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Determinants of knowledge, attitudes, and practices toward edible insect consumption in Rwanda's Nyabihu and Ngororero districts

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ABSTRACT

As global populations confront food insecurity and malnutrition, edible insects have emerged as a sustainable and nutrient-rich alternative. However, consumer acceptance remains a critical barrier to widespread adoption. This study investigates the socio-demographic and cultural factors influencing knowledge, attitudes, and practices (KAP) regarding edible insect-based foods in Nyabihu and Ngororero districts of Rwanda. A cross-sectional study was performed with 397 randomly selected households using a structured questionnaire. Data were analyzed using descriptive statistics, chi-square tests, and logistic regression to identify predictors of KAP levels. Key informant interviews provided qualitative insights into cultural perceptions and consumption trends. Among respondents, 72.5% demonstrated proficient knowledge of edible insects, 70.5% displayed favorable views, and 62.4% had consumed edible insects. Higher education, professional occupations (including civil servants and traders), and the perception of insects as a traditional food source were strongly correlated with enhanced knowledge and positive attitudes ($p < 0.05$). Conversely, cultural taboos were significant negative predictors, reducing both knowledge and attitudes. Students, traders, and government workers exhibited higher levels of positive behaviors, whereas inhabitants of Ngororero and those citing cultural taboos were less inclined to participate in entomophagy. Despite a promising knowledge and attitudinal baseline, actual consumption remains below optimal levels, constrained by persistent socio-cultural barriers. District leaders and policymakers can utilize these results to implement targeted nutrition campaigns aimed at eliminating cultural taboos and promoting edible insect consumption. Rwandan food technologists, academicians, and entrepreneurs can leverage these findings to develop insect-based food products to combat child malnutrition.

Contribution/Originality: This study provides new insights into the understanding of knowledge, attitudes, and practices of rural Rwandan populations, which are crucial for designing effective interventions and policies that encourage entomophagy as a sustainable dietary practice. The study also educates people on the nutritional benefits of edible insects and addresses widespread Rwandan myths about their consumption, which may help combat child malnutrition in Rwanda.

1. INTRODUCTION

Edible insects are increasingly recognized as a viable solution to the global challenges of malnutrition and food insecurity. Rich in essential proteins, fats, vitamins, and minerals, insects offer a nutritional profile that often surpasses conventional animal proteins (Abdullahi, Igwe, & Dandago, 2022). Insect farming also offers significant environmental advantages: it requires less land and water, emits fewer greenhouse gases, and enables high feed conversion efficiency, making it an ecologically sustainable protein source (Cong, Dean, Liu, Wang, & Hou, 2024). The Food and Agriculture Organization (FAO) of the United Nations has endorsed entomophagy (the practice of consuming insects) as a promising avenue for strengthening global food systems (Salgado-Ramos et al., 2024). However, the acceptance of insects as food remains limited due to cultural taboos, safety concerns, and a lack of consumer awareness (Lange & Nakamura, 2021).

Entomophagy has a worldwide antecedent, with over 1,900 insect species in the traditional diets of 30% of the world's population (Omuse et al., 2024). Broad consumption demonstrates their historical and ongoing relevance in human diets, highlighting their potential as a sustainable nutritional resource (Colamatteo, Bravo, & Cappelli, 2025). Over the past decade, edible insects and entomophagy have been major topics in food, nutrition, and environmental sciences (Benes, Biró, Fodor, & Gere, 2022). By 2030, the edible insect business is expected to approach $3 billion, demonstrating its rising economic importance and potential to improve global food systems (Aidoo et al., 2023).

Undernutrition can affect the gut microbiota, impair the immune system, and increase the risk of non-communicable chronic illnesses such as diabetes, hypertension, and cardiovascular disease (Hibberd, Price, Harris, & Barnard, 2023). In many Asian and African countries, especially rural areas, underprivileged people consume edible insects to combat malnutrition (Zhou et al., 2022). Due to their accessibility and affordability, edible insects are often consumed in Sub-Saharan Africa, where undernutrition and food insecurity are widespread, and 30-40% of children under 5 are stunted (Van Huis, 2020).

