(1.89)		
>= 35 years	74	60(34.48)	14(26.42)		
Mother's Occupation				10.36	**0.001**
Others	67	42 (24.14)	25 (47.17)		
Farmer	160	132 (75.86)	28 (52.83)		
Father's Occupation				2.98	0.084
Others	105	75 (43.10)	30 (56.60)		
Farmer	122	99 (56.90)	23 (43.40)		
Mother's education level				17.93	**0.000**
Sufficient	97	61 (35.06)	36 (67.92)		
Insufficient	130	113 (64.94)	17 (32.08)		
Father's education level				1.64	0.200
Sufficient	111	81 (46.55)	30 (56.60)		
Insufficient	116	93 (53.45)	23 (43.40)		
Marital status				0.02	0.887
Living in union	161	123 (70.69)	38 (71.70)		
Not living in union	66	51 (29.31)	15 (28.30)		
Household size				4.86	**0.027**
< 5 people	107	75 (43.10)	32 (60.38)		
>= 5 people	120	99 (56.90)	21 (39.62)		
Number of children < 5 years in the household				0.09	0.765
< 2	146	111 (63.79)	35 (66.04)		
>=2	81	63 (36.21)	18 (33.96)		
Religion				2.38	0.123
Christian	191	150 (86.21)	41 (77.36)		
Other	36	24 (13.79)	12 (22.64)		

Table 3: Distribution of the sample (n=227) of mothers of children aged 6-59 months in Kayanza Health District, by socioeconomic and food security characteristics, Burundi 2024

		Mothers' Unfavorable Nutritional KAP			
Variables	**n**	**Yes n (%)**	**No n (%)**	**Chi-square**	**P-value**
Availability of cultivable land				6.35	**0.012**
Yes (if >=1 ha)	56	36 (20.69)	20 (37.74)		
No (if <1ha)	171	138 (79.31)	33 (62.26)		
Existence of market gardening				0.89	0.343
Yes	107	79 (45.40)	28 (52.83)		
No	120	95 (54.60)	25 (47.17)		
Food accessibility				13.72	**0.000**
Yes	30	15 (8.62)	15(28.30)		
No	197	159 (91.38)	38 (71.70)		
Food availability				51.06	**0.000**
Yes	54	22 (12.64)	32 (60.38)		
No	173	152 (87.36)	21 (39.62)		
Meal frequency				1.46	0.227
>=3	112	82 (47.13)	30 (56.60)		
<3	115	92 (52.87)	23 (43.40)		

Table 4: Distribution of the sample (n=227) of mothers of children aged 6-59 months in Kayanza Health District, according to characteristics related to the organization and operation of the health system, Burundi 2024

		Mothers' Unfavorable Nutritional KAP			
Variables	**N**	**Yes n (%)**	**No n (%)**	**Chi-square**	**P-value**
Participation in Nutrition Education Sessions				10.48	**0.001**
Yes	172	123 (70.69)	49(92.45)		
No	55	51 (29.31)	4 (7.55)		
Quality of Reception at the health center / hospital				0.93	0.336
Good	224	171 (98.28)	53 (100)		
Poor	3	3 (1.72)	-		
Existence of a Nearby community health worker				1.59	0.206
Yes	215	163 (93.68)	52 (98.11)		
No	12	11 (6.32)	1 (1.89)		
Attendance to the health center / hospital				5.95	**0.015**
Yes	209	156 (89.66)	53 (100)		
No	18	18 (10.34)	-		
Source of health information				3.52	0.061
Formal	216	163 (93.68)	53 (100)		
Informal	11	11 (6.32)	-		

Table 5: Distribution of the sample (n=227) of mothers of children aged 6-59 months in Kayanza Health District, by hygiene-related characteristics, Burundi 2024

