Have you heard of Rift Valley fever? Findings from a multi-country study in East and Central Africa

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Abstract

Introduction

Rift Valley Fever (RVF) has caused outbreaks in Africa, impacting human health and animal trade. Recently, sporadic detections among humans and animals in East Africa have replaced large-scale outbreaks. We assessed RVF knowledge levels in East and Central Africa across countries with different epidemiological profiles.

Materials and Methods

Individuals aged ≥10 years with acute febrile illness were enrolled from six health facilities in Kenya, Uganda, and the Democratic Republic of Congo (DRC). Sociodemographic information was collected and participants asked questions on RVF transmission, symptoms, prevention, and control. Blood samples were tested for anti-RVF antibodies (IgG and IgM). Knowledge was categorized as absent, basic, or advanced. Descriptive and ordinal logistic regression analysis identified factors associated with RVF knowledge.

Results

Among 4,806 participants (median age 31, IQR 22–44, 57.5% female), only 20.5% demonstrated any RVF knowledge (16.4% basic, 4.1% advanced). Knowledge levels varied by country: DRC (3.1%), Uganda (16.1%), and Kenya (42.6%). Factors associated with RVF knowledge included age 20–40 years aOR 1.72 (95%CI 1,24–2.22) and >40 years 2.42 (95%CI 1.74–3.420), male gender aOR 1.54 (95%CI 1.31–1.82), healthcare workers aOR 7.95 (95%CI 5.25–12.1), residence in Kenya aOR 23.5 (95%CI 15.8–35.8) or Uganda 5.4 (95%CI 3.68–8.38), completing primary education aOR 3.24 (95%CI 1.94–5.75) with advanced education shown to increase knowledge, postgraduate aOR 11.5 (95%CI 4.0–32.4). Other factors included presence of livestock within the homes aOR 1.30 (95%CI 1.06–1.59) and prevention of mosquito bites aOR 1.55 (95%CI 0.46–0.66). Animal farmers, butchers, and those with close animal contact showed no association, despite being at-risk populations.

Conclusion

RVF knowledge was low overall, varying by country, age, education, and environmental factors. Increased awareness is crucial for high-exposure groups in all regions, particularly in Uganda, where exposure is higher, but knowledge remains low.

Keywords: Knowledge; Practice; Rift Valley Fever, Multi-country, East and Central Africa

Introduction

Rift Valley Fever (RVF) is a zoonotic viral disease that poses significant threats to human and animal health across Africa and the Middle East [1] with potential for substantial economic losses [2]. RVF virus is transmitted to humans primarily through contact with infected animal tissues or fluids and occasionally via mosquito bites [3]. Certain factors, such as direct exposure to livestock and handling animal products, have been associated with an increased risk of severe RVF infection [4].

In East and Central Africa, RVF has been a recurring public health concern, with outbreaks reported in over 30 African countries including large outbreaks in Kenya [5] and the detection of sporadic cases in Uganda [6], [7]. Although there have been no documented reports of outbreaks in DRC [8], there is reported circulation of the virus among ruminant animals [9] and *Aedes* mosquitos [10].

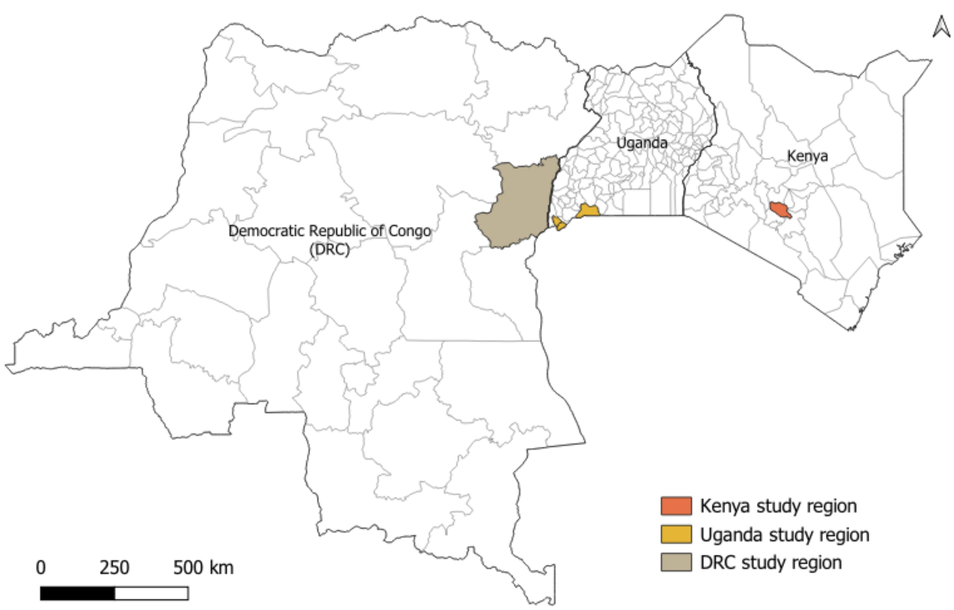
The 2006-2007 RVF outbreak in Kenya resulted in 700 human cases and 170 deaths [2] with an estimated loss of USD 32 million as a result of livestock deaths, trade bans, and reduced agricultural productivity [11]. The potential impact of large RVF outbreaks calls for effective disease surveillance, prevention, and control measures. However, the success of these measures is significantly dependant on the level of awareness and knowledge about RVF among community members.

