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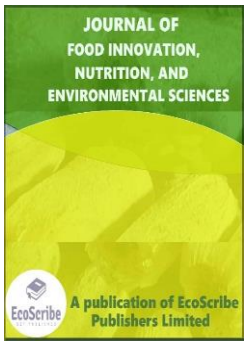

ORIGINAL RESEARCH ARTICLE

Assessment of Food Security, Eating Patterns, Physical Activity and Nutritional Status among Lactating Women in Bujumbura, Burundi

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ABSTRACT

For lactating women, nutritional requirements for supporting maternal health and optimal infant growth are generally insufficient in low-income countries, like Burundi. Due to insufficient information covering this issue, our study aimed to assess the relationship between food security, eating patterns, dietary diversity, daily physical activity, and nutritional status among lactating women in Bujumbura, Burundi. A cross-sectional study was used over one month where participants' recruitment used a consecutive sampling technique. Considering the estimated underweight prevalence (11%) among lactating women of reproductive age in Burundi, sample size was calculated to be 165. IBM SPSS version 20.0 used as analysis tool. Among 165 lactating women, most were aged 20-30 years (53.3%), married (92.7%), unemployed (64.8%), had at least secondary education (72.7%), and had fewer than three children (61.8%). After adjusting for age, marital status, education, occupation and parity, achieving minimum dietary diversity was protective against underweight (AOR = 0.267; 95%CI 0.069 -1.038, p = 0.047) and significantly associated with overweight (AOR = 2.646; 95%CI, 0.968 - 7.231 p = 0.031). Low physical activity was strongly associated with obesity ((AOR = 24.990; 95%CI 1.477-422.824, p = 0.026), and underweight (AOR = 7.937; 95%CI 1.375 -45.804, p = 0.021), while high physical activity was positively associated with achieving dietary diversity (AOR = 6.800; 95% CI 2.413 -19.161; p = 0.000). Food security alone was not significantly associated with either underweight, overweight, or obesity. Nutritional status among lactating women in Bujumbura is influenced more by dietary diversity and physical activity than by household food security alone. Promoting diverse diets and active lifestyles, alongside programs improving food access, are recommended.

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1. INTRODUCTION

Food sufficiency, physical activities, and dietary quality and diversity during the lactation period are essential for maternal and child health. Physiologically, the nutritional demand increases during pregnancy and lactation, highly in both calorie and essential nutrients. However, maternal and child malnutrition is a severe public health problem globally, contributing to approximately 51% of all deaths among under five years in 2021 (Ritchie, 2024). Hunger and malnutrition are a common problem among children and women in Burundi (Ishimwe, 2021). The country reported highest rates of children chronic malnutrition of 54% (UNICEF, 2019) with women and children being most vulnerable to the risk of hunger and malnutrition (Niragira *et al*., 2020). Among women aged 15-49, a survey shows that 19% are underweight (BMI<18.5 kg/m²) and 8% are overweight/obese (DHS, 2017). Their anemia prevalence reported to be incremented from 19% in 2010 to 39% in 2017 (DHS, 2017). The prevalence of stunting among children under five remains above, 56%, 57%, 54.2%, 52.2% and 55.8% in 2017, 2018, 2019, 2020, and 2022 respectively with sharp fall on children aged 6 to 23 months having a minimum dietary diversity, 19%, 57.3%, 17.5%, 7.7%, 20.6% in 2017, 2018, 2019, 2020, and 2022 respectively (UNICEF, 2023). In addition, anemia affected children aged 6 to 59 months with the proportion of 45% in 2010 that rose to 61% in 2017 (DHS, 2017). The proportion of pregnant women suffering from anemia rose from 19% in 2010 to 39% in 2016 (DHS, 2017). WFP (2023) reported that over 65% of Burundians are food insecure with low dietary diversity among lactating mother (often includes a large portion of starchy foods) (UNICEF, 2023).