The consequences of malnutrition are far-reaching, including increased susceptibility to anemia, respiratory infections, weakened immunity, and, ultimately, impaired physical and cognitive development (Bhutta, Guerrant, & Nelson III, 2017). Inadequate food intake, poor breastfeeding practices, micronutrient deficiencies, and recurring infections continue to undermine child health and survival. In addition, factors such as low maternal education, cultural food taboos, limited access to diverse foods, poor sanitation, and gender inequality further exacerbate the burden of undernutrition (Black et al., 2013; McNamara & Wood, 2019).

While a balanced diet containing carbohydrates, proteins, vitamins, minerals, and fats is essential for proper growth and development, food choices (like in rural Rwandan households) are often driven by availability rather than nutritional value (Pelto & Pelto, 2003). Diets in these regions are predominantly composed of starchy staples such as cassava, maize, sweet potatoes, and Irish potatoes, with minimal intake of protein-rich and micronutrient-dense foods such as fruits, vegetables, dairy, and animal-source products. Consequently, deficiencies in key nutrients such as vitamin A, iron, and zinc are common and contribute significantly to growth faltering and weakened immune systems in children (Prawirohartono, Nyström, Ivarsson, Stenlund, & Lind, 2011; Van Stuijvenberg et al., 2015).

Recent advances in food technology have allowed food technologists to fortify various plant-source ingredients with edible insects or to transform edible insects into valuable products, such as meat substitutes, baked goods, and protein-enriched flours. Processing innovations like protein hydrolysis, fermentation, and extrusion have augmented the nutritional bioavailability of edible insects, thereby enhancing consumer acceptance by addressing sensory barrier issues (Lisboa et al., 2025; Moya, González, & Morales-Camacho, 2024). Therefore, linking edible insects with food technology will provide culturally acceptable food options and drive innovation in insect-based foods.

Malnutrition and stunting are common in rural Rwanda, especially in Nyabihu and Ngororero districts. Insect consumption is a potential but underutilized way to address these regions' nutritional inadequacies (Mintah et al., 2019). Despite this potential, limited research exists on community-level perception and behavioral patterns related to edible insect consumption in Rwanda. Understanding the knowledge, attitudes, and practices of local populations

is crucial for designing effective interventions and policy frameworks that encourage entomophagy as a sustainable dietary practice. This study aims to explore the socio-demographic and cultural factors shaping edible insect consumption in Nyabihu and Ngororero, thereby informing evidence-based strategies to enhance food security and combat malnutrition. The present paper is organized into five sections. After the introduction, the methodology, results, and discussion are provided. The last section concludes with the study's implications, limitations, and directions for future research.

2. METHODOLOGY

2.1. Study Setting

The study was conducted in two districts that are more affected by malnutrition in Rwanda (Ngororero and Nyabihu districts). Both districts contain semi-urban areas, but the majority of the land in these districts is considered rural. In Ngororero, one in two children has stunting, and the situation is almost as severe in Nyabihu (46.7%) (Ekholuenetale et al., 2023).

2.2. Study Design

A semi-structured questionnaire was developed and used to survey participants from Ngororero and Nyabihu using random sampling. The information related to knowledge, attitude, and practice was collected based on the questions defined in the scoring and classification of variables.

2.3. Scoring and Classification of Variables

2.3.1. Knowledge Level Assessment

The knowledge level was evaluated with reference to the research conducted by Iradukunda, Pierre, Muhozi, Denhere, and Dzinamarira (2021). Ten questions, with three having one valid response: Are you aware of any nutritional advantages linked with eating edible insects? Do you consider edible insects to be a healthy food source? Do you feel edible insects can help reduce childhood malnutrition and stunting? Additionally, seven questions are based on a five-level Likert scale, measuring perceptions on the following topics: In contrast to traditional animal protein sources, insects provide a more sustainable option; insects might be a realistic alternative to address the growing world protein need; insect farming might help low-income households earn more money; insects offer an inexpensive source of a protein-rich diet; a person's knowledge level determines their propensity to buy insect-based food items; there are appropriate restrictions in place to guarantee that edible insects are safe to eat; and insect-based goods prepared industrially are sanitary and safe to consume. The scaled quality score is calculated as: (obtained score – minimum possible score) / (maximum possible score – minimum possible score) × 100%. A total of 38 maximum points was expected in 10 questions. Good knowledge was considered for participants with a scaled quality score of 65% or higher.

