

Testicular Cancer and Testicular Self-Examination: Knowledge, Attitude, and Practice Among University Students in Ghana

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Abstract

Testicular cancer (TCa) represents approximately 1% of all male cancers globally and is most common in males aged 15-44 years. Studies have shown that university students have poor knowledge and awareness of TCa and testicular self-examination (TSE). In sub-Saharan Africa, some studies provide insight into possible factors such as inadequate public knowledge or awareness of TCa and TSE related to poor health outcomes in males. In Ghana, no such data exists. A cross-sectional study assessed knowledge of and attitudes towards TCa and TSE practices among undergraduate male students at the Kwame Nkrumah University of Science and Technology (KNUST) in southern Ghana. A total of 391 undergraduate male students aged 17 to 35 years old participated in the survey. Half (49.4%) of the male students reported being *aware* of TCa, yet almost none (0.5%) knew of anyone in their family or close environment (e.g., friends, neighbors) who had been diagnosed with TCa. Overall, media (61.3%) was the students' primary source of information for accessing TCa information, and most students (80.5%) reported interest in receiving information on TCa and TSE. Fifth-year students demonstrated greater knowledge of TCa and TSE than students in all other academic years. A lack of knowledge on how to perform a TSE was a significant barrier to why students did not perform a TSE (χ^2 82.84, $p=0.00$). Other reported barriers were not caring (16.6%), attributing the TSE exam to a sin (6.4%), feelings of shame/guilt (12.0%), and cultural barriers (7.2%). To our knowledge, this is the first study to investigate TCa and TSE awareness, knowledge, and practice in male Ghanaian university students. Our data indicate a lack of proper and adequate TCa and TSE information among adolescent and university-aged males in Ghana. Therefore, a health promotion program designed to target this cohort to encourage early detection is paramount. Access to programs that provide accurate and high-quality information can ensure the successful attainment of accurate and high-quality knowledge and awareness.

Keywords: Ghana, testicular cancer, testicular self-examination, university students, males, cancer research, cancer prevention, health sciences, cancer

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Introduction

Testicular cancer (TCa) comprises about 1% of all male cancers globally, primarily affecting males aged 15-44 years (Huang et al., 2023). Over the last four decades, TCa incidence has significantly increased,

particularly among populations in the 'global north' (Chia et al., 2010; Park et al., 2018; Znaor et al., 2014). According to the World Health Organization (WHO), effective early detection and preventative strategies can reduce cancer incidence and mortality (Stewart & Wild, 2014). This is crucial as

TCa is highly curable if detected early. Established risk factors for TCa include testicular atrophy, cryptorchidism, maternal estrogen exposure, and genetic predisposition (Géczi et al., 2003; Jørgensen et al., 2010; Lip et al., 2013; Lutke Holzik et al., 2004).

Reports show that even in high-resource countries like the US, TCa diagnoses are often delayed, particularly among Black/African American and Latino males, as well as males who are uninsured or from lower socioeconomic backgrounds (Adams et al., 2018). Although sub-Saharan Africa lacks comprehensive TCa morbidity and mortality data (Bray et al., 2018; Huyghe et al., 2003; Omotoso et al., 2023; Znaor et al., 2014), individual studies in Ethiopia (Gutema et al., 2018; Zeleke et al., 2019), Nigeria (Ibitoye et al., 2022; Onyiriuka & Imoebe, 2013; Ugboma & Aburoma, 2011), Uganda (Muliira et al., 2012), Madagascar and South Africa (Peltzer & Pengpid, 2015) highlight that low public knowledge and awareness of TCa and testicular self-examination (TSE) contribute to poor health outcomes in males (Bresciani et al., 2021).

Globally, university students often exhibit limited knowledge of TCa and low engagement in TSE (Peltzer & Pengpid, 2015). Studies in Iran, Turkey, Malaysia, Uganda, Bangladesh, Singapore, Madagascar, and South Africa report similar findings, with low awareness of TCa and infrequent TSE practice among students (Altinel & Avci, 2013; Norhaini et al., 2014; Özbaş et al., 2011; Ramim et al., 2014; Muliira et al., 2012; Peltzer & Pengpid, 2015). Surveys of European undergraduates conducted between 1990 and 2000 also indicated inadequate TCa knowledge and TSE practices, suggesting a historically persistent public health knowledge gap and minimal attention to this public health issue (Evans et al., 2006; Wardle et al., 1994).