Knowledge studies serve as crucial tools for assessing public awareness and behaviours related to specific health issues [12]. Increasing awareness can contribute to the early detection of an outbreak and help reduce the number of infected individuals and lower the peak of an epidemic [13]. While knowledge attitude and practice (KAP) studies on RVF have been conducted previously, there remains need to explore findings across different geographical regions with varying levels of disease exposure given the changing epidemiology of RVF in the recent past [14]. Our study aims to fill this gap by providing comparative multi-country insights into RVF knowledge across Kenya, Uganda, and DRC. Each country has a distinct epidemiological background regarding RVF: Kenya and Uganda have documented human outbreaks, while the DRC has not reported related haemorrhagic fever in humans to date. By examining sociodemographic characteristics, occupational factors, and differences across countries, we not only identify gaps in knowledge but also explore how these factors relate with key preventive practices such as prevention of mosquito bites.

Materials and Methods

2.1 Study setting

The knowledge assessment was carried out as part of a 2-year longitudinal hospital-based study, conducted across three countries: Kenya, Uganda and DRC from October 2021 to February 2024. In Kenya, the study was conducted in Murang'a county at Kigetuini dispensary and Kandara sub-county hospital in the central highlands. Uganda study sites were Kabale Regonal Referral Hospital, Hamurwa Health Centre IV and Rwekubo Health Centre IV located in Kabale, Rubanda and Isingiro districts respectively in the Southwestern region. Notably, Uganda experienced an RVF outbreak in Mbarara district of western Uganda between January–March 2023, [15] which was during the study period. In DRC the study took place at Hôpital Général de Référence de Virunga, Goma located in the Eastern part of the country. Based on the primary study objective, which was to determine the prevalence of RVF virus antibodies among patients attending the healthcare facilities we planned to enrol 707 study participants from each facility in Kenya and Uganda, and 1,600 participants from the healthcare facility in DRC.



** Shaded region (Nord Kivu, DRC): Represents the study site of Goma. Because of small geographic size of Goma, the broader region of Nord Kivu is used for better visibility. shaded regions (Kenya & Uganda): Represent study regions at comparable administrative levels.

Figure 1. Geographical map showing Rift Valley Fever study regions in Kenya, Uganda and DRC from 2021 to 2024.

2.2 Sample size

***2.2.1 Sample size calculation DRC*:** We estimated a sample size of 1,600 human participants to be recruited over the 2 years. This calculation assumed an expected RVF seroprevalence of 3%, power of 80%, precision of 2% and confidence level of 95% [16].

2.2.1 Sample size calculation in Kenya and Uganda: We estimated a sample size of 707 human participants to be recruited over the 2 years at each site. This being a subset of a larger prevalence study, it assumed RVF seroprevalence of 8%, a power of 80%, precision of 2%, and confidence level of 95% [17].

2.3 Study population

We enrolled a convenience sample of patients 10 years or older who presented with acute undifferentiated fever of (≥ 37.5°C for >24 hours and ≤28 days) at each of the healthcare facilities. To ensure the study participants were recruited throughout the year, we estimated the average recruitment rate per day to attain the required sample size over 2 years. We also enrolled all individuals with (i) unexplained bleeding or (ii) severe illness of unknown infectious aetiology lasting >7 days that was unresponsive to treatment. Persons with a clearly defined clinical disease, such as, an acute upper respiratory tract infection or urinary tract infection were not included. We enrolled patients who tested positive for malaria due to common risk factors for both malaria and RVF infection, however, we limited enrolment of patients who had positive rapid diagnostics for malaria to represent no more than 20% of the enrolled study participants.

2.4 Study procedures

After consenting, the study participants were guided through a standardized questionnaire designed to collect responses including socio-demographic information, risk factors related to RVF transmission and knowledge of RVF (Supplementary table 1). Serum samples were collected to detect antibodies against RVF. De-identified data was collected through the REDCap [18] by research assistants. Details of the study procedures, including specific tests used, quality control measures, and information on sensitivity and specificity, have been previously described [19].

2.5 Determining knowledge scores

There were 10 knowledge related questions with either single or multiple correct answers (Supplementary Table 1). To assess the study participants' knowledge levels about RVF, a composite index was made by adding the scores on the individual questions. A correct response was scored as 1, while an "incorrect" or "I don't know" answer was scored as 0. In instances where there were multiple correct responses for a single question, the score would be up to 2 depending on the number of responses the participant was able to list (Supplementary Table 1). The aggregate scores ranged from 0–14. Participants who scored an aggregate of 0 were categorized as No Knowledge, 1–10 as Basic Knowledge and 11–14 as Advanced Knowledge.

2.6 Data analysis

Descriptive statistics, including frequencies and percentages for each independent variable, were used to summarize data. In bivariate analysis, we used chi-square tests to assess the association between each independent variable and RVF knowledge levels. Variables with $p<0.05$ in bivariate analysis were included in the multivariable analysis. A multivariable ordinal logistic regression model was constructed to identify independent variables associated with knowledge, while controlling for potential confounders. The backward elimination method, based on the Akaike Information Criterion (AIC), was employed for variable selection, where variables were sequentially removed from the model. This approach enabled the identification of the most parsimonious model. The proportional odds assumption of the multivariable model was assessed using the Brant test. Crude odds rations (cOR)from bivariate analysis and adjusted odds ratios (aOR) from multivariable model along with 95% confidence intervals (CIs) were calculated and reported to measure the strength of associations. All analyses were considered statistically significant at a p-value of <0.05. Data was analysed using R statistical software version 4.4.1 [20].