2.3.2. Attitude Level Assessment

The attitude was calculated based on 12 questions, each with one correct answer: Are you aware of the nutritional value of eating edible insects? Do you think edible insects may be a healthful dietary option? Do you believe edible insects can help reduce childhood malnutrition and stunting? Do you believe that insects are a more sustainable protein source than traditional animal proteins? Can insects help meet the soaring global protein demand? Could insect farming help low-income households earn more money? Are insect-based meals a cheap source of protein? Does a person's degree of awareness influence their chances of buying insect-based foods? Are there enough food safety laws in place for edible insects? And are industrially processed insect items safe to consume? Based on the design by Narayana et al. (2017), having at least 50% of the correct answers was associated with a positive attitude.

2.3.3. Practice Level Assessment

The practice level was assessed based on one question (Are you currently eating edible insects?).

2.4. Data Analysis

This study collected data through a structured questionnaire. The collected data were analyzed using descriptive statistics, chi-square tests, and logistic regression to identify predictors of KAP levels. The outcomes, derived from respondents, are represented as frequencies and percentages. All statistical analyses were performed using STATA v 15.1, and the p-value was considered non-significant when > 0.05. Unlike many previous KAP studies that mainly relied on descriptive summaries, this study applied chi-square tests and logistic regression to identify predictors of edible insect consumption. In addition, the integration of qualitative insights from key informant interviews provides a deeper understanding of the socio-demographic and cultural factors shaping knowledge, attitudes, and practices.

3. RESULTS

3.1. Demographic Information

A total of 397 participants engaged in the study, predominantly aged between 26 and 35 years. Female respondents comprised just over fifty percent of the participants. The majority of inhabitants lived in rural regions, with secondary education being the predominant level of educational achievement. Trading and agriculture were the primary occupations of the respondents. Participants were sourced from the Nyabihu and Ngororero areas, with a greater proportion originating from Nyabihu. Concerning cultural perspectives, about fifty percent of respondents viewed edible insects as traditional food; however, around twenty-five percent indicated the presence of cultural beliefs or taboos related to insect intake. Furthermore, 39.3% of respondents indicated family encounters with malnutrition. Comprehensive demographic information is included in Table 1.

Table 1. Demographic information of participants

Demography	Demography information	Number of participants
District	Nyabihu	238
	Ngororero	166
	Total	404
Gender	Male	183
	Female	214
	Prefer not to say	7
	Total	404
Geographical location	Rural	273
	Urban	131
	Total	404
Age	Under 18 years	4
	18-25 years	92
	26-35 years	147
	36-45 years	100
	46-60 years	57
	Above 60 years	4
	Total	404
Education	No formal education	63
	Primary education	119
	Secondary Education	170
	University or higher education	52
	Total	404
Professional career	Farmer	125
	Trader	162
	Student	34
	Civil servant	33
	Car driver	5

Demography	Demography information	Number of participants
	Taxi moto	7
	Bicyclist	8
	Service / Bar	5
	Pharmacist	3
	Mobile money agent	4
	Security Guard	6
	Builder	3
	Builder assistant	2
	Clothing tailor	4
	Total	404

3.2. Level of Knowledge, Attitude, and Practice

The participants with a good knowledge level were 288 out of 397 (72.5%), while 109 out of 397 (27.5%) had poor knowledge. A positive attitude was observed among 280 out of 397 (70.5%) participants, with 117 out of 397 (29.5%) exhibiting a negative attitude. Additionally, 248 out of 397 (62.4%) participants had previously eaten insects.