Given TCa's high curability with early detection, assessing the knowledge, attitudes,

and practices of male university students towards TCa and TSE is vital. Addressing knowledge gaps through targeted health education could improve awareness and preventive practices. In Ghana, despite limited cancer registry data (Amoako et al., 2019; Mensah & Mensah, 2020), modeling and institutional data estimate TCa as approximately 2.4% of all male cancers (Klufio, 2004). Data from Ghana and other low-resource settings can complement findings from the Global North, enriching the global understanding of TCa. Therefore, this study seeks to assess Ghanaian university students' knowledge, attitudes, and practices regarding TCa and TSE, providing insights that could inform future health interventions.

Methods

Study Design, Setting, and Population

A web-based cross-sectional study assessed knowledge, attitudes, and practices (KAP) regarding TCa and TSE among undergraduate male students at Kwame Nkrumah University of Science and Technology (KNUST) in southern Ghana.

Sample Size and Sampling Technique

Study Population: The study targeted all male students at KNUST who expressed interest in participating. The sample size was calculated using Cochran's formula (1963), assuming a 50% prevalence rate for KAP related to TCa and TSE, a 95% confidence interval, a Z-value of 1.96, and a 5% margin error. This calculation yielded an initial sample size of 385. To account for a potential 10% non-response rate, the target sample size was increased to approximately 422 participants.

Instrument and Data Collection

Pilot: Data were collected using a self-report questionnaire that was adapted from existing literature (Altnel & Avci, 2013; Gutema et al., 2018; Muliira et al., 2012; Peltzer & Pengpid, 2015; Ramim et al., 2014; Wardle et al., 1994). The survey instrument underwent pre-testing with a sample of five male students. Following the pre-testing, slight modifications were implemented to elucidate specific issues and enhance understanding. These modifications were implemented to improve the clarity and dependability of the survey for the intended demographic. A question related to health practices or screenings (*Have you ever avoided seeking medical help due to embarrassment about testicular cancer symptoms?*) felt too intrusive, and this was removed.

Final Survey: The survey consisted of five sections covering TCa and TSE knowledge, attitudes, behavior, demographic information, the program of study, and the academic year. Sections on TCa and TSE knowledge (13 items, Cronbach's $\alpha = 0.831$) and attitudes (11 items, Cronbach's $\alpha = 0.717$) were measured using a three-point Likert scale (Disagree = 1, Uncertain/Neutral = 2, Agree = 3). Mean scores were calculated by averaging item responses within each section, with the interpretation ranges for knowledge and attitude defined as the following: 1.00-1.66= overall 'disagree'; 1.67-2.33= overall 'uncertain'/'neutral'; and 2.34-3.00= overall 'agree.' Section four explored TSE occasion (i.e., when they perform a TSE), location, frequency, and technique. The final section comprised seven yes/no questions that addressed perceived barriers to TSE, such as "*fear of a worse result after examination.*"

Data Collection: The questionnaire was administered via Google Form, with five undergraduate students as data collectors who

shared the link within their network. A network sampling method was employed to identify potential participants (Parker et al., 2018). Given the COVID-19 pandemic, this online-peer-distribution approach was chosen to maintain health protocols, leveraging existing WhatsApp groups and email lists created for virtual learning at the University. Finally, it was the quickest and most effective means of accessing participants during the pandemic.

Data Entry, Analysis, and Presentation

Data were exported to Microsoft Excel 365 for initial cleaning and then imported to SPSS (version 22) for analysis. Results are presented as descriptive statistics (frequency and percentage) and inferential statistics (chi-square and linear regression), with a p-value ≤ 0.05 and a 95% confidence level considered statistically significant.