2.7 Ethical considerations

Study ethical approval was obtained from the Kenya Medical Research Institute (KEMRI) - Research Ethics Committee (ref: SERU 4169) licensed by the National Commission for

Science, Technology and Innovation (NACOSTI: License No: NACOSTI/P/24/38396), Uganda Virus Research Institute (UVRI) (Ref: GC/127/849), Ethical Committee of the School of Public Health, University of Kinshasa, DRC, the Institut National de la Recharche Biomedicale in DRC (Ref: ESP/CE/108/2021), the Institutional Review Board of the Institute of Tropical Medicine, Antwerp and the Ethical Committee of the Antwerp University Hospital in Belgium. In addition, administrative approval was obtained from the respective Ministries of Health of each country, and from the local administration where the health facilities were located.

Results

Characteristics of the study population

A total of 4,806 individuals were enrolled as follows: 1,968 in Uganda, 1,468 in Kenya, and 1,370 in DRC. Of enrolled participants, 57.5%, (n=2,762) were females; 58.3% (n=2,804) were 20–40 years old (median age of 31 years, IQR 22–44=34.5 years), and 34.1% (n=1,640) had completed primary education (Table 1). Type of occupation differed between countries, with crop farming being the most common occupation overall (34.0%), particularly prevalent in Uganda (60.8%). Animal farming was identified as the primary occupation by 13.9% of participants, although it was low in DRC (0.8%). In contrast, a larger proportion of the study participants (53.1%) reported that there are livestock (cattle, goat or sheep) kept within their homes which also varied across countries, with only 6.6% in DRC, compared to 79.1% in Kenya and 66.2% in Uganda. RVF seropositivity was 10.4% in Uganda, with much lower rates in Kenya (2.0%) and DRC (1.5%), (Table1).

Exposure factors for RVF infection

Of the known exposure factors for RVF infection, presence of livestock within the homes, was reported by 53.1% of all participants, including 79.1% Kenyans, 66.2% Ugandans, and 6.6% in DRC participants. Close contact with livestock, a known risk factor was common across all three countries (89.7% overall), this was reported even among participants who did not own livestock. Types of close contact included herding, milking, slaughtering, handling raw meat, cleaning livestock sheds, sleeping in the same room as livestock, feeding, and treating or spraying livestock. About half (50.2%) of the participants lived near a swamp, quarry or irrigation scheme, including 68.7% of Ugandans, 58.5% of Kenyans, and 14.9% of DRC participants. Of all participants, 19.4% reported involvement in slaughtering sick animals, primarily in Uganda (22.3%) and Kenya (14.5%). Only a minimal number (4.3%) of participants reported drinking raw milk. Nearly half of study participants (46.3%) did not use any methods to prevent mosquito bites at home including 67.8% in Kenya, 54.7% in DRC and 24.3% in Uganda. Only a minimal number (4.3%) of participants reported drinking raw milk.

Table 1. Characteristics of study participants in DRC, Kenya and Uganda, RVF study 2021-2024

Variable	Distribution, n (%) Overall N = 4,806[1]	DRC n = 1,370[1]	Kenya n = 1,468[1]	Uganda n = 1,968[1]
Age group (years)				
10-19	508 (10.6)	133 (9.7)	138 (9.4)	237 (12.0)
20-40	2,804 (58.3)	861 (62.8)	762 (51.9)	1,181 (60.0)
Above 40	1,494 (31.1)	376 (27.4)	568 (38.7)	550 (27.9)
Sex				
Female	2,762 (57.5)	939 (68.5)	734 (50.0)	1,089 (55.3)
Male	2,044 (42.5)	431 (31.5)	734 (50.0)	879 (44.7)
Education level				
No education	283 (5.9)	101 (7.4)	39 (2.7)	143 (7.3)
Primary incomplete	1,122 (23.3)	128 (9.3)	238 (16.2)	756 (38.4)
Primary complete	1,640 (34.1)	439 (32.0)	636 (43.3)	565 (28.7)
Secondary complete	1,194 (24.8)	502 (36.6)	384 (26.2)	308 (15.7)
Tertiary complete	525 (10.9)	165 (12.0)	169 (11.5)	191 (9.7)
Postgraduate complete	42 (0.9)	35 (2.6)	2 (0.1)	5 (0.3)
Occupation types				
Healthcare worker	183 (3.6)	97 (6.9)	17 (1.0)	69 (3.4)
Other professionals	463 (9.6)	169 (12.0)	144 (9.9)	150 (7.7)
Unskilled workers	530 (11.1)	111 (8.2)	280 (19.3)	139 (7.1)
Animal farmer	669 (13.9)	11 (0.8)	355 (24.1)	303 (15.3)
Crop farmer	1,634 (34.0)	37 (2.6)	400 (27.2)	1,197 (60.8)
Butcher/Slaughterhouse worker	33 (0.6)	3 (0.2)	15 (0.8)	15 (0.7)
Undisclosed	25 (0.5)	7 (0.5)	2 (0.1)	16 (0.8)
Student	619 (12.9)	233 (17.0)	155 (10.6)	231 (11.7)
Presence of livestock within household				
No	2,253 (46.9)	1,280 (93.4)	307 (20.9)	666 (33.8)
Yes	2,553 (53.1)	90 (6.6)	1,161 (79.1)	1,302 (68.2)
Slaughter sick livestock				
No	241 (80.6)	1 (100.0)	94 (85.5)	146 (77.7)
Yes	58 (19.4)	0 (0.0)	16 (14.5)	42 (22.3)
Mosquito prevention at household				
No	2,224 (46.3)	749 (54.7)	996 (67.8)	479 (24.3)
Yes	2,582 (53.7)	621 (45.3)	472 (32.2)	1,489 (75.7)
Drinking raw milk				
No	4,600 (95.7)	1,331 (97.2)	1,448 (98.6)	1,821 (92.5)
Yes	206 (4.3)	39 (2.8)	20 (1.4)	147 (7.5)
Close contact with livestock				
No	495 (10.3)	251 (18.3)	55 (3.7)	189 (9.6)
Yes	4,311 (89.7)	1,119 (81.7)	1,413 (96.3)	1,779 (90.4)
Close proximity to a swamp/quarry/irrigation scheme				
No	2,393 (49.8)	1,169 (85.1)	607 (41.5)	617 (31.3)