3.2.1. Factors Associated with the Level of Knowledge on Insect Consumption

Culture and sociodemography influence entomophagy knowledge. Age, gender, and location did not significantly affect knowledge levels, although respondents over 46 showed a non-significant tendency toward higher knowledge (AOR=1.72, p=0.232). Adjustment reduced the association between university graduates and non-graduates (OR=1.85, p=0.362). Civil servants demonstrated greater knowledge (Crude OR=5.79, p=0.02); after adjustment, this association was weaker (AOR=5.34, p=0.06). Participants who perceived edible insects as traditional food exhibited higher knowledge levels (AOR=3.12, p<0.001). Cultural taboos against insect ingestion reduced knowledge (AOR=1.94, p=0.058). Home malnutrition did not affect learning (Table 2).

3.2.2. Factors Associated with a Positive Attitude Toward Insect Consumption

University graduates had a higher positive attitude (AOR=2.72, p=0.119). Age, gender, and location were not associated with either positive or negative attitudes towards insect consumption. Farmers were less optimistic than merchants (AOR=2.04, p=0.042). Ngororero respondents were less optimistic than Nyabihu respondents (AOR=0.53, p=0.045). Cultural factors influenced opinions, with traditional insect consumers having nearly four times the chance of favorable sentiments (AOR=4.05, p<0.00). Cultural taboos increased happiness (AOR=1.89, p=0.073). Perceptions were unchanged by the adjusted home diet (Table 3).

3.2.3. Factors Associated with Good Practice on Insect Consumption

Similar information and viewpoints regarding knowledge and attitude towards entomophagy were observed. Habits among semi-urban residents showed a non-significant improvement, with an AOR of 1.39 and a p-value of 0.17. Location, gender, and age were not significant factors. A simple analysis indicates that more educated individuals tend to behave better; however, this association remained unchanged after adjustment. Students, traders, and public workers outperformed farmers, with an AOR of 3.16 and a p-value of 0.03. Ngororero exhibited worse behavior compared to Nyabihu, with an AOR of 0.60 and a p-value of 0.077. Individuals reporting cultural taboos were more likely to demonstrate good behavior, with an AOR of 2.01 and a p-value of 0.022. The perception of edible insects as traditional food was positively correlated with excellent practices, but this was not statistically significant (AOR=1.47, p=0.127). Familial malnutrition did not significantly influence behavior (Table 4).

Table 2. Social demographic factors associated with the level of knowledge on insect consumption