		Mothers' Unfavorable Nutritional KAP			
Variables	**N**	**Yes n (%)**	**No n (%)**	**Chi-square**	**P-value**
Environmental Sanitation				158.33	**0.000**
Yes	69	16 (9.20)	53 (100)		
No	158	158 (90.80)	-		
House Conditions				0.64	0.423
Good	109	81 (46.55)	28 (52.83)		
Poor	118	93 (53.45)	25 (47.17)		
Household Water Used for Drinking and Cooking				18.26	**0.000**
Potable	113	73 (41.95)	40 (75.47)		
Non-potable	114	101 (58.05)	13 (24.53)		
Latrines in good condition				0.33	0.564
Yes	74	55 (31.61)	19 (35.85)		
No	153	119 (68.39)	34 (64.15)		
Knowledge of key handwashing times				32.95	**0.000**
Yes	83	46 (26.44)	37 (69.81)		
No	144	128 (73.56)	16 (30.19)		

Table 6: Distribution of the sample (n=227) of mothers of children aged 6-59 months in the Kayanza Health District, by characteristics related to breastfeeding and child feeding, Burundi 2024

		Mothers' Unfavorable Nutritional KAP			
Variables	**N**	**Yes n (%)**	**No n (%)**	**Chi-square**	**P-valuees**
Exclusive Breastfeeding				0.63	0.427
Yes	166	125 (71.84)	41(77.36)		
No	61	49 (28.16)	12 (22.64)		
Breastfeeding Frequency				4.23	**0.040**
On Demand	65	42 (63.64)	23 (85.19)		
Specific Times	28	24 (36.36)	4 (14.81)		
Food Forbidden				0.26	0.611
No	217	167 (95.98)	50 (94.34)		
Yes	10	7 (4.02)	3 (5.66)		
Personal motivation				0.31	0.580
Good health	226	173 (99.43)	53 (100)		
Other	1	1 (0.57)	-		

Table 7: Analysis of the association between the different variables (p<0.20 in bivariate analysis) and the unfavorable nutritional KAP of mothers of children aged 6-59 months (n=227), Burundi 2024

	Mothers' Unfavorable Nutritional KAP		Bivariate Analysis		Multivariate Analysis	
Variables	**Oui n (%)**	**Non n (%)**	**ORB (IC à 95%)**	**P-value**	**ORa (IC à 95%)**	**P-value**
Mother's Age						
20-35 years	93 (53.45)	38 (71.70)	1		1	
< 20 years	21 (12.07)	1(1.89)	8.58 [1.11-66.07]	**0.039**	4.07 [0.40-41.78]	0.237
>= 35 years	60 (34.48)	14 (26.42)	1.75 [0.87-3.50]	0.113	7.62 [2.37-24.43]	**0.001***
Mother's Occupation						
Others	42 (24.14)	25 (47.17)	1		1	
Farmer	132 (75.86)	28 (52.83)	2.80 [1.48-5.33]	**0.002**	0.33 [0.036-3.05]	0.328
Father's Occupation						
Others	75 (43.10)	30 (56.60)	1		1	
Farmer	99 (56.90)	23 (43.40)	1.72 [0.93-3.20]	0.086	1.16 [0.13-10.60]	0.896
Mother's education level						
Sufficient	61 (35.06)	36 (67.92)	1		1	
Insufficient	113 (64.94)	17 (32.08)	3.92 [2.04-7.56]	**0.000**	9.33 [3.07-28.38]	**0.000***
Household size						
< 5 people	75 (43.10)	32 (60.38)	1		1	
>= 5 people	99 (56.90)	21 (39.62)	2.01 [1.07-3.76]	**0.029**	0.25 [0.013-4.83]	0.357
Religion						
Christian	150 (86.21)	41 (77.36)	1		1	
Other	24 (13.79)	12 (22.64)	0.55 [0.25-1.18]	0.126	0.74 [0.04-14.90]	0.845
Availability of cultivable land						
Yes (if >=1 ha)	36 (20.69)	20 (37.74)	1		1	
No (if <1ha)	138 (79.31)	33 (62.26)	2.32 [1.19-4.52]	**0.013**	1,23 [0.44-3.46]	0.689
Food accessibility						
Yes	15 (8.62)	15(28.30)	1		1	
No	159 (91.38)	38 (71.70)	4.18 [1.88-9.29]	**0.000**	6.69 [1.68-26.68]	**0.007***
Food availability						
Yes	22 (12.64)	32 (60.38)	1		1	
No	152 (87.36)	21 (39.62)	10.53 [5.18-21.40]	**0.000**	22.37 [7.27- 8.85]	**0.000***
Participation in Nutrition Education Sessions						
Yes	123 (70.69)	49 (92.45)	1		1	
No	51 (29.31)	4 (7.55)	5.08 [1.74-14.81]	**0.003**	12.09 [2.82-51.78]	**0.001***
Household Water Used for Drinking and Cooking						
Potable	73 (41.95)	40 (75.47)	1		1	
Non-potable	101 (58.05)	13 (24.53)	4.25 [2.12-8.52]	**0.000**	1.21 [0.13-11.19]	0.864
Knowledge of key handwashing times						
Yes	46 (26.44)	37 (69.81)	1		1	
No	128 (73.56)	16 (30.19)	6.43 [3.27-12.66]	**0.000**	18.47 [6.20-55.02]	**0.000***
Breastfeeding Frequency						
On Demand	42 (63.64)	23 (85.19)	1		1	
Specific Times	24 (36.36)	4 (14.81)	3.29 [1.02-10.63]	**0.047**	8.30 [0.57-120.16]	0.121