Recent analyses reported that, Most Burundian women consume on average approximately 4 of the 10 Minimum Dietary Diversity for Women food groups, which is below the FAO/WHO minimum dietary diversity threshold (Emera *et al*., 2025). These suggest that a large proportion of Burundian mothers begin lactation already nutritionally compromised, which can impair both their health and breast-milk quality. Although food insecurity and dietary monotony are endemic in Burundi, they are insufficiently assessed for risk factors among mothers during lactation, a life stage of high nutritional demand. The existing geographic inequalities in food insecurity is considered as a major challenge in achieving the goal of Burundi's National Development Plan (NDP 2018-2027) and the UNSD second goal of Sustainable Development (Zero Hunger) by 2030 (Pe´rez-Escamilla, 2017). The budget allocations for nutrition related initiatives as a proportion of the total state budget on 2023-2024 was very low (0.32%) (UNICEF, 2023) reflecting the need for better understanding on the local health needs for the allocation of resources accordingly. Thus, this study aimed to assess the interplay between food security, eating patterns, physical activity, and nutritional status among lactating women in Bujumbura. Understanding these relationships is crucial for developing targeted interventions to improve women health outcomes in this urban setting.

2. MATERIALS AND METHODS

2.1 Study area

The study conducted in Bujumbura urban located at 3°23′S 29°22′E northeastern shore of Lake Tanganyika in Burundi (**Figure 1**). Bujumbura is a Burundi's largest city and near the border with the Democratic Republic of the Congo (DRC), serving as the country's primary port and a vital commercial center. Bujumbura is the economic hub of the country, having industries focused on processing and manufacturing like textiles, leather and agricultural products. Its urban settings often show diverse socio-economic status and nutritional challenges.

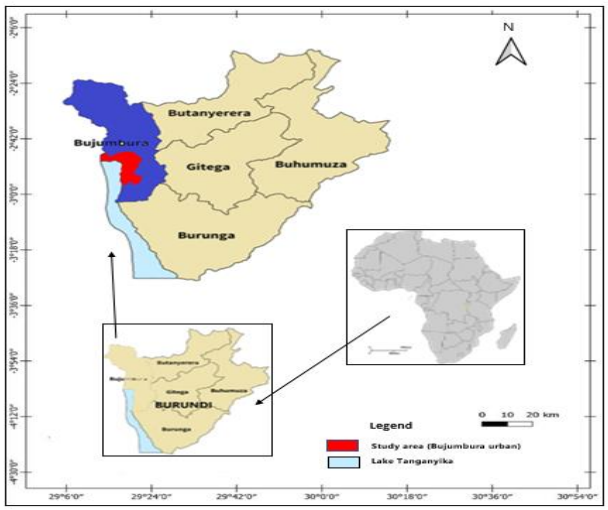

Fig. 1. Map showing study area (Bujumbura urban, Burundi)

2.2 Study design

The study adopted a cross-sectional analytical design collecting data at a single point in a specific time.

2.3 Study population

The study population comprised lactating women aged 18 to 49 years residing in Bujumbura, Burundi and caring for infants aged 0-12 months. Lactating women aged 18 to 49 years, currently lactating regardless of parity, and had infants aged 0-12 months were included. Infants aged 0-12 months were selected due to its critical for growth and survival, where feeding practices; exclusive breastfeeding and timely complementary feeding, directly determine nutritional status and development. Women with seriously ill or hospitalized, who refused consent for either quantitative or qualitative components and who were non-residents of Bujumbura or had lived in the city for less than six months were not included.

2.4 Sampling procedures

The study was conducted at Kamenge (Roikhaled) Hospital (CHUK), a tertiary-level public teaching and national

referral hospital providing comprehensive maternal and child health services. A facility-based cross-sectional study

was conducted using a consecutive sampling technique over a period of 30 days. A total of 210 lactating women attending postnatal clinics were approached and screened for eligibility, of whom 175 met the inclusion criteria. Among eligible participants, 165 provided written informed consent and were enrolled in the study, while 10 declined to participate, primarily due to lack of time and personal reasons. No participants were excluded after enrollment; therefore, the final sample size included in the analysis was 165.

2.5 Sample size determination

Moisture, Sample size was calculated using Cochran's formula for prevalence studies (Cochran, 1977):

$$n = \frac{Z^2.p\,.(1-p)}{e^2}$$

Z = 1.96 (95% confidence level)
p = 0.11, estimated underweight prevalence among women of reproductive age in Burundi (11%) (Global Nutrition report, 2023)
e = 0.05, margin of error (acceptable one)

$$n = \frac{1.96^2 x\ 0.11(1-0.11)}{0.05^2}$$

Adjusting for non-response, 10% non-response rate was added as recommended by Setia (2016),

$$n = 150 + (0.10x150) \qquad n = 165$$

Then, the sample size of 165 lactating women was used in the study.

