Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Knowledge, perceptions, and experiences regarding cancer among final-year medical interns in the kivu sub-region of the Democratic Republic of the Congo: a multi-institutional cross-sectional study

David Banyanga
banyangadavid046@gmail.com
Faculty of Medicine ,Université Officielle de Bukavu
Dismas Mpusulo
CHU de Treichville, Félix Houphouët-Boigny University
Balagizi Ganywamulume
Faculty of Medicine , Université Evangélique en Afrique
Muniali Merveille
Faculty of Medicine ,Université Officielle de Bukavu
Richard Kambale Keukeu
Faculty of Medicine , Université libre des Pays des Grands Lacs
Lumamaba Alpha
Faculty of Medicine , University of Kindu
David Kavuka Biluge
Faculty of Medicine , Université Evangélique en Afrique
Mwaka Shukuru Sivahera
Faculty of Medicine , Université Catholique du Graben
Balegana Cirhuza
Centre Hospilalier Biopharm
Lucien Baraka
Medical Research Circle
Kikandi Kabechi Gloire
Faculty of Medicine , University of Goma
Tshass Chasinga Baharanyi
Faculty of Medicine , Université Evangélique en Afrique
Elabrar Ibrahim
Faculty of Medicine, Alexandria University
Vandrome Nakundi
Congo Cancer Care , Triple C
Prof.Dr.Waleed Arafat
Faculty of Medicine, Alexandria University
Fabien Imani Shangalume
University of Kinshasa, Democratic Republic of the Congo

Research Article

Keywords: Medical education; Cancer knowledge, conflict-affected setting, Democratic Republic of the Congo

Posted Date: November 5th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11131709/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License. Read Full License

Additional Declarations: No competing interests reported.

Abstract

Background: Cancer imposes a growing burden in sub-Saharan Africa, with mortality-to-incidence ratios near 65%. In the conflict-affected Kivu sub-region of the Democratic Republic of the Congo, late-stage presentation, absent specialized oncology services, and weak health systems place final-year medical interns at the frontline of care. Evidence on their cancer-related competencies remains scarce.

This study aimed to assess knowledge, perceptions, and experiences regarding cancer among final-year medical interns in North Kivu, South Kivu, and Maniema, and to identify factors associated with knowledge levels.

Methods: A multi-institutional cross-sectional survey was conducted from 1 March to 31 May 2026. An expert-reviewed and pilot-tested questionnaire comprising 74 knowledge items (score range, 0–74) and 5 perception items (score range, 0 - 5) was administered online or face-to-face across seven institutions. A beta-binomial mixed-effects model with university as a random intercept assessed factors associated with knowledge performance.

Results: Among 260 participants (mean age, 26 ± 2 years; 63% male), the mean knowledge score was 46.2 ± 9.3 (≈62%). Only 1.2% achieved good knowledge, while 52.7% had insufficient or poor knowledge. Performance was highest for cancer definition (78.1%) and lowest for the single palliative-care item (21.9%), awareness and information sources (43.2%), and risk factors (57.9%). Perceptions were predominantly favorable (82.3%), although only 24.2% ranked cancer control as a top national priority. Higher perception scores were associated with higher odds of correct responses (aOR, 1.19; 95% CI, 1.12–1.26; P < .001). Originating from outside the DRC was associated with higher odds of correct responses (aOR, 1.69; 95% CI, 1.13–2.55; P = .012), although this association was exploratory (n=10).

Conclusions: Final-year medical interns showed moderate cancer knowledge, with important gaps in prevention, risk factors, and the single palliative-care item despite predominantly favorable perceptions. Strengthening undergraduate oncology education is warranted.

INTRODUCTION

Cancer remains one of the most pressing public health challenges of the twenty-first century. According to the latest GLOBOCAN estimates, approximately 20.6 million new cancer cases and 9.8 million cancer-related deaths occurred worldwide in 2024(1). In Africa, about 1.22 million new cases and more than 727,000 deaths were recorded in the same year, corresponding to a mortality-to-incidence ratio of nearly 60%. The continent continues to bear a disproportionately high burden, with projections indicating a substantial further increase by 2050(1, 2).

The global response to cancer is coordinated by organizations such as the World Health Organization (WHO), the Union for International Cancer Control (UICC), and the International Cancer Control Partnership (ICCP)(3). These bodies emphasize prevention, early detection, treatment, and palliative care, while supporting member states in the development, implementation, and evaluation of National Cancer Control Plans (NCCPs) to strengthen health-system capacity(4)

In sub-Saharan Africa, rapid and often unplanned urbanization, dietary transitions, and lifestyle changes including sedentary behavior, alcohol consumption, tobacco use, low-fiber diets, and shifts in reproductive patterns have created favorable conditions for the rise of non-communicable diseases, including cancer(5, 6). As a result of this epidemiological transition, the number of cancer cases has increased substantially in recent decades(5, 7).

Low- and middle-income countries, particularly those in sub-Saharan Africa, face distinctive challenges: late-stage diagnosis, severe shortages of specialized infrastructure and trained oncology personnel, weak health systems, and inadequately implemented or absent national cancer control programmes. Geographic, social, and financial barriers further compound these difficulties. Consequently, mortality rates remain approximately 65%, compared with around 30% in high-income countries(7–9).

In the Democratic Republic of the Congo (DRC), the absence of a population-based cancer registry still limits access to comprehensive national epidemiological data(10–14). However, a National Cancer Control Center (NCCC) was established in November 2020 as the coordinating structure for the national cancer control programme, and efforts are underway to develop a prioritized National Cancer Control Plan. According to the imPACT Review Report (Cancer Control Capacity and Needs Assessment, Democratic Republic of the Congo, November 2021), conducted by the Ministry of Public Health, Hygiene and Prevention in collaboration with the World Health Organization (WHO), the International Agency for Research on Cancer (IARC) and the International Atomic Energy Agency (IAEA), GLOBOCAN 2020 estimates indicate that women accounted for 27 222 of the 48 839 new cancer cases recorded in the country. Cervical cancer was the leading site (7 772 cases, 28.55%), followed by breast cancer (7 267 cases, 26.69%) and colorectal cancer (1 449 cases, 5.32%)(11). In comparison, a hospital-based series from the oncology department of the Kinshasa Hospital Center (2007–2021) documented 1 104 cancers among women, of which breast cancer represented nearly half (509 cases, 46.11%) and cervical cancer 27.45% (303 cases); other sites each accounted for between 0.18% and 4.71% of recorded cases(15).

These structural weaknesses are markedly aggravated in the eastern part of the country. For more than three decades the DRC has experienced recurrent violent conflict, especially in the Kivu region. The consequences include massive population displacement, persistent food insecurity, widespread destruction of infrastructure, and profound deterioration of the health system. Access to cancer care is severely restricted by repeated attacks on health facilities, acute staffing shortages (reaching 40% in some areas), and the partial collapse of health services(16, 17).