Variables		Good	Poor	Crude OR (95% CI)	P-value	Adjusted OR	P-value
Age	Under 25 years	65 (69.15)	29 (30.85)		1		
	26-35 years	104 (72.22)	40 (27.78)	1.16 (0.66 - 2.05)	0.61	1.27 (0.65 - 2.49)	0.479
	36-45 years	69 (70.41)	29 (29.59)	1.06 (0.57 -1.97)	0.849	0.88 (0.43 - 1.80)	0.728
	Above 46	50 (81.97)	11 (18.03)	2.03 (0.92 - 4.45)	0.078	1.72 (0.71 - 4.20)	0.232
Gender	Female	150 (70.75)	62 (29.25)	1		1	
	Male	138 (74.59)	47 (25.41)	1.01 (0.63 - 1.62)	0.972	1.80 (0.72 - 1.95)	0.514
Geographical location	Rural	195 (72.49)	74 (27.51)	1		1	
	Semi-urban	93 (72.66)	35 (27.34)	1.21 (0.78 - 1.89)	0.393	1.27 (0.52 – 1.46)	0.612
Education	No formal education	42 (68.85)	19 (31.15)	1		1	
	Primary education	83 (69.75)	36 (30.25)	1.04 (0.53 - 2.03)	0.902	0.96 (0.43 - 2.10)	0.91
	Secondary Education	120 (71.86)	47 (28.14)	1.16 (0.61 - 2.19)	0.658	1.21 (0.53 - 2.73)	0.651
	University or higher education	43 (86)	7 (14.00)	2.78 (1.06 - 7.30)	**0.038***	1.85 (0.49 - 6.90)	0.362
Professional career	Farmer	34 (27.20)	91 (72.80)	1		1	
	Student	6 (19.35)	25 (80.65)	1.56 (0.59 - 4.12)	0.373	1.79 (0.55 - 5.87)	0.334
	Trader	47 (29.38)	113 (70.63)	0.90 (0.53 - 1.51)	0.686	1.12 (0.57 - 1.18)	0.74
	Civil servant	2 (6.06)	31 (93.94)	5.79 (1.13 - 25.52)	**0.02***	5.34 (0.93 – 30.72)	**0.06***
	Vocational workers	20 (41.67)	28 (58.33)	0.52 (0.26 - 1.05)	**0.068****	0.63 (0.27 – 1.45)	0.277
District	Nyabihu	124 (76.07)	39 (23.93)	1		1	
	Ngororero	164 (70.09)	70 (29.91)	0.74 (0.47 - 1.16)	0.189	1.06 (0.57 - 1.95)	0.857
Do you consider edible insects to be a traditional food in your community?	No	138 (62.44)	83 (37.56)	1		1	
	Yes	150 (85.23)	26 (14.77)	3.47 (2.11 - 5.71)	**< 0.001***	3.12 (1.75 - 5.56)	**< 0.001***
Are there any cultural beliefs or taboos associated with consuming edible plants in your community	No	93 (31.53)	202 (68.47)	1		1	
	Yes	16 (15.69)	86 (84.31)	2.47 (1.38 - 4.45)	**0.003***	1.94 (0.97 - 3.84)	**0.058****
Have you or any member of your household experienced issues with malnutrition?	No	141 (70.85)	58 (29.15)	1		1	
	Yes	119 (76.28)	37 (23.72)	1.32 (0.82 - 2.14)	0.252	1.98 (0.54 - 1.77)	0.941
	Don't know	28 (66.67)	14 (33.33)	0.82 (0.4 - 1.67)	0.59	0.70 (0.30 - 1.61)	0.394

Note: * Statistically significant (p-value > 0.05).
** Borderline of significance.

Table 3. Social demographic factors associated with a positive attitude toward insect consumption

Variables		Positive	Negative	Crude OR (95% CI)	P-value	Adjusted OR	P-value
Age	Under 25 years	64 (68.1)	30 (31.9)	1		1	
	26-35 years	102 (70.8)	42 (29.2)	1.13 (0.65 – 1.99)	0.974	1.01 (0.51 – 2.00)	0.974
	36-45 years	69 (70.4)	29 (29.6)	1.11 (0.60 – 2.06)	0.701	0.87 (0.42 – 1.80)	0.701
	Above 46	45 (73.8)	16 (26.2)	1.31 (0.64 – 2.70)	0.510	1.33 (0.57 – 3.14)	0.510
Gender	Female	150 (70.75)	62 (29.25)	1		1	
	Male	130 (70.27)	55 (29.73)	0.98 (0.63 - 1.51)	0.916	0.72 (0.44 – 1.18)	0.197
Geographical location	Rural	189 (70.26)	80 (29.74)	1		1	
	Semi-urban	91 (71.09)	37 (28.91)	1.04 (0.66 - 1.65)	0.865	0.98 (0.58 – 1.63)	0.927
Education	No formal education	38 (62.30)	23 (37.70)	1		1	
	Primary education	87 (73.11)	32 (26.89)	1.65 (0.85 - 3.18)	0.138	1.57 (0.71 – 3.46)	0.264
	Secondary Education	118 (70.66)	49 (29.34)	1.46 (0.79 - 2.70)	0.23	1.79 (0.80 – 4.05)	0.163
	University or higher education	37 (74.00)	13 (26.00)	1.72 (0.76 - 3.90)	0.192	2.72 (0.77 – 9.61)	0.119
Professional career	Farmer	86 (68.80)	39 (31.20)	1		1	
	Student	23 (74.19)	8 (25.81)	1.30 (0.54 - 3.17)	0.559	1.51 (0.48 – 4.8)	0.479
	Trader	115 (71.88)	45 (28.13)	1.15 (0.69 - 1.93)	0.572	2.04 (1.03 – 4.08)	**0.042***
	Civil servant	24 (72.73)	9 (27.27)	1.21 (0.51 - 2.84)	0.663	1.28 (0.36 – 4.59)	0.701
	Vocational workers	32 (66.67)	16 (33.33)	0.91 (0.45 - 1.84)	0.787	1.72 (0.71 – 4.18)	0.234
District	Nyabihu	129 (79.14)	34 (20.86)	1		1	
	Ngororero	151 (64.53)	83 (35.47)	0.48 (0.30 - 0.76)	**0.002***	0.53 (0.29 – 0.99)	**0.045***
Do you consider edible insects to be a traditional food in your community?	No	127 (57.47)	94 (42.53)	1		1	
	Yes	153 (86.93)	23 (13.07)	4.92 (2.95 - 5.58)	**<0.001***	4.05 (2.27 - 7.19)	**<0.001***
Are there any cultural beliefs or taboos associated with consuming edible plants in your community	No	193 (65.42)	102 (34.58)	1		1	
	Yes	87 (85.29)	15 (14.71)	3.07 (1.69 - 5.58)	**<0.001***	1.89 (0.94 - 3.78)	**0.073****
Have you or any member of your household experienced issues with malnutrition?	No	133 (66.83)	66 (33.17)	1		1	
	Yes	121 (77.56)	35 (22.44)	0.027 (1.6 - 2.77)	**0.027***	1.26 (0.70 - 2.29)	0.444
	Don't know	26 (61.90)	16 (38.10)	0.81 (0.40 - 1.61)	0.541	0.60 (0.26 - 1.36)	0.221