2.6 Data collection

A pre-tested structured questionnaire was administered to obtain information on socio-demographic characteristics and obstetric history and feeding practices. Household's food security was assessed and classified according to FAO/USAID HFIAS guidelines that uses 4-weeks recall. This highlighted 9 questions with responding options of never, rarely (1-2 times), sometimes (3-10 times) and often (>10 times). The respondent was required to tick on either option, only once per option per each question. Food secure household was classified as one responded no real food problems (either "never" or "rarely" in question one and all remained questions as "never"), otherwise was termed as food insecure (Coates *et al*., 2007). The Minimum Dietary Diversity for Women (MDD-W) tool that uses a 24-hour recall to count how many of 10 standardized food groups a woman (15-49 years) consumed was used to asses Minimum Dietary Diversity. Each group consumed was scored 1 and one not consumed was scored 0. The MDD-W score was calculated as the sum of groups (0-10). A woman consumed greater than 5 food groups (out of 10) was classified as achieving minimum dietary diversity (FAO & FHI 360, 2016). Physical activity (PA) was assessed by using the Global Physical Activity Questionnaire (GPAQ) from WHO. (WHO, 2020). It was then quantified using MET-minutes per week, where one MET (metabolic equivalent of task) is the energy cost of resting. Energy expenditure for an activity was then calculated as;

$$\boldsymbol{MET-minutes/week} = MET\ value \times (minutes\ per\ day) \times (days\ per\ week)$$

Where MET value was taken as constant valued 8.0 for vigorous work and vigorous recreational activities, and 4.0 for moderate work, moderate recreational activities and transport activities. Then, the physical activity was calculated as a total MET-minutes per week. It was classified as low (inactive) physical activity (<600 MET-minutes/week), moderate (minimally active) physical activity (≥600 MET-minutes/week) and high (active) physical activity (≥3000 MET-min/week) (WHO, 2020).
Anthropometric measurements were conducted using standardized procedures to assess the nutritional status of participating lactating women. Height was measured with a stadiometer, while weight was recorded on a calibrated digital scale following the NHANES 2021 Anthropometry Procedures Manual (CDC, 2021). Measurements were taken twice, and the average was recorded to ensure accuracy. Before measurements, each mother removed her shoes and any heavy items (example, jackets or handbags) to minimize error. After height and weight measuring, BMI was calculated using the formula;

$$\boldsymbol{BMI} = \frac{Weight\ (kg)}{Height\ (m)^2}$$

Participants were then classified according to WHO cutoffs: underweight (<18.5 kg/m²), normal weight (18.5-24.9 kg/m²), overweight (25-29.9 kg/m²), and obese (≥30 kg/m²).

2.7 Statistical analysis

Statistical analysis was conducted using SPSS version 20.0 Outcome variables with two categories (food security and dietary diversity) were analyzed using binary logistic regression, while variables with more than two categories (physical activity levels and nutritional status) were analyzed using multinomial logistic regression, with the most common category selected as the reference group for comparison. For each regression model, the adjusted odds ratio (AOR) and 95% confidence interval (CI) were calculated to quantify the strength and direction of associations between independent variables and the outcomes. A p-value < 0.05 was used to determine statistical significance. All reported p-values, AORs, and confidence intervals were interpreted in the context of the study objectives, and results were presented in tabular form to facilitate comparison across variables.

2.8 Ethics approval and Consent

An introductory letter was obtained from East African National Sciences Institute (EANSI) and presented to Kamenge (Roikhaled) Hospital (CHUK) to facilitate data collection. Permission to conduct the study was sought through appropriate institutional channels, and participation was voluntary, with informed consent obtained and confidentiality maintained throughout the study.