Sociodemographic Characteristics

The results of our study show (See Table 2) that the mother's age (p=0.023), her profession (p=0.001), her level of education (p=0.000) as well as the size of the household (p=0.027) are statistically different between the groups of mothers with unfavorable nutritional KAP and those with favorable nutritional KAP.

Socioeconomic and Food Security Characteristics

The results of our study show (See Table 3) that the availability of arable land (p=0.012), food accessibility (p=0.000), as well as food availability (p=0.000) are statistically different between groups of mothers with unfavorable nutritional KAP and those with favorable nutritional KAP.

Characteristics related to the organization and operation of the health system

Our results show (See Table 4) that participation in nutritional education sessions (p=0.001) and attendance at the FoSa (p=0.015) are statistically different between groups of mothers with unfavorable nutritional KAP and those with favorable nutritional KAP.

Hygiene-related characteristics

The results of our study show (See Table 5) that environmental sanitation (p=0.000), water used in the household for drinking and cooking (p=0.000), as well as knowledge of key moments for hand washing (p=0.000) are statistically different between groups of mothers with unfavorable nutritional KAP and those with favorable nutritional KAP.

Characteristics related to breastfeeding and child feeding

Our results show (See Table 6) that only the frequency of breastfeeding (p=0.040) is statistically different between groups of mothers with unfavorable nutritional KAP and

those with favorable nutritional KAP.

Table 7 After the analyses (bivariate analysis supplemented by a multivariate analysis) six variables were significantly associated (p<0.05) with the unfavorable nutritional KAP of mothers of children aged 6-59 months in Kayanza HD. These are the mother's age, the mother's level of education, food accessibility, food availability, participation in nutrition education sessions as well as knowledge of key moments for hand washing.

- Mothers aged 35 or older would be 7.62 times more likely to have unfavorable nutritional KAP in the fight against chronic malnutrition than mothers aged 20 to 35.
- Mothers with a low level of education (uneducated and primary level) would be 9.33 times more likely to have unfavorable nutritional KAP in the fight against chronic malnutrition than those with a high level of education (secondary and university).
- Mothers from households without food access would be 6.69 times more likely to have unfavorable nutritional KAP in terms of combating chronic malnutrition than those from households with food access.
- Mothers from households without food availability would be 22.37 times more likely to have unfavorable nutritional KAP in terms of combating chronic malnutrition than those from households with food availability.
- Mothers who did not participate in nutrition education sessions were 12.09 times more likely to have unfavorable nutritional KAP in the fight against chronic malnutrition than those who did.
- Mothers who were unaware of key handwashing times were 18.47 times more likely to have unfavorable nutritional KAP in the fight against chronic malnutrition than those who were aware of them.