In this environment of limited technical platforms and virtually no specialized oncology resources, cancer management falls largely to general practitioners, internists, gynecologists, and surgeons who lack formal oncology training. Many patients therefore receive suboptimal care or are referred

abroad at prohibitive cost, widening existing socioeconomic disparities. Late detection driven by low awareness of warning signs, cultural beliefs, preference for traditional medicine, and geographic and financial barriers further contributes to high mortality(17, 18).

Against this backdrop, medical interns (final-year medical students undertaking clinical training) from the medical schools of the Greater Kivu region occupy a strategically important position. These institutions the Official University of Bukavu, the Catholic University of Bukavu, the Evangelical University in Africa, the University of Goma, the University of Kindu, and the University of Graben graduate more than 300 physicians each year. These young doctors will form the frontline of healthcare delivery across the region and beyond. Although cancer incidence is rising in the DRC, and particularly in the Kivu sub-region, oncology remains a relatively unattractive specialty for trainees, partly because formal specialist training pathways are not available locally. Strengthening interns' knowledge of risk factors, clinical warning signs, prevention strategies, and basic management principles therefore offers a realistic opportunity to improve early recognition and reduce avoidable mortality.

Despite the clear importance of this workforce, few studies have examined the knowledge, perceptions, and experiences of medical trainees regarding cancer in conflict-affected areas of Central Africa. The present multi-institutional cross-sectional study aims to address this gap by assessing the level of cancer-related knowledge, perceptions, and experiences among final-year medical interns in the Kivu sub-region of the Democratic Republic of the Congo.

Aim of the study

This study aimed to assess the knowledge, perceptions, and experiences regarding cancer among final-year medical interns in the Kivu sub-region of the Democratic Republic of the Congo, in order to identify gaps relevant to undergraduate medical education and curriculum development.

METHODS

Study Design

This exploratory cross-sectional study evaluated the knowledge, perceptions, and experiences related to cancer among final-year medical students in the eastern Democratic Republic of the Congo. The survey was conducted in French from 1 March 2026 to 31 May 2026 across hospitals in the Kivu region. Participants could complete the questionnaire online or in person. The online version was administered via a Kobo Toolbox form and distributed through professional networks and communication channels, including email, WhatsApp, and Telegram. The face-to-face version used printed copies of the same questionnaire and was administered by trained data collectors.

Study Setting

The Kivu region, located in the eastern Democratic Republic of the Congo (DRC), comprises three provinces: North Kivu, South Kivu, and Maniema. The region hosts several public and private universities offering undergraduate medical programmes leading to the Doctor of Medicine (MD) degree. Final-year medical interns, who constitute the region's future medical workforce, undertake a mandatory clinical internship (commonly referred to as *internat* or *stage clinique*) prior to graduation.

These medical interns are posted to various teaching and referral hospitals across the Kivu provinces for their clinical rotations and practical training. The present study recruited final-year medical interns from major public and private medical education institutions in the region. Participation was open to both Congolese students and students from neighboring countries enrolled in these programmes.

Study Population

The target population consisted of final-year medical students who were undertaking their clinical internship during the study period.

Inclusion Criteria

Participants were eligible if they:

- were enrolled in the final year of a medical degree program;
- were actively undertaking their clinical internship during the study period; and
- provided informed consent to participate in the study.

Exclusion Criteria

Students who were not in their final year of medical training, those who had not yet commenced their internship, or those who declined participation were excluded.

Sampling Strategy

An institution-based recruitment approach was used across the participating medical training institutions. All eligible final-year medical interns identified through the participating institutions and meeting the predefined inclusion criteria were invited to participate during the study period. Recruitment was conducted through the participating institutions and their affiliated teaching hospitals, and the online survey link was made available to eligible interns.

The participating institutions and affiliated teaching hospitals were: University Clinics of Bukavu/Official University of Bukavu (150 interns); Bukavu Provincial General Referral Hospital/Catholic University of Bukavu (152 interns); Panzi General Referral Hospital/Evangelical University in Africa (146 interns); Goma Provincial General Referral Hospital and HEAL Africa Hospital/University of Goma (327 interns); Butembo General Referral Hospital/Catholic University of Graben (93 interns); Keshero General Referral Hospital/University of the Free Great Lakes (74 interns); and Kindu General Referral Hospital/University of Kindu (170 interns).

Based on the available institutional records, the total population across the seven participating universities was approximately 1,112 final-year medical interns. Before the final survey, the questionnaire was pilot-tested among 28 final-year medical interns who were excluded from the final study. Following the pilot phase, 266 eligible interns accessed the final survey; 6 did not provide informed consent, resulting in 260 participants included in the final analysis. Because the number of interns actually reached or invited at each institution could not be independently verified, a formal response rate was not calculated.

Survey Development

The questionnaire was developed specifically for this study based on a review of the relevant literature(19) and subsequently reviewed by experts to assess the relevance, clarity, and comprehensiveness of the items. Cognitive testing was then conducted to assess how the target population understood and interpreted the questions. The revised questionnaire was pilot-tested among 28 final-year medical students who were excluded from the final study. The pilot study assessed the feasibility, clarity, comprehensibility, and overall performance of the questionnaire and helped identify ambiguous or incomplete response options. Based on the pilot feedback, the questionnaire was refined by expanding selected response options, adding “Other (specify)” fields where appropriate, refining several response categories, replacing the rotation-based measure of internship stage with the cumulative duration of internship, and adding questions addressing the perceived adequacy of cancer prevention, diagnosis, and management in the DRC. The refined questionnaire was then used for the final survey. These procedures provided preliminary evidence of content relevance and usability; however, the instrument has not undergone formal psychometric validation. An English-language version of the questionnaire is provided as Supplementary File 1.

Data Collection Tool

The self-administered questionnaire comprised five main sections:

1. **Sociodemographic characteristics**: age, sex, province of origin, marital status, university attended, and duration of clinical internship (in months).
2. **Awareness and knowledge of cancer**: definition of cancer, common cancer types, risk factors, prevention strategies, screening methods, therapeutic modalities, and palliative care.
3. **Perceptions toward cancer**: curability of cancer, public-health importance of cancer, adequacy of cancer prevention and management services in the DRC, priority given to cancer control, and the influence of myths and cultural traditions on cancer management.
4. **Cancer-related experiences**: personal history of cancer, family history of cancer, exposure to individuals diagnosed with cancer, and observed treatment experiences and outcomes.
5. **Open-ended questions**: qualitative insights on cancer prevention, management, and context-specific challenges.