3. RESULTS AND DISCUSSION

3.1 Demographic information

Among 165 lactating women, most were aged 20-30 years (53.3%), married (92.7%), unemployed (64.8%), had attained at least secondary education (72.7%), and had fewer than three children (61.8%) (**Table 1**). Similar age structures and high marriage rates among lactating women have been reported in Ethiopia, reflecting peak fertility and lactation periods where childbearing predominantly occurs within marriage (Seid & Cherie, 2022; Gizachew *et al*., 2024). Studies in Nepal and Southern Ethiopia also reported high unemployment among lactating women, indicating rare formal employment despite education attainment (Singh *et al*., 2020; Gizachew *et al*., 2024). Although many women had at least secondary education, studies show that education alone does not guarantee food security or dietary diversity due to household food insecurity, food cost, availability, and access (Zegeye *et al*., 2025; Seid & Cherie, 2022).

3.2 Food Security Among Lactating Women

Food insecurity was highly prevalent in the study, affecting 84.2% of lactating women (**Table 1**). This is similar to other East African studies where it persists in urban populations due to economic constraints and fluctuating food prices (Leroy *et al*., 2021). A systematic review showed its disproportionately effects on women in low-resource settings, often reducing dietary quality and meal reduction (Carvajal-Aldaz *et al*., 2022). This prevalence is higher than national estimates of 65% (WFP, 2023), suggesting that, lactating women in dense urban areas like Bujumbura face heightened economic stress, similar to findings in Kenya where food insecurity predicts underweight and overweight (Keino *et al*., 2014). Binary logistic regression showed peasant engagement and education were significant determinants, with primary or no education reducing food insecurity compared to tertiary education (**Table 1**). This suggest that, higher education does not always ensure stable income (Smith & Haddad, 2015; Global Nutrition Report, 2023). Age, marital status, and parity were not significant determinants of food security (Assenga & Kayunze, 2020). In response to rising food costs, lactating women adopt various coping strategies that reflect both proactive and constrained measures to maintain household food access. These included starting economic activities, reducing meals, buying food at the same cost, or buying affordable foods only. Tsegaye *et al*., (2018) reported that, households combine income-generating strategies with dietary modifications to manage food insecurity.

Table 1. Binary logistic regression for demographic information and determinants of food security and minimum dietary diversity among lactating women in Bujumbura, Burundi (n=165)

Variable	Categories	n (%)	Food security [a]			Attain Minimum Dietary Diversity [b]		
			AOR	95% CI	Sig	AOR	95% CI	Sig
Age	Above 40	5(3.0%)	*Reference*					
	31 to 40	65(39.4%)	1.217	0.040-36.909	0.910	1.026	0.042-25.228	0.987
	20 to 30	88(53.3%)	0.689	0.050-9.471	0.781	1.766	0.109-28.518	0.689
	<20	7(4.2%)	0.649	0.049-8.605	0.743	1.209	0.075-19.483	0.894
Marital status	Divorce	6(3.6%)	*Reference*					
	Married	153(92.7%)	0.106	0.005-2.278	0.152	17.88	0.812-23.71	0.068
	Single	6(3.6%)	0.870	0.073-10.429	0.912	2.274	0.196-26.410	0.512
Educational level	Tertiary	47(28.5%)	*Reference*					
	Secondary	73(44.2%)	2.513	0.399-15.838	0.327	1.486	0.296-7.459	0.630
	Primary	34(20.6%)	7.889	1.556-40.012	0.013	1.254	0.351-4.478	0.727
	None	11(6.7%)	3.524	1.151-10.791	0.027	0.440	0.161-1.200	0.109
Occupation	None	107(64.8%)	*Reference*					
	Small business	21(12.7%)	1.034	0.184-5.818	0.970	0.339	0.065-1.771	0.200
	Employed	18(10.9%)	1.453	0.339-6.235	0.615	2.586	0.765-8.740	0.126
	Peasant	19(11.5%)	0.249	0.069-0.903	0.034	1.355	0.409-4.487	0.619
Parity	> 5	4(2.4%)	*Reference*					
	3 to 5	59(35.8%)	1.509	0.124-18.429	0.747	0.828	0.068-10.095	0.882
	< 3	102(61.8%)	1.162	0.091-14.913	0.908	0.361	0.028-4.682	0.436
Food security	Food insecure	139(84.2%)				*Reference*		
	Food Secure	26(15.8%)				1.145	0.408-3.215	0.797

a. The reference category: Food insecurity
b. The reference category: Not attain minimum dietary diversity