Discriminatory power of the model

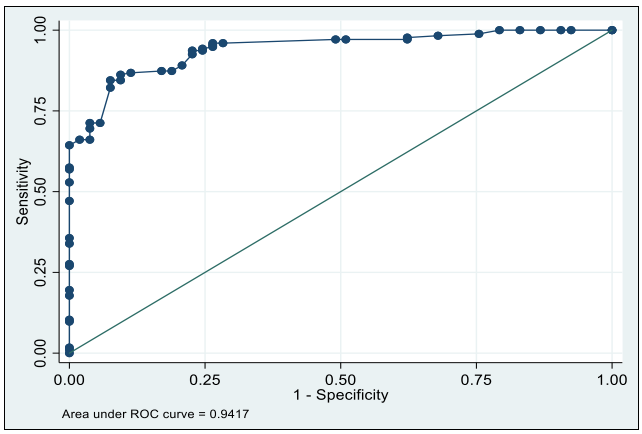

Fig 1: ROC curve

The graph above shows the ROC curve obtained from the results of the final model. The area under the ROC curve is 0.9417. The model's ability to correctly classify observations is 94.17%. We can therefore conclude that this model has predictive power, with excellent discrimination.

Discussion

The objective of our study was to analyze the factors associated with unfavorable nutritional knowledge, attitudes, and practices among mothers of children aged 6 to 59 months regarding the fight against chronic malnutrition in the Kayanza Health District in Burundi.

Our study shows that 76.65% of respondents had unfavorable nutritional knowledge, attitudes, and practices regarding the fight against chronic malnutrition. This could explain the high prevalence of chronic malnutrition among children under five years of age that prevails in the Kayanza Health District (60.4%).

At the end of the multivariate analysis, six factors were identified as predictors of unfavorable nutritional KAP of mothers of children aged 6 to 59 months in the fight against chronic malnutrition. These are the age group of the mother 35 years and over (p=0.001), the insufficient level of education (uneducated and primary level) of the mother (p=0.000), limited food accessibility of the household (p=0.007), low food availability of the household (p=0.000), non-participation in nutrition education sessions (0.001) as well as insufficient knowledge of mothers of key moments for hand washing (p=0.000).

Maternal age often influences mothers' nutritional knowledge, attitudes and practices regarding their children's feeding, which in turn influences the prevalence of stunting in these children. Our study found that mothers aged 35 and over are 7.62 times more likely to have unfavorable nutritional CAP in the fight against chronic malnutrition than mothers in other age groups (ORA=7.62; 95% CI [2.37-24.43]; p=0.001). Our results are close to those of Mounkaïla A.A.I. *et al*. (2022) in Niger where they found that there is a significant relationship between the age of introduction of complementary foods and the age of mothers [25-29 years] (p=0.001) [23]. This could be explained by the fact that mothers in this age group most often have many children to take care of as well as other household activities, which does not allow them to have the time to document themselves in relation to the favorable nutritional KAP in the fight against chronic malnutrition of their children.

Mothers' low educational attainment (unschooled and primary school) is often associated with failure to access health facilities (FoSa) in time to seek care in the event of their own or their child's illness, or to seek other health information as needed.