The knowledge domains assessed in the questionnaire were deliberately aligned with core undergraduate medical competencies expected of a graduating physician. Items on the definition of cancer, cancer types, risk factors, and general cancer knowledge map to foundational biomedical and clinical knowledge. Prevention and screening domains address competencies in health promotion, early detection, and population health. Treatment modalities and cancer burden/barriers items evaluate understanding of basic management principles and health-system constraints. The palliative-care domain specifically targets competencies in symptom control, patient-centered communication, and end-of-life care areas of particular relevance in settings where most patients present at advanced stages. Finally, awareness and information-sources items assess the ability to access and critically appraise reliable clinical information, a key component of lifelong learning and evidence-based practice.

Data Management and Variable Coding

A comprehensive data dictionary (codebook) was developed prior to analysis. Each variable was assigned:

- A unique variable name;
- A descriptive label;
- Variable type;
- Categories and coding scheme;

- Correct responses (for knowledge items);
- Positive responses (for perception items); and
- Inclusion criteria for score computation.

All responses were reviewed and cleaned before analysis. The final dataset contained no missing values after exclusion of questionnaires lacking informed consent.

Construction of the Knowledge Score

Each knowledge item was scored as 1 for a correct response and 0 for an incorrect or "Don't know" response, yielding a total knowledge score ranging from 0 to 74. The score was analyzed primarily as a continuous measure. For descriptive purposes, knowledge scores were also categorized into four levels: poor (< 50%), insufficient (50–64.9%), moderate (65–84.9%), and good (≥ 85%). These thresholds were adapted from a published methodological framework for KAP surveys, which recommends more stringent thresholds for health professionals than for the general population, reflecting the higher level of knowledge expected in medically trained populations (20). The categories were used to describe performance on the study questionnaire and should not be interpreted as formal measures of clinical competency.

Construction of the Perception Score

Participants' perceptions of cancer were assessed using five prespecified items addressing cancer curability, its importance as a public health problem, the adequacy of cancer prevention, diagnosis and management in the DRC, prioritization of cancer control, and the perceived influence of myths and cultural traditions on cancer management. Each item was coded according to a predefined favorable response established during questionnaire development. A favorable response was assigned 1 point, whereas all other responses were assigned 0 points. The five items were combined to provide a composite index of favorable responses across these prespecified dimensions, ranging from 0 to 5. Higher scores indicated a greater proportion of favorable responses. This index was not considered a validated psychometric scale. For descriptive analyses, scores were categorized according to the proportion of favorable responses: <50% was classified as unfavorable and ≥ 50% as favorable. This categorization was used solely for descriptive purposes. The perception score was retained as a continuous variable for correlation analyses and multivariable regression modeling.

Statistical Analysis

All collected data underwent thorough review and quality checks before being entered into the R software (R Foundation for Statistical Computing, Vienna, Austria) for analysis. Numerical variables were presented as the mean and standard deviation (SD), while categorical variables were presented using frequencies (N) and percentage (%). A Student's t-test was used to compare means between two groups defined by a binary categorical variable. Associations between participant characteristics and knowledge score were initially explored using:

- Analysis of variance (ANOVA) for categorical variables with more than two categories;
- Spearman rank correlation coefficient for continuous variables and score variables.

The corresponding test statistics and p-values were reported.

Assessment of Model Assumptions

The knowledge score was defined as the number of correct responses across 74 knowledge items and was therefore treated as a discrete, bounded outcome ranging from 0 to 74. A simple linear regression was initially used to explore the unadjusted association between perception and knowledge scores. Because the residuals deviated significantly from normality (Shapiro-Wilk test, $p = 0.0005$), count-based generalized linear models were subsequently considered. A multivariable Poisson regression was initially fitted; however, significant overdispersion was detected (dispersion ratio = 1.59, Pearson $\chi^2 = 394.80$, $p < 0.001$). A negative binomial model was therefore fitted as an alternative count model and showed no evidence of residual overdispersion (dispersion ratio = 0.96, $p = 0.656$). Given that the knowledge score represented the number of correct responses out of a fixed total of 74 items, a beta-binomial mixed-effects model was subsequently specified to account for the bounded binomial structure and potential extra-binomial variability. Because participants were recruited across seven universities, university was included as a random intercept rather than as a fixed effect. The beta-binomial mixed-effects model was retained as the primary multivariable model based on its compatibility with the bounded outcome, successful convergence, absence of singularity, satisfactory simulated-residual diagnostics, and lower AIC compared with the alternative models. A negative binomial mixed-effects model was retained as a sensitivity analysis to assess the robustness of the main associations.

Ethical Considerations

The study was approved by the Ethics Committee of the Official University of Bukavu (Approval No. UOB/CEM/059/2026). All procedures were performed in accordance with the ethical standards of the institutional research committee and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards(21). Informed consent was obtained via an informed consent form (ICF) attached to the online questionnaire. Access to

the questionnaire was possible only after completion of the ICF, which described the potential benefits, risks, and rationale of the survey. The ICF explicitly stated that participation was voluntary and that withdrawal was permitted at any stage.

RESULTS

After excluding the 28 participants who took part in the pilot survey, 266 final-year medical interns accessed the final survey. Six participants did not provide informed consent, resulting in 260 participants included in the final analysis.

Table 1
Sociodemographic Characteristics of Medical Interns

Characteristic	**n = 260**
Age (Years) mean ± SD	26 ± 2
Sex	
Female	95 (37%)
Male	165 (63%)
Province	
Other province	16 (6.2%)
Outside the country	10 (3.8%)
Maniema	48 (18%)
North kivu	82 (32%)
South kivu	104 (40%)
Marital status	
Single	236 (91%)
Married	24 (9.2%)
Internship duration	9 ± 5
University	
Catholic University of Bukavu	23 (8.8%)
Catholic University of Graben	56 (22%)
University of Kindu	50 (19%)
Evangelical University in Africa	49 (19%)
University of Goma	35 (13%)
University of the Free Great Lakes	12 (4.6%)
Official University of Bukavu.	35 (13%)
[1]Mean ± SD; n (%)	

The study included 260 final-year medical interns with a mean age of 26 ± 2 years. Participants were predominantly male (63%), with females accounting for 37%. Most originated from South Kivu (40%) and North Kivu (32%), while 18% came from Maniema, 6.2% from other provinces, and 3.8% from outside the country. The vast majority (91%) were single, and 9.2% were married. On average, participants had completed 9 ± 5 months of their internship.