3.2 Eating pattern and dietary diversity among lactating women

Despite widespread food insecurity, 53.3% of lactating women in Bujumbura consumed three meals daily, though 61.2% reported late eating and 35.8% ate only when hungry (**Table 2**). Consumption of animal-source foods was low (3.2%), while plant-based staples such as beans (41.3%) and vegetables (39.2%) dominated (**Figure 2**), consistent with national reports indicating limited animal product intake due to cost (WFP, 2023). This mirrors dietary patterns in other food-insecure urban settings, where reliance on low-cost, plant-based foods provides some variety but may lack bioavailable nutrients (Islam *et al*., 2023; Weil *et al*., 2023). Notably, 75.2% of women achieved the Minimum Dietary Diversity for Women (MDD-W), suggesting short-term food varieties consumption (**Table 2**), consistent with findings from *Tubaramure* program evaluations (Leroy *et al*., 2021). Such high dietary diversity despite high food insecurity also reflects the differences in the recall time, 24-hour for minimum dietary diversity reflecting a temporary intake, and 4-week for food security capturing a chronic access problem. Thus, a household may eat a varied diet in one day but still be food insecure over time. Binary logistic regression indicated no significant association between socio-demographic variables and minimum dietary diversity attaining (**Table 1**), highlighting the influence of broader factors such as household income, market access, agrobiodiversity, and seasonality (Assenga & Kayunze, 2020).

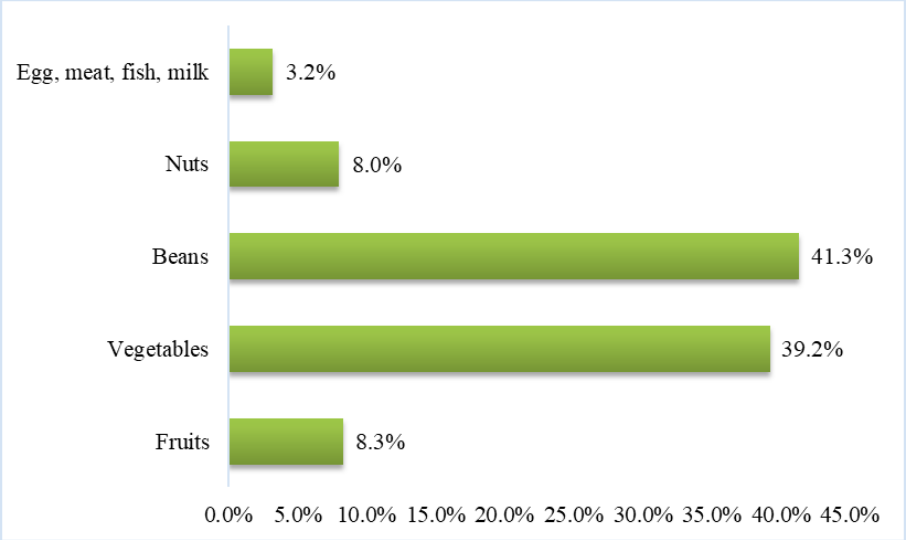

Fig.2. Common food taken among lactating women in Bujumbura urban, Burundi

Table 2. Minimum dietary diversity and eating pattern of lactating women in Bujumbura, Burundi (n=165)

Variables		Frequency	Percent (%)
MDD-W			
Attained		124	75.2
Not attained		41	24.8
Meals consumed per day			
One		7	4.2
Two		56	33.9
Three		88	53.3
> three		14	8.5
Total		165	100.0
Feeling of hunger			
Yes	Eat very late	101	61.2
	Eat when hungry	59	35.8
No		5	3.0

3.4 Daily physical activity among lactating women

Physical activity ranged from moderate (≥600 MET-min/week) to high (≥3000 MET-min/week), with 43% in each category and only 14% below the normal range (< 600 MET-min/week) (**Figure 3**). Despite these levels, national data indicate that 40% of Burundian women do not meet WHO activity recommendations (World Obesity Federation, 2025). Non-organized activities, including walking and household chores, contributed substantially to overall physical activity, though formal exercise offers additional health benefits (Bizimana *et al*., 2016). These patterns align with WHO guidance for postpartum women, emphasizing the role of routine daily movements in energy expenditure (WHO, 2020).