Yes	2,413 (50.2)	201 (14.9)	861 (58.5)	1,351 (68.7)
RVF seropositivity (IgM/IgG)				
Negative	4,547 (94.7)	1,345 (98.5)	1,439 (98.0)	1,763 (89.6)
Positive	253(5.3)	19 (1.5)	29 (2.0)	205 (10.4)

[1] n (%)

RVF knowledge

As shown in Table 2, only 1 in 5 participants had heard of RVF, including 42.6% Kenyans, followed by 16.1% Ugandans and 3.1% DRC participants. Of the participants that had heard of RVF, 58.4% knew humans can be infected by the RVF virus. The top responses on how RVF can be transmitted in humans included eating raw meat from sick animals and mosquito bites at 37.3% and 33.2% respectively. Sixty-six percent knew RVF virus can infect livestock, 75.6% believing that animal infection can be prevented with vaccination (84%) listed as the top prevention method.

Table 2: Distribution of Rift Valley Fever knowledge and information sources among study participants in DRC, Kenya, and Uganda

	Distribution, n (%)			
Variable	**Overall**	**DRC**	**Kenya**	**Uganda**
Have you heard of RVF				
No	3816 (79.5)	1323 (96.9)	842 (57.4)	1651 (83.9)
Yes	985 (20.5)	42 (3.1)	626 (42.6)	317 (16.1)
Can humans be infected with RVF virus? (n=985)				
I don't know	335 (34.0)	3 (7.1)	253 (40.4)	78 (24.6)
No	77 (7.8)	0 (0.0)	69 (11.2)	8 (2.5)
Yes	573 **(58.2)**	39 (92.9)	303 (48.4)	231 (72.9)
Knowledge of how RVF is transmitted in humans (multiple responses, n=573)				
Mosquito bites	190 (33.2)	36 (92.3)	47 (15.6)	107 (46.3)
Eating raw meat from a sick animal	214 **(37.3)**	33 (77.0)	111 (36.7)	70 (30.3)
Drinking raw milk from a sick animal	166 (30.0)	30 (76.9)	88 (29.0)	48 (20.8)
Slaughtering/skinning sick animals	126 (22.0)	28 (71.8)	66 (21.8)	32 (13.9)
Handling abortus	59 (10.3)	28 (71.8)	23 (7.6)	8 (3.5)
Milking sick animals	80 (14.0)	21 (53.8)	40 (13.2)	19 (8.2)
Contact with blood of a sick animal	132 (23.0)	26 (66.7)	63 (20.8)	43 (18.7)
Can RVF be prevented in humans? (n=573)				
I don't know	219 (38.2)	2 (5.1)	152 (50.2)	61 (26.5)
No	12 (2.1)	1 (2.6)	6 (2.0)	5 (2.2)
Yes	342 **(59.7)**	36 (92.3)	142 (46.9)	164 (71.3)
Knowledge of prevent RVF in humans (among respondents aware that RVF is preventable, n=342)				
Avoid consuming uninspected meat/raw milk	240 **(70.2)**	34 (94.3)	105 (73.9)	101 (61.6)
Use protective gear for aborted materials	83 (24.3)	29 (80.6)	33 (23.2)	21 (12.8)
Avoid contact with fluids from sick animals	152 (44.4)	31 (86.1)	74 (52.1)	47 (28.7)
Drain stagnant waters/clearing bushes	42 (12.3)	24 (66.7)	5 (3.5)	13 (8.0)
Can animals be infected with the RVF virus? (n=985)				
I don't know	300 (30.4)	5 (12.0)	199 (31.8)	96 (30.3)
No	35 (3.6)	0 (0.0)	22 (3.5)	13 (4.1)
Yes	650 **(66.0)**	37 (88.0)	405 (64.7)	208 (65.6)
Knowledge of how RVF is transmitted in animals (multiple responses, n=650)				
Mosquito	171 (**26.3**)	34 (91.9)	40 (10.0)	97 (46.6)
Ticks	73 (11.2)	13(35.1)	0 (0.0)	60 (28.8)
Biting flies	42 (6.5)	19 (51.4)	3 (0.7)	20 (9.6)
Can RVF be prevented in animals?				
I don't know	86 (13.1)	0 (2.6)	69 (17.6)	12 (6.2)
No	74 (11.3)	0 (0.0)	38 (9.3)	36 (17.2)
Yes	495 **(75.6)**	37 (97.4)	298 (73.0)	160 (76.6)
Knowledge of ways to prevent RVF in animals				
Vaccination	416 **(84.0)**	27 (73.0)	282 (94.6)	107 (66.9)
Treatment	283 (57.1)	12 (12.4)	202 (67.8)	69 (43.1)
Avoiding contact with sick herd	54 (10.9)	32 (86.5)	9 (3.0)	13 (8.1)
Quarantine	94 (19.0)	29 (78.4)	3 (1.0)	62 (38.8)