Interns were recruited from seven medical schools across the Kivu region. The largest proportions came from the Catholic University of Graben (22%), University of Kindu (19%), and The Evangelical University in Africa (19%), followed by the University of Goma (13%), The Official Offial University of Bukavu (13%), the Catholic University of Bukavu (8.8%), and University of the Free Great Lakes (4.6%) (Table 1)

Table 2
Cancer Knowledge Among Medical Interns: Performance by Knowledge Domain

Knowledge Domain	Number of Items = 74	Mean Correct (%)
Cancer Awareness and Information Sources	7	43.2
Cancer Burden and Barriers	9	64.3
Cancer Types	13	65.8
Definition of Cancer	5	78.1
General Cancer Knowledge	7	73.7
Palliative-care item	1	21.9
Prevention and Screening	11	61.8
Risk Factors	12	57.9
Treatment Modalities	9	64.8

Performance varied substantially across knowledge domains. The highest level of knowledge was observed for the Definition of Cancer domain, with a mean correct response rate of 78.1%, followed by General Cancer Knowledge (73.7%). Moderate performance was also observed for Cancer Types (65.8%), Treatment Modalities (64.8%), and Cancer Burden and Barriers (64.3%). Lower performance was observed for Prevention and Screening (61.8%) and Risk Factors (57.9%). The weakest performance was observed in the Cancer Awareness and Information Sources domain (43.2%). Only 21.9% of participants correctly answered the single palliative-care knowledge item. (Table 2)

Table 3
Perceptions Toward Cancer

Perception Item	Positive Responses (n)	Positive Responses (%)
Believe that cancer can be cured	212	81.5
Do you think that cancer prevention, diagnosis and treatment are adequate in the DRC?	138	53.1
Level of priority given to the fight against cancer in the DRC	63	24.2
Do you think cancer is a major public health problem in the Kivu sub-region?	216	83.1
The influence of myths and traditions on cancer management	234	90.0

Participants generally expressed favorable perceptions toward cancer and cancer control. Most believed that cancer can be cured (81.5%) and considered it a major public health problem in the Kivu sub-region (83.1%). Most also recognized the influence of myths and traditions on cancer management (90.0%). However, 53.1% perceived cancer prevention, diagnosis, and treatment services in the DRC as inadequate, while only 24.2% assigned the highest priority to cancer control efforts. (Table 3)

Table 4
Cancer-Related Experiences

Characteristic	n (%)
Personal history of cancer (n = 260)	
No	245 (94.2)
Yes	15 (5.8)
Family history of cancer (n = 260)	
No	220 (84.6)
Yes	40 (15.4)
Relationship with affected relative (n = 40)	
Parent	9 (22.5)
Uncle/Aunt	13 (32.5)
Grand-parent	8 (20.0)
Sibling	2 (5.0)
Cousin	3 (7.5)
Great-grand-parent	2 (5.0)
Other	3 (7.5)
Observed treatment modality (n = 10)	
Conventional medical treatment	8 (80.0)
Combined conventional and traditional treatment	1 (10.0)
No treatment	1 (10.0)
Observed outcome (n = 10)	
Recovery	6 (60.0)
Death	4 (40.0)
Values are presented as n (%). Denominators vary according to the applicability of each question because subsequent questions were conditionally displayed based on previous responses.	

Among the 260 participants, 15 (5.8%) reported a personal history of cancer, while 40 (15.4%) reported a family history of cancer. Among participants with a family history of cancer, the affected relative was most commonly an uncle or aunt (32.5%), followed by a parent (22.5%) and a grandparent (20.0%). Smaller proportions reported an affected cousin (7.5%), sibling (5.0%), great-grandparent (5.0%), or another relative (7.5%). Among the 10 participants who reported observing or experiencing cancer treatment, 80.0% reported conventional medical treatment, whereas 10.0% reported a combination of conventional and traditional treatments and 10.0% reported no treatment. Regarding observed outcomes, 60.0% reported recovery, while 40.0% reported death (Table 4).

The histogram shows the distribution of knowledge scores as percentages of participants; the dashed vertical line indicates the mean score. The mean knowledge score was 46.2 ± 9.3 points (median, 48; IQR, 40–53), corresponding to approximately 62% of the maximum score (Fig. 1).

Table 5
Distribution of Knowledge and Perception Levels

Knowledge level	n = 260	Percent
Good knowledge	3	1.2
Moderate knowledge	120	46.2
Insufficient knowledge	92	35.4
Poor knowledge	45	17.3
Perception level		
Favorable perception	214	82.3
Unfavorable perception	46	17.7

Overall, participants demonstrated moderate levels of cancer knowledge, with nearly half (46.2%) classified as having moderate knowledge, while only 1.2% achieved a good knowledge level. More than half of the participants (52.7%) had poor or insufficient knowledge. In contrast, most participants had a favorable perception index (82.3%), whereas 17.7% had an unfavorable perception index (Table 5).

Table 6
Exploratory Associations with Cancer Knowledge Score

Variable	Category	n	Knowledge Score Mean (SD)	Test	Statistic	P_value
Sex	Female	95	45.78 (8.75)	Student t-test	-0.605	0.546
	Male	165	46.48 (9.56)	Student t-test		
Marital status	Married	24	44.75 (10.7)	Student t-test	0.719	0.478
	Single	236	46.38 (9.12)	Student t-test		
Personal cancer history	No	245	46.33 (9.06)	Student t-test	0.53	0.604
	Yes	15	44.6 (12.42)	Student t-test		
Family history of cancer	No	220	46.06 (9.07)	Student t-test	-0.626	0.534
	Yes	40	47.15 (10.33)	Student t-test		
Province	Other province	16	46.44 (9.95)	ANOVA	5.831	0.000166
	Outside the country	10	54.6 (3.27)	ANOVA		
	Maniema	48	42.19 (10.71)	ANOVA		
	North kivu	82	48.27 (8.42)	ANOVA		
	South kivu	104	45.64 (8.61)	ANOVA		
Age		260	-	Spearman	-0.012	0.846
Internship duration		260	-	Spearman	0.018	0.773
Perception score		260	-	Spearman	0.331	4.79e-08

No significant associations were observed between cancer knowledge score and sex, marital status, personal history of cancer, family history of cancer, age, or internship duration (all $p > 0.05$). Knowledge scores differed significantly across provinces (ANOVA: $F = 5.83$, $p < 0.001$), with the highest mean score observed among participants residing outside the country and the lowest among those from Maniema. A positive correlation was found between perception score and knowledge score (Spearman's $\rho = 0.331$, $p < 0.001$), indicating that higher perception scores were associated with better cancer knowledge (Table 6).