3.5 Nutritional status among lactating women

The data reveal a double burden of malnutrition with 9.1% underweight, 35.8% overweight, 6.1% obese, and 49.0% healthy weight (**Figure 4**). Overweight prevalence in this urban sample exceeds national estimates (10.5%) and mirrors trends in other urban sub-Saharan African populations undergoing nutritional transition (Atsu, 2024; Global Nutrition Report, 2023). This coexistence of overweight and food insecurity reflects the food insecurity–obesity paradox, where limited budgets promote reliance on inexpensive, energy-dense foods, a pattern supported by evidence from Kenya (Carvajal-Aldaz *et al*., 2022). Keino *et al*. (2014) reported that, limited food access may predispose women to both undernutrition and overweight due to irregular eating and dependence on cheap calories

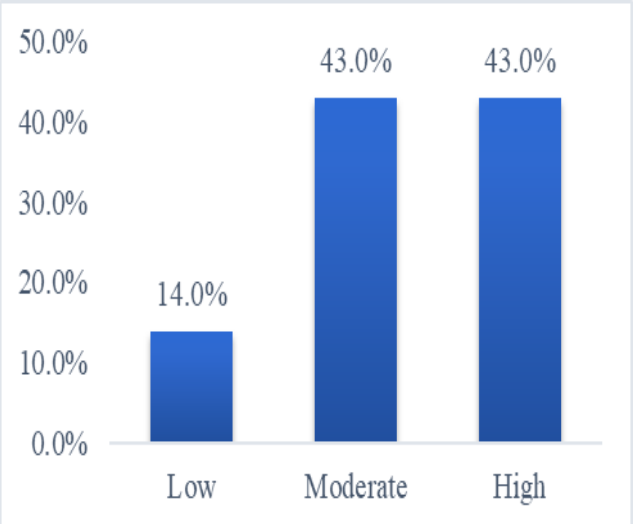

Fig. 3. Daily physical activity among lactating women in Bujumbura, Burundi

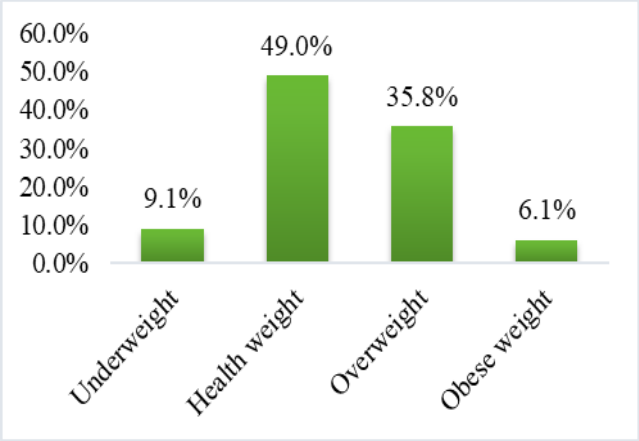

Fig.4. Nutritional status among lactating women in Bujumbura, Burundi

3.6 Food security, dietary diversity and daily physical activity

Binary logistic regression showed that, food security was not significantly associated with maintaining minimum dietary diversity (AOR =1.145; 95%CI 0.408-3.215 p = 0.797) After adjusting for age, marital status, education, occupation and parity (**Table 1**). This supports evidence that food secure households may still consume monotonous diets due to cultural practices, food preferences, or economic prioritization (Chakona, 2023). Thus, food access does not automatically guarantee diet quality among lactating women. After adjusting for age, marital status, education, occupation and parity, multinomial logistic regression showed that high physical activity was strongly associated with attaining minimum dietary diversity than not attaining minimum dietary diversity (AOR = 6.800; 95% CI 2.413 - 19.161; p = 0.000) compared to normal physical activity (**Table 3**). This suggests that women who are more physically active may also engage in healthier dietary behaviors or possess better overall functional and socio-economic status. Similar associations have been reported among postpartum women in low- and middle-income countries, where active lifestyles were linked with improved dietary practices (Zegeye *et al*., 2025).