Results

Sociodemographic Characteristics of the Study Participants

Three hundred ninety-one undergraduate male students aged 17 to 35 years old participated in the survey (**Table 1**). Most identified as Christian (90%), and one-third (34.0%) were either dating, engaged, or married. Among the participants, 32.5% were enrolled in the College of Health Sciences, with the remainder distributed across other colleges: Humanities and Social Sciences (21.2%), Art and Built Engineering (17.1%), Engineering (12.5%), Science (11.0%), and Agriculture and Natural Resources (5.6%). Nearly half of the respondents were in their second (20.2%) or third year (25.6%) of college.

General Knowledge and Awareness of TCa and TSE (Table 2a): Knowledge about TCa was assessed through questions regarding general awareness, source of knowledge, and family history. While nearly half (49.4%) of the male students reported having been *aware* of TCa (“*Have you heard of testicular cancer before?*”), fewer (39.9%) reported *knowing* anything about it (“*Do you know anything about testicular cancer?*”). The majority (61.6%) identified the media as their primary source of information on TCa. Few participants reported knowing someone with TCa (0.5% reported a family member, and 2.1% reported knowing a friend).

Of the 391 male undergraduate student respondents, 78.3% agreed that “*a TSE is important in the early diagnosis of TCa.*” Among this subgroup, more than half (60.3%) cited the media as their primary source of information on TCa. Of the 144 (36.3%) undergraduate male students *aware* of TSE (“*Have you heard of the TSE?*”), one-third (34.0%) reported performing a TSE, and only five of them (10.4%) did so monthly. Further examination of these practices is discussed later in the manuscript.

Overall, almost twice as many students reported receiving their TCa information from the media than from health professionals (61.7% vs 37.4%). However, in a subgroup of students who reported both “*hearing about TCa*” and “*knowing anything about it,*” an interesting trend appears: whilst 21-year-olds and 23-to 35-year-olds cited health professionals as their primary source of TCa information, 17 to 20-year-olds and 22-year-olds cited the media as their primary source of TCa information.

Associations Between Demographics and General Knowledge, Attitudes, and Practice: In a Chi-Squared test of independence conducted to examine the relationship between socio-demographic variables and TCa awareness (“*heard about TCa*”), TC

knowledge (“*know anything about TCa*”), TSE awareness (“*heard about TSE*”) ($p < 0.001$) and TSE performance (“*do you perform a TSE?*”). The results indicated a significant association between age and all four outcomes, program of study and all four outcomes, and year of study and all four outcomes (see **Table 2b-e**). Older students, students enrolled in the College of Health Science, and students in their 4th year of study reported higher rates in TCa knowledge awareness and TSE knowledge and performance. No association was found between relationship status and the four outcomes, the same for religious affiliation (Christian vs Muslim), except TCa knowledge and religious affiliation, where a significant association was found (Chi-Squared de Pearson; $p=0.009$); a higher number of Christian undergraduates, male students reported “*knowing anything about TCa*” than Muslim undergraduate male students. There was no significant association between TSE awareness and religion ($p=0.660$) or relationship status ($p=0.745$).

Significant associations ($p < 0.001$) were found between awareness of TCa (“*hearing about TCa before*” and “*knowing anything about TCa*”) and TSE (“*heard about TSE*”). Similarly, if students reported “*hearing about TSE*”, they were more likely to know that performing a TSE ($p < 0.001$) was important for the early diagnosis of TCa ($p < 0.001$). *Levels of Knowledge about TCa and TSE*

Graph 1a displays response frequencies for the Likert-scale questions regarding ‘students’ level of knowledge,’ while **Table 3a** provides mean scores. Mean scores ranged from 1.67 - 2.34, indicating general uncertainty. Participants recognized that early detection increases recovery chances ($\bar{x} = 2.35$) and that TSE is the earliest detection method for TCa ($\bar{x} = 2.40$); however, they expressed uncertainty regarding other TCa and TSE knowledge items.