Table 7
Factors Associated with Cancer Knowledge Score in a Beta-Binomial Mixed-Effects Model

Group	Predictors	Adjusted OR (95% CI)[1]	p-value
	Age (years)	**0.97 (0.94 to 1.01)**	**0.106**
	Sex		
	Female		
	Male	1.14 (0.99 to 1.31)	0.075
	Province of origin		
	Other province		
	Outside DRC	1.69 (1.13 to 2.55)	**0.012**
	Maniema	0.82 (0.54 to 1.24)	0.348
	North kivu	1.02 (0.73 to 1.43)	0.892
	South kivu	0.88 (0.62 to 1.24)	0.467
	Marital status		
	Célibataire (Single)		
	Marié(e) (Married)	1.01 (0.82 to 1.25)	0.898
	Internship duration (months)	1.00 (0.98 to 1.01)	0.788
	Personal history of cancer		
	No		
	Yes	0.91 (0.70 to 1.18)	0.476
	Family history of cancer		
	No		
	Yes	1.05 (0.88 to 1.26)	0.571
	Perception score	1.19 (1.12 to 1.26)	**< 0.001**

[1]Adjusted OR: adjusted odds ratio; CI: confidence interval. Estimates are from a beta-binomial mixed-effects regression model with university as a random intercept.

The beta-binomial mixed-effects model, which accounted for the bounded 0–74 structure of the knowledge score and clustering by university, showed satisfactory convergence and residual diagnostics and had the lowest AIC among the evaluated models (AIC = 1850.6). The university random effect was estimable without singularity in this model. The association between perception score and knowledge remained consistent in sensitivity analysis using a negative binomial mixed-effects model.

Higher perception scores were associated with 19% higher odds of correct responses on the knowledge items, after accounting for potential clustering within the seven participating universities. Originating from outside the DRC was associated with 69% higher odds of correct responses than the reference province; however, this association was exploratory (n = 10). No statistically significant associations were observed for age, sex, internship duration, marital status, or personal or family history of cancer (Table 7).

Discussion

Cancer is emerging as a critical public health challenge in low- and middle-income countries (LMICs), including the Democratic Republic of the Congo (DRC)(7). In the conflict-affected Kivu sub-region, this burden is intensified by late-stage presentation, insufficient specialized infrastructure, and the near-absence of a functional national cancer control program or population-based registry(22).

Final-year medical interns constitute the future frontline workforce responsible for early recognition, basic management, referral, and palliative support. Their knowledge, perceptions, and readiness therefore directly shape the quality of cancer care that patient will receive. Despite this strategic importance, evidence on oncology-related competencies among medical trainees in conflict-affected Central Africa remains scarce. The present study provides the first multi-institutional assessment of cancer knowledge, perceptions, and experiences among final-year medical interns in North Kivu, South Kivu, and Maniema

Our study reveals that among the 260 participants, the mean knowledge score was 46.2 ± 9.3 out of 74 items (approximately 62%). Only 1.2% reached a good knowledge level (≥ 85% correct), while more than half (52.7%) were classified as having insufficient or poor knowledge. Domain performance varied markedly: definition of cancer (78.1%) and general cancer knowledge (73.7%) were strongest, whereas risk factors (57.9%), prevention and screening

(61.8%), cancer awareness and information sources (43.2%), with particularly low performance on the single palliative-care item (21.9%). Perceptions were predominantly favorable (82.3% positive overall). Most interns recognized cancer as a major public-health problem in the Kivu sub-region (83.1%), believed it to be curable (81.5%), and acknowledged the influence of myths and traditions on management (90.0%). However, only 24.2% assigned the highest priority to cancer control efforts in the DRC, and just over half considered existing prevention, diagnosis, and treatment services adequate. In multivariable analysis, higher perception scores were associated with odds of correct responses on the knowledge items (adjusted OR [aOR], 1.19; 95% CI, 1.12–1.26; P < .001), after accounting for potential clustering within the seven participating universities. Participants originating from outside the DRC were associated with higher odds of correct responses than those from the reference province (aOR, 1.69; 95% CI, 1.13–2.55; P = 0.012), although this finding was considered exploratory because only 10 participants were in this category.

Although overall knowledge was moderate, the pattern of domain-specific deficits is consistent with findings from other African medical-training settings. Studies of final-year students in Guinea reported poor overall knowledge of breast cancer in 82.7% of participants(23). Surveys in Kenya, Nigeria, and Algeria have similarly documented limited awareness of epidemiology, risk factors, screening modalities, and treatment options, alongside strong support for strengthened undergraduate oncology education(23–25). The particularly low palliative-care knowledge observed in the present study (21.9%) mirrors reports from other resource-constrained environments, where formal teaching on symptom control, prognosis communication, and end-of-life care remains scarce or absent from curricula (8, 26, 27). This gap is especially consequential in the DRC, where the majority of patients present at advanced stages and curative options are limited. Knowledge remained heavily weighted toward basic definitions and high-risk factors, while preventive lifestyle counselling and early-detection strategies were weaker an imbalance previously noted among physicians in other LMIC settings.

Perceptions and attitudes

The predominantly favorable perceptions observed here are encouraging and align with the knowledge-attitude-practice framework. Interns who viewed cancer as a solvable public-health priority and recognized the distorting effects of myths were significantly more likely to retain factual knowledge. This interdependence between knowledge and attitude has been reported in other oncology KAP studies(28, 29) and suggests that interventions improving knowledge may have downstream benefits on attitudinal orientation, creating a reinforcing loop conducive to more effective clinical behavior. The high recognition of cultural myths and traditions (90%) underscores the need for training that equips future physicians to address community beliefs respectfully while promoting evidence-based early detection and treatment adherence.

Contextual challenges of the Kivu sub-region

These findings must be interpreted against the unique realities of eastern DRC. Decades of recurrent conflict have produced massive population displacement, destruction of health infrastructure, severe workforce shortages (up to 40% in some areas), and the near-absence of specialized oncology services(16, 17). In such environments, general practitioners and interns constitute the de facto frontline of cancer care. Late diagnosis driven by low community awareness, preference for traditional medicine, geographic and financial barriers, and the lack of a functional national cancer registry or control plan further amplifies the consequences of trainee knowledge deficits(15, 18, 30). Geographic variation (higher scores among the small group of participants from outside the country and lower scores in Maniema) may reflect differences in curriculum intensity, clinical exposure, or access to external educational resources. The absence of associations with age, sex, internship duration, or personal/family cancer history indicates that current clinical rotations and incidental exposure are insufficient to close knowledge gaps; structured, longitudinal oncology teaching appears necessary.