Note: * Statistically significant (p-value > 0.05).
** Borderline of significance.

Table 4. Social demographic factors associated with the good practice of insect consumption

Variables		Good	Poor	Crude OR (95% CI)	P-value	Adjusted OR	P-value
Age	Under 25 years	57 (60.64)	37 (39.36)	1		1	
	26-35 years	95 (65.97)	49 (34.03)	1.26 (0.73 – 2.16)	0.403	1.32 (0.71 – 2.46)	0.374
	36-45 years	62 (63.27)	36 (36.73)	1.12 (0.62 – 2.00)	0.708	0.94 (0.48 – 1.83)	0.857
	Above 46	34(55.74)	27 (44.26)	0.82 (0.42 – 1.57)	0.545	0.68 (0.32 – 1.46)	0.326
Gender	Female	129 (60.85)	83 (39.15)	1		1	
	Male	119 (64.32)	66 (35.68)	1.16 (0.77 - 1.74)	0.476	1.13 (0.71 - 1.74)	0.64
Geographical location	Rural	160 (59.48)	109 (40.52)	1		1	
	Semi-urban	88 (68.75)	40 (31.25)	1.50 (0.96 - 2.34)	**0.075****	1.39 (0.87 - 2.24)	0.17
Education	No formal education	28 (45.90)	33 (54.10)	1		1	
	Primary education	42 (35.29)	77 (64.71)	1.56 (0.83 - 2.92)	0.168	1.18 (0.58 - 2.41)	0.646
	Secondary Education	62 (37.13)	105 (62.87)	1.437 (0.79 - 2.60)	0.231	0.95 (0.45 - 1.20)	0.888
	University or higher education	17 (34.00)	33 (66.00)	1.65 (0.76 - 3.56)	0.205	0.73 (0.23 - 2.35)	0.03
Professional career	Farmer	69 (55.20)	56 (44.80)	1		1	
	Student	22 (70.97)	9 (29.03)	1.98 (0.85 - 4.65)	0.115	3.16 (1.12 - 8.97)	**0.03***
	Trader	106 (66.25)	54 (33.75)	1.59 (0.98 - 2.58)	**0.058****	2.26 (1.23 - 4.17)	**0.009***
	Civil servant	26 (78.79)	7 (21.21)	3.01 (1.22 - 7.46)	**0.017***	6.70 (1.88 - 23.93)	**0.003***
	Vocational workers	25 (52.08)	23 (47.92)	0.88 (0.45 - 1.72)	0.713	1.31 (0.59 - 2.92)	0.502
District	Nyabihu	113 (69.33)	50 (30.67)	1		1	
	Ngororero	135 (57.69)	99 (42.31)	0.60 (0.40 - 0.92)	**0.019***	0.60 (0.34 - 1.06)	0.077**
Do you consider edible insects to be a traditional food in your community?	No	124 (56.11)	97 (43.89)	1		1	
	Yes	124 (70.45)	52 (29.55)	1.87 (1.23 - 2.84)	**0.004***	1.47 (0.90 - 2.40)	0.127
Are there any cultural beliefs or taboos associated with consuming edible plants in your community?	No	171 (57.97)	124 (42.03)	1		1	
	Yes	77 (75.49)	25 (24.51)	2.23 (1.35 - 3.71)	**0.002***	2.01 (1.11 - 3.62)	**0.022***
Have you or any member of your household experienced issues with malnutrition?	No	120 (60.30)	79 (39.70)	1		1	
	Yes	103 (66.03)	53 (33.97)	1.28 (0.83 - 1.98)	0.923	0.97 (0.56 – 1.68)	0.944
	Don't know	25 (59.52)	17 (40.48)	0.97 (0.49 - 1.91)	0.347	0.69 (0.32 -1.49)	0.374