TCa and TSE knowledge levels were associated with age ($\chi^2 = 32.990$, $p < 0.001$) and academic year ($\chi^2 = 92.161$, $p < 0.001$). Fifth-year students exhibited greater TCa and TSE knowledge than their peers, while students from the College of Health Sciences had the highest knowledge levels compared to those in other colleges ($\chi^2 = 127.850$, $p < 0.001$).

Attitudes Towards TCa and the TSE: Graph 1b illustrates the range of responses to Likert-scale questions on *attitudes towards TCa and TSE*, while mean scores are presented in **Table 3b**. Undergraduate male students did not express strong negative feelings about performing TSE monthly ($\bar{x} = 1.29$), viewing it as time-consuming ($\bar{x} = 1.41$) or painful ($\bar{x} = 1.62$). However, many students were uncertain about whether not performing a TSE increases their risk of TCa ($\bar{x} = 2.02$) or whether TCa could affect their careers ($\bar{x} = 1.87$) or marriage ($\bar{x} = 2.2$).

Older male students were more likely to view TCa as “*more serious than other diseases*” ($p = 0.041$) and perceived TSE to be “*time-consuming*” ($p = 0.370$). Males in relationships reported more significant concerns about potential ridicule (“*(my) family will make fun of me if I do TSE*”) ($p = 0.014$) compared to those not in relationships.

Predictors of Knowledge and Attitude: Linear regression analysis identified predictors of ‘levels of knowledge’ (**Table 4a**) and attitudes (**Table 4b**) toward TCa and TSE. The model explained 35% of the variance in knowledge, with academic year as the only significant predictor. The predictors for attitudes accounted for 38%, but none were individually significant.

TSE Practice: In the final section of the survey, undergraduate male students were asked about their TSE practices, including frequency, techniques, occasion, and

location. In a previous question on this practice, fifty-one (13.2%) undergraduate male students confirmed they had performed a TSE; however, in this section, when asked if they had “examined their testis before,” only one-third (27.9%) reported doing so.

Based on this discovery, two chi-square tests and a cross-tabulation were conducted to ensure the contextualization of the responses to the remaining questions in this section. Firstly, a chi-square test was conducted, and an association was found between “*performing a TSE*” and “*ever examining their testis before*” ($\chi^2 = 145.026$, $p < 0.001$). Thus, a subgroup ($n = 50$; 27.7%) of respondents who had reported performing a TSE and examining their testis before was selected further to explore their technique, frequency, and occasion.

The two most frequent periods were ‘once a month’ (29.87%) or ‘daily to weekly’ (22.1%). When asked about the technique they used, more than half (62.0%) employed ‘inspection and palpation’ techniques. They performed a TSE examination mainly in the bathroom (57.1%), while lying in bed (22.4%), or in front of a mirror (16.3%). More than half (54.0%) of this subgroup of undergraduate male students reported performing a TSE examination ‘before or after showers.

Barriers to Performing a TSE: The main barriers to performing a TSE included a lack of know-how (78.6%) and fear of results (26.6%) (**Table 5**). Among those who had *never* examined their testes, almost all (90.3%) cited a lack of knowledge on performing a TSE as a barrier ($\chi^2 = 82.84$, $p < 0.001$). These findings align with previous research, underscoring the link between health knowledge and healthy behavior. Other barriers included indifference (‘not caring’) (16.6%), viewing TSE as sinful (6.4%), feelings of shame (12.0%), and cultural barriers (7.2%).

Table 1. Male undergraduate students' demographic characteristics		Value (%)
Age in years (M= 21.7; SD: 2.6)		
	17-19yo	74 (18.9%)
	20yo	64 (16.4%)
	21yo	68 (17.4%)
	22yo	41 (10.5%)
	23yo	69 (17.6%)
	24-25yo	69 (17.6%)
Relationship Status		
	Not in a relationship	257 (76.5%)
	Dating, Engaged, Married	133 (34.0%)
Program of Study		
	College of Agriculture and Natural Resources	19 (4.9%)
	College of Art and Built Environment	66 (16.9%)
	College of Engineering	49 (12.5%)
	College of Health Sciences	127 (32.5%)
	College of Humanities and Social Sciences	83 (21.2%)
	College of Science	43 (11.0%)
Year of Study		
	1 st Year	56 (14.3%)
	2 nd Year	79 (20.2%)
	3 rd Year	100 (25.6%)
	4 th Year	72 (18.4%)
	5 th Year	72 (18.4%)
	6 th Year	12 (3.1%)
Faith		
	Christian	351 (89.8%)
	Muslim	33 (8.4%)
	Non-Religious/Other	6 (1.5%)