Implications for medical education and health-system strengthening

The findings of this study highlight areas for strengthening oncology-related education within undergraduate medical curricula in the Kivu sub-region and similar resource-constrained, conflict-affected settings. The lack of a significant association between internship duration and cancer knowledge does not establish that current clinical rotations or incidental exposure are ineffective. However, the observed knowledge gaps, particularly in palliative care, suggest the potential value of more structured and longitudinal oncology teaching covering epidemiology, risk-factor counselling, warning signs, available screening methods, treatment principles, and core palliative-care concepts. Further educational research is warranted to evaluate how such approaches could be integrated into medical training and whether they improve cancer-related knowledge and clinical preparedness. These findings align with recent scoping reviews showing that undergraduate oncology education remains fragmented and insufficient in many settings worldwide(31)

Recent international evidence supports this approach. Scoping reviews of undergraduate oncology education highlight persistent gaps and call for systematic integration of cancer content across pre-clinical and clinical years(32). National frameworks, such as the Australian Cancer Education Framework, demonstrate that a concise set of core competencies can be embedded within existing curricula without requiring specialized infrastructure(33). Parallel recommendations from African contexts, including Rwanda, Kenya, Tanzania and South Africa, emphasize both the acceptability of dedicated cancer modules among students and the particular importance of palliative-care training for generalist physicians who will manage the majority of advanced-stage cases(24, 32, 34).

Practical, context-adapted strategies feasible in eastern DRC include short case-based discussions and simulated communication exercises within existing teaching hospitals, focused clinical attachments to oncology or palliative-care services where available, and the use of open-access digital resources supplemented by regional mentorship networks. At the policy level, these educational reforms should be aligned with the development of a national cancer control plan that prioritizes human-resource capacity building (35–39). Strengthening the oncology readiness of the several hundred physicians graduating annually from Kivu medical schools represents one of the most feasible and high-impact investments available to reduce avoidable cancer mortality in the region.

Strengths and limitations

Strengths of the study include its multi-institutional design covering major medical education institutions in North Kivu, South Kivu, and Maniema, systematic questionnaire development and pilot testing, and predefined scoring procedures for knowledge and perceptions. Domain-specific analyses also allowed identification of areas requiring further educational attention.

Limitations include the absence of a predefined sampling frame and complete denominator of eligible interns, which prevented estimation of the proportion of the target population reached and does not exclude selection bias. The cross-sectional design precludes causal inference regarding the association between perceptions and knowledge. Self-reported experiences and perceptions may be subject to recall and social-desirability bias. Although the questionnaire underwent expert review, cognitive testing, and pilot testing, it has not undergone formal psychometric validation. Finally, the evolving security context may limit generalizability to other periods or regions of the DRC.

Conclusion

Final-year medical interns in the Kivu sub-region demonstrated moderate overall cancer knowledge, with important gaps in prevention, risk factors, information sources, and palliative care, despite predominantly favorable perceptions of cancer. Perception scores were positively associated with knowledge scores. Strengthening cancer education within medical curricula, particularly in these identified domains, may help improve preparedness for cancer prevention, early detection, referral, and patient-centred care.

Declarations

Acknowledgments

We thank all medical interns who participated in the study and the academic institutions that facilitated data collection.

Funding

The authors received no specific funding for this study.

Supplementary data

https://github.com/Imani-fab/KAP_CANCER_UNIVERSITIES_KIVU.git

Human Ethics and consent for participation.

The study was approved by the Ethics Committee of the Official University of Bukavu (Approval No. UOB/CEM/059/2026). All procedures involving human participants were performed in accordance with the ethical standards of the institutional research committee and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. Informed consent was obtained electronically from all participants before participation in the survey. Participation was voluntary, and participants could withdraw at any time without consequence.

Consent for publication

Not Applicable.

Conflicts of Interest

The authors declare no conflicts of interest

Authors contribution.

David Banyanga contributed to conceptualization, writing – original draft, writing – review & editing, visualization, validation, supervision, methodology, investigation, formal analysis, and data curation.

Fabien Imani Shangalume contributed to project administration, supervision, writing – review & editing, validation, methodology, investigation, formal analysis, and data curation.

Prof.Dr. Waleed Arafat contributed to supervision, writing – review & editing, validation, methodology, investigation, and data curation.

Balagizi Ganywamulume contributed to writing – review & editing, validation, methodology, investigation, and data curation.

Dismas Mpusulu contributed to writing – review & editing, software, resources, and data curation.

David Kavuka Biluge contributed to data collection, writing – review & editing, validation, methodology, investigation, and data curation.

Merveille Muniali contributed to writing – review & editing, validation, methodology, investigation, and data curation.

Richard Kambale Keukeu contributed to writing – review & editing, validation, investigation, and data curation.

Alpha Lumamaba contributed to writing – review & editing, validation, and data curation.

Mwaka Shukuru Sivahera contributed to writing – review & editing, validation, investigation, and data curation.

Balegana Cirhuza contributed to writing – review & editing, validation, and data curation.

Lucien Baraka contributed to writing – review & editing, validation, and data curation

Gloire Kikandi Kabechi contributed to writing – review & editing, validation, and data curation.

Tshass Chasinga Baharanyi contributed to writing – review & editing and validation.

Elabrar Ibrahim contributed to writing – review & editing and validation.

Vandrome Nakundi contributed to writing – review & editing and validation.

All authors reviewed the manuscript.