[1]n (%)

Factors associated with RVF knowledge.

In bivariate analysis, age was an important factor associated with knowledge on RVF, with individuals aged 20–40 years (cOR: 2.2, 95% CI: 1.7–3.0, p<0.001) and those above 40 years (cOR: 2.8, 95% CI: 2.1–3.8, p<0.001) more likely to have advanced knowledge compared to the 10-19 years' age group. Males had higher odds of advanced knowledge (cOR: 1.8, 95% CI: 1.6–2.1, p<0.001). Education level showed positive association with RVF knowledge, with tertiary education completion having the highest odds ratio (cOR: 9.3, 95% CI: 5.7–16.3, p<0.001), (Supplementary Table 2).

Occupational categories show varying associations with RVF knowledge levels. Healthcare workers had significantly higher odds of advanced knowledge (cOR: 4.4, 95% CI: 3.2–6.1, p<0.001). Positive associations were also observed in other groups, other professionals (cOR: 1.5, 95% CI: 1.1–1.8, p<0.001) and animal farmers (cOR: 1.9, 95% CI: 1.6–2.2, p<0.001). Unskilled workers also showed higher odds of better knowledge (cOR: 1.7, 95% CI: 1.4–2.1, p<0.001), while crop farmers and butchers/slaughterhouse workers were not significantly associated with high degrees of knowledge. Seropositive individuals showed marginally higher odds of having better knowledge (cOR: 1.1, 95% CI: 0.8–1.5, p=0.14), (Supplementary Table 2).

Presence of livestock within homes was strongly associated with better knowledge (cOR: 3.2, 95% CI: 2.8–3.8, p<0.001), as was close contact with animals (cOR: 2.8, 95% CI: 2.1–3.9, p<0.001). The presence of swamps, quarries, or irrigation schemes in the vicinity of the home was also associated with higher knowledge levels (cOR: 3.4, 95% CI: 2.9–3.9, p<0.001). Practicing mosquito prevention was also associated with better knowledge (cOR: 1.8, 95% CI: 0.7–0.9, p<0.001), while drinking raw milk showed negative association (cOR: 0.6, 95% CI: 0.4–0.9, p=0.021). There were also differences in knowledge levels across countries, with Kenya showing the highest odds of better knowledge compared to DRC (cOR: 21.4, 95% CI: 15.7–30.0, p<0.001), (Supplementary Table 2).

In multivariable analysis, age was associated with advanced RVF knowledge, individuals aged 20–40 years (aOR: 1.72, 95% CI: 1.22–2.42) and those above 40 years (aOR: 2.42, 95% CI: 1.74–3.42) were more likely to have higher knowledge levels compared to the 10-19 years' age group. Males were more likely to have higher knowledge levels compared to females (aOR: 1.54, 95% CI: 1.31–1.82).

Compared to those with no education, individuals with postgraduate education had the highest odds of better knowledge (aOR: 11.5, 95% CI: 4.00–32.4), followed by those with tertiary (aOR: 7.20, 95% CI: 4.13–13.2) and secondary education (aOR: 5.53, 95% CI: 3.26–9.95). Being a healthcare worker was strongly associated with higher knowledge levels (aOR: 7.95, 95% CI: 5.25–12.1). Country of residence was also a significant factor, with participants from Kenya (aOR: 23.5, 95% CI: 15.8–35.8) and Uganda (aOR: 5.4, 95% CI: 3.68–8.38) showing higher odds of better knowledge compared to those from DRC.

Environmental factors such as presence of swamps, quarries, or irrigation schemes near the subject's home were associated with higher knowledge levels (aOR: 2.87, 95% CI: 2.40–3.44). Individuals who reported preventing mosquito bites were likely to have higher knowledge levels (aOR: 1.56, 95% CI: 0.46–0.66). Respondents who reported to be having presence of livestock within their homes were likely to have better knowledge levels (aOR: 1.30,95%CI 1.06–1.59, p=0.01). Other factors such as RVF seropositivity, drinking raw milk, other occupation categories, and having close contact with livestock did not show statistically significant associations with RVF knowledge levels in this multivariable model.