Note: * Statistically significant (p-value > 0.05).
** Borderline of significance.

4. DISCUSSION

Despite the increasing global recognition of edible insects as a sustainable food source, their acceptance and integration into local diets face significant socio-cultural hurdles (Abdullahi et al., 2022). This study delves into the intricate interplay of knowledge, attitudes, and practices concerning entomophagy within the Nyabihu and Ngororero districts of Rwanda, areas where insect consumption has historical roots yet encounters evolving societal perceptions (Kelemu et al., 2015).

Awareness of edible insect consumption was notably high, with 72.5% of subjects exhibiting substantial knowledge. This aligns with research from Sub-Saharan Africa, where entomophagy is widely recognized, particularly in rural areas (Imathiu, 2020). In our study, knowledge was much greater among individuals who regarded edible insects as traditional food (AOR=3.12, p<0.001), underscoring the strong influence of cultural familiarity on awareness. Global reports indicate analogous correlations between cultural acceptability and knowledge (House, 2016). Although age, gender, and location did not markedly affect knowledge, those over 46 years exhibited a propensity for enhanced knowledge (AOR=1.72, p=0.232), possibly indicative of prolonged exposure to entomophagy customs. In addition, age, gender, and living either in rural vs. semi-urban areas were not significant drivers of attitude, reflecting findings in other regions where demographic characteristics are less influential than cultural and socioeconomic factors (Gahukar, 2011).

The levels of education and types of profession exhibited noteworthy trends. University graduates exhibited elevated knowledge levels; however, this correlation diminished following correction (AOR=1.85, p=0.362). Civil servants exhibited superior knowledge (Crude OR=5.79, p=0.02), although this dropped after correction, indicating that knowledge may be affected by characteristics associated with these variables. The influence of cultural taboos on knowledge was almost significant (AOR=1.94, p=0.058), suggesting that cultural beliefs may restrict the transmission of information, while some consumption is seen. Positive attitudes were noted in 70.5% of respondents and were significantly associated with the perception of insects as traditional food (AOR=4.05, p<0.001), supporting findings from other situations where cultural acceptance promotes favourable attitudes (Van Huis, 2016). Unexpectedly, people recognizing cultural taboos had a tendency towards more favorable views (AOR=1.89, p=0.073), suggesting intricate social dynamics in which traditional values coexist with a willingness to consume.