Our study found that mothers with no formal education and those with a primary school education were 9.33 times more likely to have unfavorable nutritional KAP in the fight against chronic malnutrition than those with secondary and university education (AOR=9.33; 95% CI [3.07-28.38; p=0.000). Our results are similar to those found by Dembélé Y. *et al* (2023) in their study on the knowledge, attitudes and practices of mothers regarding malnutrition in children under 5 years old in the CSREF of Sikasso in 2022 where only 28.1% of uneducated mothers knew the causes of malnutrition and 19.8% of uneducated mothers knew the main signs and only 49.5% of uneducated women knew how to prevent malnutrition [18]. Our results also corroborate with those of Mounkaïla A.A.I. *et al*. (2022) in their study on the knowledge, attitudes and practices of mothers of children aged 6 to 24 months regarding complementary feeding in the commune of Liboré in Niger where they found that there is a significant relationship between the child's diet before 6 months and the mothers' level of education [23].

Our results are also comparable to those of Kauky M. S. *et al*. (2023) in their study in Tanzania, where they found that malnutrition is more common among children whose mothers have no formal education or only primary education

than among those whose mothers have secondary or higher education [24].

The household's standard of living plays a role in the well-being of household members. Indeed, in a riding school where there is affluence related to the satisfaction of basic needs, its members can participate in various activities organized in the community, such as awareness sessions on health or nutrition promotion.

The results of our study show that mothers with limited food accessibility are 6.69 times more likely to have unfavorable nutritional KAP in the fight against chronic malnutrition than those with good food accessibility (AOR=6.69; 95% CI [1.68-26.68]; p=0.007). Those with low food availability are 22.37 times more likely to have unfavorable nutritional KAP in the fight against chronic malnutrition than those with sufficient food availability (AOR=22.37; 95% CI [7.27-68.85]; p=0.000). Our results are similar to those of Mutisya LM., (2019) in his study in Ethiopia where he found that children from poor households are 1.7 times more likely to be malnourished than those from rich households [25]. Our results are also comparable to those of Kauky M. S. *et al*. (2023) in their study in Tanzania where the results revealed a negative relationship between belonging to a wealthier household and stunting in children. This suggests that children from wealthier households are less likely to experience stunting than those from poorer households. Kauky M.S. *et al*. state that wealthier households likely have better access to resources such as nutritious food, clean water, and health services, which leads to improved growth and development in children [24].

The results of our study show that mothers who did not participate in nutrition education sessions are 12.09 times more likely to have unfavorable nutritional CAP in the fight against chronic malnutrition than those who participated (AOR=12.09; 95% CI [2.82-51.78]; p=0.001). Our results are similar to those found by Abate AD *et al*. (2023) in their study for which mothers who received follow-up visits for postnatal consultation were 4.32 times more likely to start complementary feeding on time for children aged 6 to 23 months than mothers who did not [AOR = 4.32, 95% CI (2.77-6.72)]; p= <0.001 [26]. Our findings are similar to those of a study conducted in AbyeiAdi, Ethiopia, by Mekbib E. *et al*. (2014) where mothers who received follow-up visits for postnatal care were significantly associated with timely initiation of complementary feeding for children aged 6–23 months [AOR = 2.80, 95% CI (1.11–7.03)] [27]. This could be attributed to the fact that, as part of postnatal care services, health professionals educate and counsel mothers on complementary feeding practices.

The study by Abate AD *et al*. (2023) also found that mothers who received follow-up visits for antenatal care were 6.19 times more likely to initiate complementary feeding on time than mothers who did not [AOR = 6.19, 95% CI (4.08-9.40)]; p=0.001 [26]. Our findings are similar to a study conducted in Addis Ababa, Ethiopia by Yeheyis T. *et al* (2016) where mothers who received antenatal care were significantly associated with timely initiation of complementary feeding for children aged 6-23 months [AOR = 4.78, 95% CI (1.30-17.47)] [28]. One possible reason is that visiting a health facility during pregnancy is an excellent opportunity to obtain health information and advice on complementary feeding.

Our results are also similar to those of Prasetyo *et al*. (2021) in their study where they found that nutrition education can improve the knowledge and practices of mothers of children aged 6 to 23 months regarding complementary feeding of their children [29].