Table 4: Multivariable model results showing factors associated with RVF knowledge among study participants in DRC, Kenya and Uganda (2021-2024)

Variable	Crude Odds Ratios			Adjusted Odds Ratios		
	cOR[1]	95% CI[1]	p-value	aOR[1]	95% CI[1]	p-value
Age group (years)						
(ref 10-19)	□	□	<0.001	□	□	<0.001*
20-40	2.23	1.67, 3.04		1.72	1.24, 2.42	
Above 40	2.77	2.06, 3.81		2.42	1.74, 3.42	
Sex						
(ref=Female)	□	□	<0.001	□	□	<0.001*
Male	1.83	1.59, 2.11		1.54	1.31, 1.82	
Education Level						
(ref=No education)	□	□	<0.001	□	□	<0.001*
Primary complete	4.37	2.73, 7.51		3.24	1.94, 5.75	
Primary incomplete	2.06	1.26, 3.59		1.51	0.89, 2.71	
Secondary	4.78	2.96, 8.24		5.53	3.26, 9.95	
Tertiary	9.33	5.69, 16.3		7.20	4.13, 13.24	
Postgraduate	6.02	2.45, 14.3		11.5	4.00, 32.4	
Healthcare workers						
(ref=No)	□	□	<0.001	□	□	<0.001*
Yes (ref=No)	4.42	3.22, 6.06		7.95	5.25, 12.1	
Country						
(ref=DRC)	□	□	<0.001	□	□	<0.001*
Kenya	21.4	15.7, 30.0		23.5	15.8, 35.8	
Uganda	6.06	4.41, 8.54		5.4	3.68,8.38	
Presence of Livestock within households						
(ref=No)	□	□	<0.001	□	□	0.01
Yes	3.18	2.72, 3.72		1.30	1.06, 1.59	
Preventing mosquito bites						
(ref=No)	□	□	0.007	□	□	<0.001*
Yes (ref=No)	1.83	0.72, 0.95		1.55	0.46, 0.66	
Drinking raw milk						
(ref=No)	□	□	0.011	□	□	0.111
Yes	0.61	0.40, 0.90		0.70	0.44, 1.08	
Having close contact with animals						
(ref=No)	□	□	<0.001	□	□	0.108
Yes	2.83	2.09,3.94		1.35	0.94,1.99	
Presence of swamp/quarry/irrigation scheme						
(ref=No)	□	□	<0.001	□	□	<0.001*
Yes	3.20	2.75, 3.74		2.87	2.40, 3.44	

Discussion

In this study, we evaluated knowledge of RVF among 4,806 individuals across Kenya, Uganda, and the DRC. Our findings indicate that levels of knowledge related to RVF were low, highlighting significant gaps that may hinder effective disease prevention and control efforts in these regions despite ongoing transmission of the disease. Factors associated with better RVF knowledge included age, education level, sex, occupation, country of residence, presence of a water body near the home and those who are proactive about preventing mosquito bites.

We observed better RVF knowledge in older age groups, suggesting that cumulative exposure to information may play a key role in enhancing awareness. In Baringo, Kenya families with older household heads had greater RVF knowledge compared to families with younger household heads [13]. Similarly a study among livestock farmers in Malawi found that those over 45 years of age demonstrated better knowledge and attitudes toward the disease [21]. This is also consistent with various studies in Uganda including RVF knowledge study among slaughterhouse workers and community members in Kabale district which found out that older individuals were more knowledgeable about RVF [22]. An Ebola and Marburg virus knowledge study in Uganda also showed that older age was associated with greater awareness [23], reinforcing the link between age and knowledge. These findings indicate a potential vulnerability to RVF among younger populations especially given the lack of large outbreaks in the recent past and points to the need for targeted educational interventions aimed at younger age groups.

Education showed strong association with RVF knowledge, with higher levels of education corresponding to increased awareness. Postgraduate education was associated with eleven times higher awareness of RVF highlighting the significant impact of advanced education on RVF knowledge. This finding aligns with recent research conducted in Tanzania, which demonstrated that RVF knowledge is significantly related to sex, education, and locality [24]. The disparities in RVF knowledge across different educational levels shows the importance of making RVF information accessible and understandable to those with lower education levels possibly through community-based education programs. Community-based education programs in West Africa during the Ebola outbreak were instrumental in increasing public understanding of the disease, leading to improved prevention practices and a reduction in the spread of the virus [25].

While healthcare workers exhibited higher levels of knowledge, likely due to their training, this was not the case for other occupational groups, including those at greater risk of exposure. An important finding of the study is the significant gap in RVF knowledge among high-risk occupational groups, such as animal farmers, butchers and slaughterhouse workers. This brings out the need for targeted interventions to raise RVF awareness among these higher at-risk groups, ensuring that those considered highly vulnerable are adequately informed and protected.