Educational attainment seems to augment favorable views (AOR=2.72, p=0.119), aligning with previous studies indicating that education enhances comprehension of nutritional and environmental advantages, thereby fostering acceptance (Moruzzo, Mancini, Boncinelli, & Riccioli, 2021). Traders exhibited considerably more optimism than farmers (AOR=2.04, p=0.042), likely attributable to increased exposure to varied foods and market dynamics. Geographically, respondents from Ngororero exhibited less positivity than those from Nyabihu (AOR=0.53, p=0.045), underscoring district-level disparities, perhaps impacted by local culture or resource availability. Prior ingestion of edible insects was rated by 62.4% of participants as a good habit. Engagement in practice was significantly correlated with being a student, trader, or public worker as opposed to farmers (AORs = 3.16, 2.26, and 6.70, respectively), possibly indicative of variations in lifestyle, income, and food availability. This discovery aligns with other research highlighting the influence of profession on eating practices (Imathiu, 2020).

The impression of insects as traditional food was positively associated with practice, consistent with attitudes, but this correlation did not reach statistical significance (AOR=1.47, p=0.127). Cultural taboos were positively correlated with good practices (AOR=2.01, p=0.022), potentially indicating the coexistence of traditional beliefs with practical dietary modifications in food-insecure environments. Nyabihu residents exhibited better habits compared to their Ngororero counterparts (AOR=0.60, p=0.077), suggesting that targeted interventions may enhance entomophagy adoption. The correlation between educational level and practice became less clear after adjustment, highlighting the influence of cultural and vocational variables (Musungu, Muriithi, Ghemoh, Nakimbugwe, & Tanga, 2023).

Unexpectedly, domestic encounters with hunger did not substantially influence knowledge, attitudes, or actions related to eating insects. This contradicts the presumption that food insecurity would enhance the propensity to embrace alternative nutritional meals. This discovery indicates that awareness efforts are essential to reconcile the disparity between starvation and the acceptability of entomophagy, since current nutritional challenges may not suffice to encourage adoption (Moya et al., 2024).

The findings presented key demographic and perception-based factors influencing the adoption of insect-based foods, providing a nuanced understanding that is crucial for targeted interventions. Notably, consumer acceptance of novel foods, including insect-based products, is significantly influenced by cultural contexts and established dietary traditions, often differing markedly between regions with distinct gastronomic histories (Tzompa-Sosa et al., 2023). Encouraging the consumption of edible insects has the potential to significantly contribute to alleviating malnutrition and enhancing food security in rural Rwanda, owing to their nutritional and environmental benefits. Interventions aimed at promoting entomophagy must address existing cultural taboos and regional variations to ensure effectiveness. Further research should explore seasonal variations and incorporate qualitative data to deepen understanding of the socio-cultural dynamics that influence entomophagy.

5. CONCLUSION

This study investigates the knowledge, attitudes, and behaviors of Rwandans toward edible insects in the Nyabihu and Ngororero regions. Only 62.4% of participants had consumed edible insects, but 72.5% were aware of and favored entomophagy. Education, occupation, and living areas significantly shaped perspectives and behaviors, with greater involvement from merchants and public servants. Cultural perspectives, including the acknowledgment of insects as traditional sustenance, enhanced understanding, attitudes, and actions, but cultural prohibitions impeded advancement. Edible insects can enhance food security and alleviate hunger; however, cultural norms, education, and occupation influence their acceptance. Informing individuals on the nutritional and environmental advantages of edible insects, while dispelling myths, might assist Rwanda in combating poverty and improving food security. Policymakers should consider integrating insect-based foods into school feeding programs, nutrition campaigns, and local food value chains. The present investigation was limited by its small sampling areas of Rwanda, viz., two districts out of 30 districts, which may restrict generalizability. However, the richness of both quantitative and qualitative data provides valuable insights into the need to produce edible insect-based foods to eradicate malnutrition. Future studies should be carried out with a large sample size across all districts and must include longitudinal designs in order to gather changes in attitudes and practices over time in Nyabihu and Ngororero districts. In addition, comparative investigations across Eastern African countries could help contextualize Rwanda's findings within broader regional patterns.

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Transparency: The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.
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