References

1. Siegel RL, Kratzer TB, Wagle NS, Sung H, Jemal A, Cancer statistics. 2026. CA A Cancer J Clinicians. 2026;76(1):e70043. 10.3322/caac.70043
2. Cancer Today [Internet]. [cited 2026 Sep 17]. Available from: https://gco.iarc.who.int/today/
3. Torode JS, Tittenbrun Z, Romero Y, Johnson SE, Bourque JM, Given LS, et al. Ten Years of the International Cancer Control Partnership: Promoting National Cancer Control Plans to Shape the Health System Response for Cancer Control. JCO Global Oncol. 2023;9e2200232. 10.1200/GO.22.00232.
4. Romero Y, Tittenbrun Z, Trapani D, Given L, Hohman K, Cira MK, et al. The changing global landscape of national cancer control plans. Lancet Oncol. 2025;26(1):e46–54. 10.1016/S1470-2045(24)00405-4.
5. Ngwa W, Addai BW, Adewole I, Ainsworth V, Alaro J, Alatise OI, et al. Cancer in sub-Saharan Africa: a Lancet Oncology Commission. Lancet Oncol. 2022;23(6):e251–312. 10.1016/S1470-2045(21)00720-8.
6. Juma K, Juma PA, Shumba C, Otieno P, Asiki G. Non-Communicable Diseases and Urbanization in African Cities: A Narrative Review. In: Public Health in Developing Countries - Challenges and Opportunities [Internet]. IntechOpen; 2019 [cited 2026 Sep 17]. Available from: https://www.intechopen.com/chapters/69370 10.5772/intechopen.89507
7. Minnaar CA, Hugo M, Pillay P, Naidoo T, Kotzen JA, Ramiah D. Addressing the cancer burden in LMICs: the potential of modulated electro-hyperthermia. Front Oncol. 2025;15:1590920. 10.3389/fonc.2025.1590920.
8. Bamodu OA, Chung CC. Cancer Care Disparities: Overcoming Barriers to Cancer Control in Low- and Middle-Income Countries. JCO Glob Oncol. 2024;10e2300439. 10.1200/GO.23.00439.
9. Farmer P, Frenk J, Knaul FM, Shulman LN, Alleyne G, Armstrong L, et al. Expansion of cancer care and control in countries of low and middle income: a call to action. Lancet. 2010;376(9747):1186–93. 10.1016/S0140-6736. (10)61152-X PubMed PMID: 20709386.
10. Global Cancer Observatory [Internet]. [cited 2026 Sep 17]. Available from: https://gco.iarc.who.int/
11. democratic-republic-of-congo-impact-review-report-2022.
12. The Global Initiative. for Cancer Registry Development [Internet]. [cited 2026 Sep 17]. The global initiative for cancer registry development. Available from: https://gicr.iarc.who.int/about-the-gicr/
13. Ayubi E, Lyus R, Brhlikova P, Pollock AM. JRSM Open. 2024;15(1):20542704231217888. 10. 1177/20542704231217888 PubMed PMID: 38223747; PubMed Central PMCID: PMC10785726. A critical appraisal of the quality of data submitted by sub-Saharan African cancer registries to GLOBOCAN 2020.
14. 180-congo-democratic. -republic-of-fact-sheet.pdf [Internet]. [cited 2026 Sep 17]. Available from: https://gco.iarc.who.int/media/globocan/factsheets/populations/180-congo-democratic-republic-of-fact-sheet.pdf
15. Mukuku O, Mwang Sulu SM, Mashinda DK, Babaka Batalansi D, Wembonyama SO, Mboloko JE, et al. Epidemiology of cancers in women in Kinshasa, Democratic Republic of the Congo. JCPCR. 2022;13(2):51–4. 10.15406/jcpcr.2022.13.00487.
16. Sers R. Humanitarian and health-care crises in eastern DR Congo. Lancet. 2025;405(10478):532–3. 10.1016/S0140-6736(25)00290-9.
17. Mukuku O, Govender K. Goma's unfolding crisis: the humanitarian catastrophe and its devastating public health consequences in the eastern Democratic Republic of the Congo. BMJ Glob Health. 2025;10(8):e019719. 10.1136/bmjgh-2025-019719.
18. Hatem M, Blavier A, Alldén S, Foucart J, Taxil B, Keyser LE, et al. Unjustified silence in the face of this new war in eastern DR Congo. Lancet. 2025;405(10483):971. 10.1016/S0140-6736(25)00334-4.
19. Artino AR, La Rochelle JS, Dezee KJ, Gehlbach H. Developing questionnaires for educational research: AMEE Guide 87. Med Teach. 2014;36(6):463–74. 10.3109/0142159. X.2014.889814 PubMed PMID: 24661014; PubMed Central PMCID: PMC4059192.
20. Essi MJ, Njoya O. L'enquête CAP en recherche médicale. HEALTH Sci DISEASE. 2013;14(2). 10.5281/hsd. v14i2.183.

21. Declaration of Helsinki. Ethical Principles for Medical Research Involving Human Subjects. ResearchGate [Internet]. 2026 Jul 18 [cited 2026 Sep 26]. Available from: https://www.researchgate.net/publication/283816379_Declaration_of_Helsinki_Ethical_Principles_for_Medical_Research_Involving_Human_Subjects
22. Preer Parham G, Mukuta Mathieu K, Gombo YouYou T, Hicks ML, Henry-Tillman R, Mutombo A, et al. Establishing women's cancer care services in a fragile, conflict and violence affected ecosystem in Africa. ecancer. 2021;15. 10.3332/ecancer.2021.1231.
23. Condé IK, Cissé K, Bah M, Keïta M, Touré PGL, Camara S, et al. Graduating Medical Students' Views on Breast Cancer in Guinea: A Cross-Sectional Study. AJHES. 2025;4(2):1–18. 10.56893/ajhes2025v04i02.01.
24. Affey M, Aden NM, Saman J, Affey F, Maalim A, Sheikh IM et al. Baseline knowledge, attitudes and perceptions on the oncology profession among final-year medical students in Kenya: a cross-sectional study [Internet]. 2026 [cited 2026 Sep 5]. Available from: http://ecancer.org/en/journal/article/2146-baseline-knowledge-attitudes-and-perceptions-on-the-oncology-profession-among-final-year-medical-students-in-kenya-a-cross-sectional-study 10.3332/ecancer.2026.2146
25. Tozoula Bambara A, Akanni F, Zerbo R. Représentation sociale de la chimiothérapie et du cancer chez les étudiants de troisième cycle d'études médicales à Ouagadougou. Bull Cancer. 2019;106(10):860–7. 10.1016/j.bulcan.2019.04.005.
26. Henry M, Asuzu C, Savard S, Devault-Tousignant C, Timmermans S, Khosravi K, et al. Psychosocial and palliative care in African national cancer control plans: A qualitative study. Psycho-oncology. 2024;33(5):e6346. 10.1002/pon.6346.
27. Yeo SL, Lee A, Ng RHL, Lwin MO, Lin Y. Advancing the understanding of palliative care in Singapore: knowledge, attitudes, receptiveness, and the moderating role of media information-seeking preferences. Front Public Health 14:1774749. 10.3389/fpubh.2026.1774749 PubMed PMID: 42007335; PubMed Central PMCID: PMC13083184.
28. Wang C, Jin J, Wang C, Wu J, Liu Y. Knowledge attitude and practice regarding cancer screening among Chinese medical students. Sci Rep. 2025;16(1):14. 10.1038/s41598-025-29124-w.
29. Nie D, Ma H, Huang G, Zhao T, Li W. Knowledge, Attitudes, and Practices of Physicians Regarding Targeted Drug Therapy for Lung Cancer. IJGM. 2024;17:2681–9. 10.2147/IJGM.S465079.
30. David A, Julia M, David H, Serge M, Vincent M, Rive L, et al. Epidemiological profile of cancer at the laboratory of anatomy and pathological cytology of mungbere in the Democratic Republic of Congo. J Cancer Policy. 2023;37:100434. 10.1016/j.jcpo.2023.100434.
31. Theros JS, Fuchs JW, Nunes D, Fuchs JR, Mohindra NA. Advances and gaps in undergraduate medical oncology education: a scoping review. Discov Educ. 2025;4(1):500. 10.1007/s44217-025-00950-4.
32. Manirakiza A, Rubagumya F, Fehr AE, Triedman AS, Greenberg L, Mbabazi G, et al. Oncology Training in Rwanda: Challenges and Opportunities for Undergraduate Medical Students (The EDUCAN Project). J Canc Educ. 2020;35(2):359–65. 10.1007/s13187-019-1473-6.
33. Starmer DL, Russell K, Juliff D. A Cancer Education Framework for Australian Medical Schools: an Announcement of a New Educational Program. J Canc Educ. 2023;38(2):677–81. 10.1007/s13187-022-02173-9.
34. Mushy SE, Mkoka DA, Lukumay GG, Massae AF, Rohloff CT, Mgopa LR, et al. The need for and acceptability of a cancer training course for medical and nursing students in Tanzania: a convergent mixed methods study. BMC Med Educ. 2024;24(1):614. 10.1186/s12909-024-05497-w.
35. Balbach ML, Neely G, Yorke A, Figueroa-Medina E, Paly J, Shulman RM, et al. Developing an educational hub: impact of a distance-learning curriculum in a multinational cohort. BMC Med Educ. 2024;24(1):406. 10.1186/s12909-024-05193-9.
36. von Grünigen S, Dessane B, Le Pape P, Falaschi L, Geissbühler A, Bonnabry P. Development and Evaluation of an e-Learning Module for Low- and Middle-Income Countries on the Safe Handling of Chemotherapy Drugs. J Canc Educ. 2023;38(1):285–91. 10.1007/s13187-021-02113-z.
37. Virtual Reality in Cancer Care: Bridging Gaps in Education and Training [text] [Internet]. IAEA. 2024 [cited 2026 Sep 5]. Available from: http://www.iaea.org/newscenter/news/virtual-reality-in-cancer-care-bridging-gaps-in-education-and-training
38. Shrestha S, Chigbo CO, O'Reilly S, Grover S, Swanson W, Loehrer PJ, et al. Advancing oncology education in low-income and middle-income African settings: global insights for local action. Lancet Oncol. 2026;27(8):e367–78. 2045(26)00242-1 PubMed PMID: 42508437.
39. Domgue JF, Dille I, Fry L, Mafoma R, Bouchard C, Ngom D, et al. Enhancing cervical and breast cancer training in Africa with e-learning. Lancet Global Health. 2023;11(1):e28–9. 10.1016/S2214-109X. (22)00499-5 PubMed PMID: 36521948.