Participants from Kenya and Uganda demonstrated greater likelihood for higher levels of RVF knowledge compared to those from DRC. Kenya has had recurrent RVF epidemics with cases documented in 36 out of 47 counties in Kenya, including Murang'a, our study site [26]. Similarly, the Uganda Institute of Public Health reported confirmed RVF cases across 21 of 135 districts in Uganda from 2017 to 2023 [27]. These reports may have contributed to increased awareness and higher levels of knowledge about RVF in both countries. Although Uganda had the highest seroprevalence (10.4%), it did not have the highest knowledge levels. Transmission of RVF has been predominantly cryptic in the recent past; lack of awareness of ongoing RVF transmission has resulted in limited public education programs on the virus. Kenya demonstrated high odds of knowledge and a much lower seroprevalence (2.0%), even though small RVF outbreaks are a common occurrence in country, raising the possibility that community awareness on how to prevent RVF could have led to effective behavior modifications and lower rates of exposure. Recent analysis by [14] detail the distribution and frequency of these RVF cases in Kenya's highlands, illustrating the virus's cryptic presence in non-epidemic settings. DRC, with the lowest seroprevalence (1.5%), also had the lowest odds of RVF knowledge. No RVF outbreak has been detected in DRC which then limits the need for communication and awareness campaigns regarding the disease. In addition, the risk of transmission of RVF virus has been much lower in Goma, DRC where we carried out our study, limiting the need for behavior modifications there to prevent transmission. Our findings suggest that several factors could influence awareness regarding the disease. These include exposure to the virus, the magnitude and frequency of outbreaks, the extent of public health campaigns, environmental factors, occupation and different practices. Future research should aim to identify and quantify these factors to inform tailored, country-specific strategies for RVF education and prevention.

We observed a positive association between mosquito bite prevention and RVF knowledge, aligning with previous studies. For instance [28] reported a positive correlation between RVF knowledge and the use of mosquito nets in Senegal yet [29] in Tanzania found that individuals with higher RVF knowledge were not necessarily more likely to use mosquito nets. Across the three countries, use of mosquito bite prevention methods was higher than RVF knowledge. This proposes that mosquito bite prevention may be better framed as a general health intervention that prevents the transmission of several mosquito borne diseases. Broad community-wide health interventions often have a greater impact on health improvement than disease-specific strategies alone [30].

We found that presence of livestock within homes was significantly associated with improved RVF knowledge, however, there was no association between individuals who reported animal farming to be their primary occupation and RVF knowledge. These findings suggest gaps in occupational health knowledge of RVF among animal farmers that needs to be addressed.

Our study had a few limitations. We relied on self-reported data which can at times lead to participants reporting socially favourable behaviours. One of the key strengths however is that the study was able to achieve and surpass the target sample size indicating better precision.

Conclusions

In conclusion, our study reveals significant gaps in RVF knowledge across Kenya, Uganda, and DRC, with notable variations associated with sociodemographic factors, occupation, and geographical location. The disparity in awareness pinpoints the need for targeted, context-specific interventions to enhance RVF knowledge and prevention practices. We recommend the development of tailored educational programs that address the unique needs of different age groups, education levels, and occupational sectors, with a particular focus on younger populations and, those with lower formal education. There is also needed to bridge the knowledge gap among high-risk groups, especially animal farmers, butchers and slaughterhouse workers.

Supporting information: The following supplementary material is included in this manuscript: Supplementary Table 1. A description on the criteria of knowledge scoring and Supplementary Table 2. Bivariate analysis investigating factors associated with RVF knowledge levels.

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Supplementary Table 1. Description of the criteria of knowledge scoring

Question	Correct answer	Score
Have you ever heard of Rift Valley Fever?	Yes	1
Can humans get RVF?	Yes	1
If yes, how does one get RVF	8 answers	Score of 0 if no answer ticked. Score of 1 if 1 answer ticked. Score of 2 if 2 or more answers picked
What are the signs and symptoms of RVF in humans	22 answers	Score of 0 if no answer ticked. Score of 1 if 3 answers ticked. Score of 2 if 4 or more answers picked
Is RVF preventable in humans	Yes	1
How is RVF prevented in humans	4 answers	Score of 0 if no answer ticked. Score of 1 if 1 answer ticked. Score of 2 if 2 or more answers picked
Can animals get RVF	Yes	1
If yes, what do you think transmits RVF in animals	Yes	1
Can RVF be prevented in animals	Yes	1
If Yes, what methods can be used to prevent RVF in animals	4 answers	Score of 0 if no answer ticked. Score of 1 if 1 answer ticked. Score of 2 if 2 or more answers picked

Supplementary Table 2. Bivariate analysis of factors associated with RVF knowledge levels among healthcare facility participants from Kenya, Uganda and DRC, 2022–2024