Demonstrations can make learning more explicit and concrete, and encourage participants to be more active in observing and experimenting on their own [30].

The results of our study show that mothers who do not know the key moments for handwashing are 18.47 times more likely to have unfavorable nutritional KAP in the fight against chronic malnutrition than those who do (AOR = 18.47; 95% CI [6.20-55.02]; p = 0.000). Our results are consistent with those of Barengayabo P. (2020) in her study, where poor knowledge of key moments for handwashing with soap by mothers is associated with an increased risk of stunting in their children [31]. Also, our results are supported by other studies which confirm that handwashing with soap significantly reduces the occurrence of diarrhea [32], and consequently, contributes to the reduction of stunting. In addition, handwashing with soap is one of the cheapest and most effective ways to prevent infectious diseases and prevent the transmission of bacteria and certain viruses [33]. This gap could be explained by the fact that the majority of mothers have limited access to information on handwashing with soap.

Limitations of Study

Being a cross-sectional study, our research simultaneously investigated the nutritional KAP of mothers of children aged 6 to 59 months in terms of combating chronic malnutrition and the factors associated with it. As a result, certain biases may appear, such as memory bias, because respondents may forget old information, distorting the chronology of the occurrence of the problem studied and that of the risk factors.

Conclusion

Our study aimed to analyze the factors associated with the nutritional knowledge, attitudes and practices of mothers of children aged 6 to 59 months in the fight against chronic malnutrition in households in the Kayanza Health District and focused on a sample of 227 mothers in October 2024.

The results of the National Survey on Nutritional Situation and Mortality based on the SMART methodology of 2022 indicate that the prevalence of chronic malnutrition is very high in the Kayanza HD (60.4%), which means that this condition remains a serious public health problem among children aged 6 to 59 months, thus highlighting the seriousness of the nutritional situation in households in the Kayanza HD. Given that the nutritional knowledge, attitudes and practices of mothers play an undeniable role in the nutrition of their children, our study focused on the factors associated with the latter. The results of our study indicate that the nutritional KAP of mothers of children aged 6-59 months are significantly associated with the age group of the mother of 35 years and above (ORA=7.62; 95% CI [2.37-24.43]; p=0.001), the insufficient level of education (uneducated and primary level) of the mother (ORA=9.33; 95% CI [3.07-28.38]; p=0.000), limited household food accessibility (ORA=6.69; 95% CI [1.68-26.68]; p=0.007), low household food availability (ORA=22.37; 95% CI [7.27-68.85]; p=0.000), non-participation in nutrition education sessions (AOR=12.09; 95% CI [2.82-51.78]; p=0.001) as well as insufficient knowledge among mothers about key handwashing times (AOR=18.47; 95% CI [6.20-

55.02]; p=0.000). These six factors were identified as predictors of unfavorable nutritional KAP among mothers of children aged 6 to 59 months in Kayanza Health District households.

To combat chronic malnutrition in the Kayanza Health District, specific interventions should target the six predictive factors of chronic malnutrition that our study has just identified.

Consent to Publish

To Publish Before submitting the manuscript, there was consent of the authors for its submission.

Availability of Data and Materials

I declare on my honor that the data and materials used in the writing of this manuscript are available in the file entitled "manuscript data submit". I also declare that this data may be made public by the scientific community for research purposes or during review of the manuscript by editors or reviewers.

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Acronyms and Abbreviations

AOR	Adjusted Odds Ratio
CI	Confidence Interval
DHS	Demographic and Health Survey
DRC	Democratic Republic of Congo
EANSI	East African Nutritional Sciences Institute
ENSNMB	National Nutritional Situation and Mortality Survey
ENSNSAB	National Survey on Nutrition and Food Security in Burundi
HC	Health Center
KAP	Knowledge, Attitudes, and Practices
KHD	Kanyanza Health District
OR	Odds Ratio
WHO	World Health Organization

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