Figures

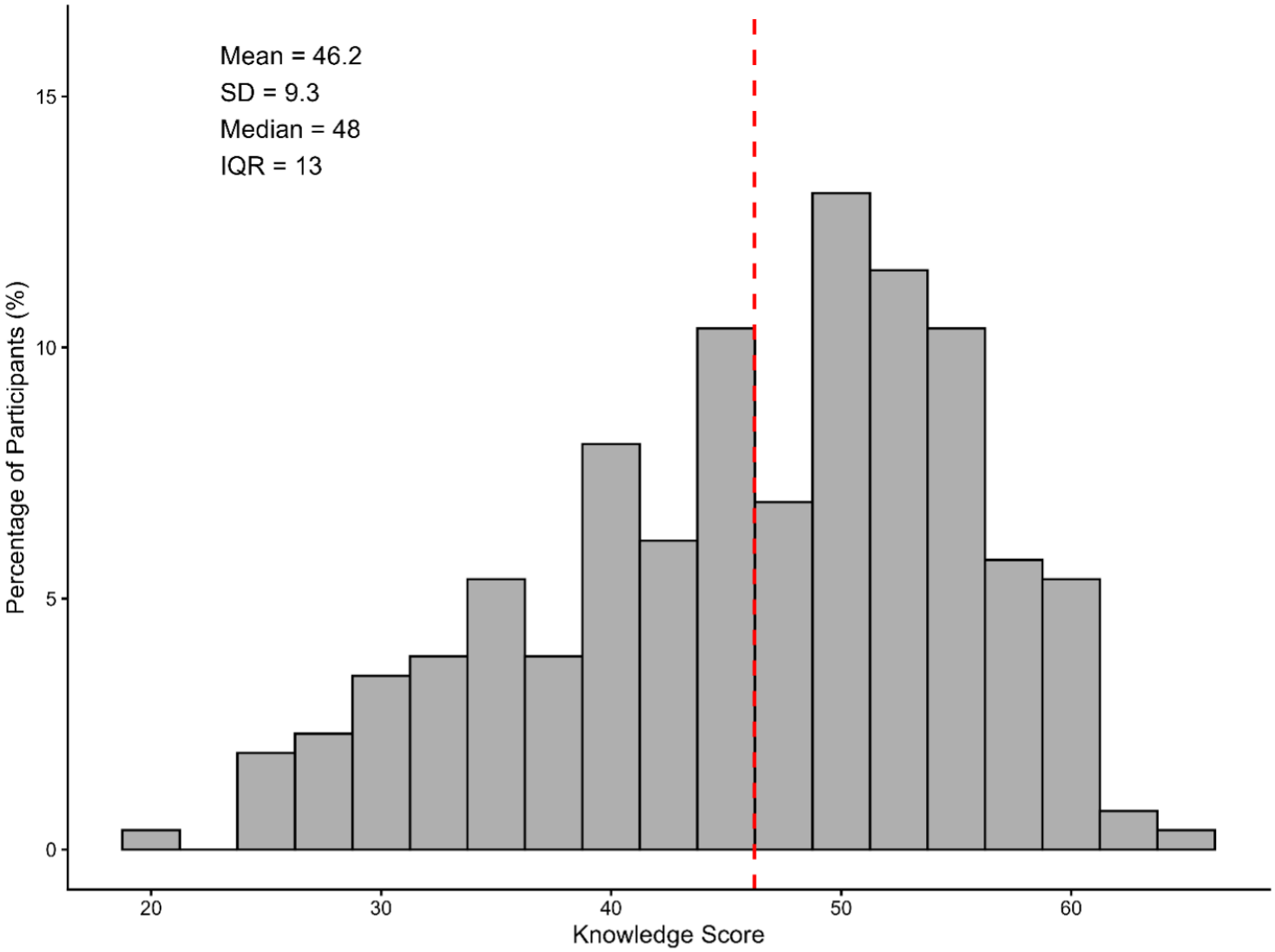


Figure 1

Distribution of cancer knowledge scores among final-year medical interns.

The histogram shows the distribution of knowledge scores as percentages of participants; the dashed vertical line indicates the mean score. The mean knowledge score was 46.2 ± 9.3 points (median, 48; IQR, 40–53), corresponding to approximately 62% of the maximum score (Figure 1).

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SupplementaryFile1EnglishQuestionnaireCancerInternsKivu.docx