Variable	**Overall**, N = 4,806[1]	**No knowledge**, n = 3,821[1]	**Basic knowledge**, n = 786[1]	**Advanced knowledge**, n = 199[1]	**cOR (95 CI)**	**p-value**[2]
Country						<0.001*
DRC	1,370 (28.5)	1,328 (34.8)	7 (0.9)	35 (17.6)	**ref**	
Kenya	1,468 (30.5)	842 (22.0)	548 (69.7)	78 (39.2)	21.4 (15.7,30.0)	
Uganda	1,968 (40.9)	1,651 (43.2)	231 (29.4)	86 (43.2)	6.1 (4.4,8.5)	
Age group (years)						<0.001*
10–19	508 (10.6)	455 (11.9)	50 (6.4)	3 (1.5)	**ref**	
20–40	2,804 (58.3)	2,236 (58.5)	434 (55.2)	134 (67.3)	2.2 (1.7,3.0)	
Above 40	1,494 (31.1)	1,130 (29.6)	302 (38.4)	62 (31.2)	2.8 (2.1,3.8)	
Sex						<0.001*
Female	2,762 (57.5)	2,314 (60.6)	357 (45.4)	91 (45.7)	**ref**	
Male	2,044 (42.5)	1,507 (39.4)	429 (54.6)	108 (54.3)	1.8 (1.6,2.1)	
Education Level						<0.001*
No education	283 (5.9)	266 (7.0)	15 (1.9)	2 (1.0)	**ref**	
Primary complete	1,640 (34.1)	1,277 (33.4)	317 (40.3)	46 (23.1)	4.4 (2.7,7.5)	
Primary incomplete	1,122 (23.3)	991 (25.9)	115 (14.6)	16 (8.0)	2.1 (1.3,3.6)	
Secondary complete	1,194 (24.8)	915 (23.9)	224 (28.5)	55 (27.6)	4.8 (3.0,8.2)	
Tertiary complete	525 (10.9)	340 (8.9)	113 (14.4)	72 (36.2)	9.3 (5.7,16.3)	
Postgraduate	42 (0.9)	32 (0.8)	2 (0.3)	8 (4.0)	6.0 (2.5,14.3)	
Occupation						
Healthcare workers						<0.001*
No	4,623 (96.2)	3,714 (97.2)	768 (97.7)	141 (70.9)	**ref**	
Yes	183 (3.8)	107 (2.8)	18 (2.3)	58 (29.1)	4.4 (3.2,6.1)	
Non-healthcare worker professionals						0.003*
No	4,343 (90.4)	3,481 (91.1)	688 (87.5)	174 (87.4)	**ref**	
Yes	463 (9.6)	340 (8.9)	98 (12.5)	25 (12.6)	1.5 (1.1,1.8)	
Unskilled workers						<0.001*
No	4,276 (89.0)	3,449 (90.3)	644 (81.9)	183 (92.0)	**ref**	
Yes	530 (11.0)	372 (9.7)	142 (18.1)	16 (8.0)	1.7 (1.4,2.1)	
Animal farmer						<0.001*
No	4,137 (86.1)	3,363 (88.0)	597 (76.2)	177 (88.9)	**ref**	
Yes	669 (13.9)	458 (12.0)	189 (23.8)	22 (11.1)	1.9 (1.6,2.2)	
Crop farmer						0.023*
No	3,172 (66.0)	2,529 (66.2)	497 (63.2)	146 (73.4)	**ref**	
Yes	1,634 (34.0)	1,292 (33.8)	289 (36.8)	53 (26.6)	1.0 (0.9,1.2)	
Butcher/Slaughterhouse worker						0.2
No	4,773 (99.3)	3,797 (99.4)	777 (98.9)	199 (100.0)	**ref**	
Yes	33 (0.7)	24 (0.6)	7 (1.1)	0 (0.0)	1.2 (0.5,2.6)	
Undisclosed						0.7
No	4,781 (99.5)	3,799 (99.4)	783 (99.6)	199 (100.0)	**ref**	
Yes	25 (0.5)	22 (0.6)	3 (0.4)	0 (0.0)	0.5 (0.1,1.5)	
Student						0.2
No	4,187 (87.1)	3,323 (87.0)	696 (88.5)	168 (84.4)	**ref**	

Yes	619 (12.9)	498 (13.0)	90 (11.5)	31 (15.6)	1.0 (0.8,1.2)	
RVF Seropositivity						0.044*
Negative	4,558 (94.8)	3,625 (94.9)	750 (95.4)	183 (92.0)	**ref**	
Positive	248 (5.2)	196 (5.1)	36 (4.6)	16 (8.0)	1.2 (0.9,1.5)	
Keeping livestock						<0.001*
No	2,253 (46.9)	167(21,2)	80 (40.2)	2006 (52.5)	**ref**	
Yes	2,553 (53.1)	619 (78.8)	119 (59.8)	1,815 (47.5)	3.2 (2.8,3.8)	
Have close contact with animals						<0.001*
No	495 (10.3)	451 (11.8)	32 (4.1)	12 (6.0)	**ref**	
Yes	4,311 (89.7)	3,370 (88.2)	754 (95.9)	187 (94.0)	2.8 (2.1,3.9)	
Slaughtering sick animal(s)						0.081
No	241 (80.6)	150 (76.9)	69 (88.5)	22 (84.6)	**ref**	
Yes	58 (19.4)	45 (23.1)	9 (11.5)	4 (15.4)	0.5 (0.2,0.9)	
Drink raw milk						0.021*
No	4,600 (95.7)	3,644 (95.4)	759 (96.6)	197 (99.0)	**ref**	
Yes	206 (4.3)	177 (4.6)	27 (3.4)	2 (1.0)	0.6 (0.4,0.9)	
Mosquito prevention						<0.001*
No	2,224 (46.3)	1,799 (47.1)	372 (47.3)	53 (26.6)	**ref**	
Yes	2,582 (53.7)	2,022 (52.9)	414 (52.7)	146 (73.4)	1.8 (0.7,0.9)	
Presence of swamp/quarry/irrigation scheme near residence						<0.001
No	2,393 (49.8)	2,118 (55.4)	224 (28.5)	51 (25.6)	**ref**	
Yes	2,413 (50.2)	1,703 (44.6)	562 (71.5)	148 (74.4)	3.4 (2.9,3.9)	

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