3.7 Food security, dietary diversity, paily physical activity and nutritional status

After adjusting for age, marital status, education, occupation and parity, multinomial logistic regression showed food security was not significantly associated with either underweight, overweight or obese weight (**Table 4**). This suggest that household food access alone may not capture maternal nutritional status, consistent with findings from Kenya where food security lost significance after controlling for dietary and behavioral factors (Keino *et al*., 2024). Dietary diversity was protective with women achieving minimum diversity having lower odds of underweight (AOR = 0.267; 95%CI 0.069 -1.038, p = 0.047) than normal weight compared to women who were not archiving minimum dietary diversity (**Table 4**). Similarly,

evidence from Dessie Town, Ethiopia showed that inadequate dietary diversity was independently associated with maternal undernutrition (AOR = 3.8, 95%CI 2.08-77.03) (Seid & Cherie, 2022). Low physical activity increased the odds of underweight (AOR = 7.937; 95%CI 1.375 -45.804, p = 0.021) than normal weight when compared to high physical activity (**Table 4**), reflecting poor health, fatigue or insufficient energy intake, as observed in Taiwanese adults (Lee *et al*., 2023).

For overweight, while attaining minimum dietary diversity was associated with higher odds (AOR = 2.646; 95%CI, 0.968 - 7.231 p = 0.031) than not attaining minimum dietary diversity when compared to normal weight, physical activity was not-significant (**Table 4**). This aligns with emerging evidence from sub-Saharan Africa indicating that diversified diets in urban areas often include energy-dense and processed foods, contributing to increased body weight among women of reproductive age (Zegeye *et al*., 2025). Obesity was strongly associated with low physical activity (AOR = 24.990; 95%CI 1.477-422.824, p = 0.026) than high physical activity when compared to normal weight (**Table 4**) demonstrating that sedentary behavior during the postpartum period substantially increases the risk of obesity among women (Mosha *et al*., 2021).

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Table 3. Multinominal logistic regression for association between physical activity, food security and dietary diversity among lactating women (n=165)

Physical activity [c]		**AOR**	**95% CI**	**Sig**
Low physical activity	Food secure	0.782	0.185 - 3.307	0.738
	Food insecure	*Reference*		
	Attained diversity	1.402	0.467 - 4.214	0.547
	Not attained diversity	*Reference*		
High physical activity	Food secure	1.360	0.493 -3.752	0.553
	Food insecure	*Reference*		
	Attained diversity	6.800	2.413 -19.161	0.000
	Not attained diversity	*Reference*		

c. The reference category is: Normal physical activity

Table 4. Multinomial logistic regression for association between food security, dietary diversity, daily physical activity and nutritional status among lactating women (n=165)

Nutritional status [a]		**AOR**	**95% CI**	**Sig**
Underweight	Food secure	0.346	0.033 - 3.576	0.373
	Food insecure	*Reference*		
	Attained diversity	0.267	0.069 -1.038	0.047
	Not attained diversity	*Reference*		
	Low activity	7.937	1.375 -45.804	0.021
	Moderate activity	1.210	0.209 -7.008	0.832
	High activity	*Reference*		
Overweight	Food secure	2.005	0.743 -5.410	0.170
	Food insecure	*Reference*		
	Attained diversity	2.646	0.968 - 7.231	0.031
	Not attained diversity	*Reference*		
	Low activity	1.236	0.348 - 4.385	0.743
	Moderate activity	0.880	0.367 -2.107	0.774
	High activity	*Reference*		
Obese weight	Food secure	1.351	0.155 -11.791	0.786
	Food insecure	*Reference*		
	Attained diversity	10.238	0.722 -145.223	0.086
	Not attained diversity	*Reference*		
	Low activity	24.990	1.477 - 422.824	0.026
	Moderate activity	13.737	0.890 - 212.085	0.061
	High activity	*Reference*		

a. The reference category is: Normal weight

CONCLUSION

Nutritional status among lactating women in Bujumbura is influenced more by dietary diversity and physical activity than by household food security alone. Despite a relatively educated population, high unemployment and suboptimal postpartum, dietary practices limit maternal nutrition. Interventions promoting diverse diets and active lifestyles, alongside programs improving food access, are critical to enhancing maternal nutritional outcomes in urban Burundi.

CONFLICT OF INTEREST

All authors declare that they do not have any conflicts of interest that could have appeared to influence the work reported in this paper.

DATA AVAILABILITY

The data used to support the findings of this study are available upon reasonable request from the corresponding author.

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