Table 2a. General Knowledge and Awareness of TCa and TSE	Response	Value (%)	
Have you ever heard of TCa before?*			<i>Yes, I would like to receive information on TSE.</i>
	No	198 (50.6%)	132 (66.7%)
	Yes	193 (49.4)	183 (94.8%)
Where did you get information on TCa?			
	Conference/Panel	3 (1.4%)	3 (100%)
	Professionals	78 (37.0%)	73 (93.6%)
	Media	130 (61.6%)	122 (92.8%)
Does anyone in your family have TCa? (currently or in the past)			
	No	389 (99.5%)	313 (80.5%)
	Yes	2 (0.5%)	2 (100%)
Is anyone in your close environment (friends, neighbors, etc.) diagnosed with TCa? (currently or in the past)			
	No	380 (97.2%)	304 (80.0%)
	Yes	8 (2.0%)	8 (100%)
Do you know anything about TCa?*			
	No	235 (60.1%)	166 (70.6%)
	Yes	156 (39.9%)	149 (95.5%)
Have you heard of TSE?*			
	No	244 (63.2)	175 (71.1%)
	Yes	142 (36.8)	135 (95.1%)
Do you perform TSE?*			

	No	335 (86.8)	264 (78.8%)
	Yes	51 (13.2)	46 (90.2)
How often do you perform a TSE?			
	Monthly (same day, every month)	6 (1.5%)	6 (100%)
	Regularly (consistent practice)	22 (5.6%)	21 (95.5%)
	Irregularly (not monthly)	153 (53.7%)	143 (93.5%)
Would you like to receive information about TSE?			
	No	76 (19.4%)	
	Yes	315 (80.6%)	
Is TSE important in the early diagnosis of TCa?*			
	No	11 (5.3%)	8 (72.7%)
	Do not know/Uncertain	34 (16.4%)	30 (88.2%)
	Yes	162 (78.3%)	156 (96.3%)

* $p < 0.001$; ** $p = 0.003$

Table 2b. Associations between demographics and general knowledge, attitudes, and practice			Have you ever heard of TCa before?	
Age in years	Category	Coded	NO	YES
	17-19 y.o.	0	55 (74.3%)	19 (25.7%)
	20 y.o.	1	41 (64.1%)	23 (35.9%)
	21 y.o.	2	40 (58.8%)	28 (41.2%)
	22 y.o.	3	16 (39.0%)	25 (61.0%)
	23 y.o.	4	19 (27.5%)	50 (72.5%)
	24-25 y.o.	5	26 (37.7%)	43 (62.3%)
			Chi-cuadrado de Pearson 44.599; p<0.001	
Program of Study				
	College of Agriculture & Natural Resources; College of Art & Built Environment; College of Engineering	1	98 (73.1%)	36 (26.9%)
	College of Health Sciences	2	16 (12.6%)	111 (87.4%)
	College of Humanities and Social Sciences	3	58 (69.9%)	25 (30.1%)
	College of Science	4	24 (55.8%)	19 (44.2%)
			Chi-cuadrado de Pearson 113.406; p<0.001	
Year of Study				
	1 st & 2 nd Year	0	87 (64.4%)	48 (35.6%)
	3 rd Year	1	64 (64.0%)	36 (36.6%)
	4 th – 6 th Year	2	47 (30.1%)	109 (69.9%)
			Chi-cuadrado de Pearson 43.691; p<0.001	

*Relationship status; religion: no significant association found

Table 2c. Associations between demographics and general knowledge, attitudes, and practice			Do you know anything about TCa? Value (%)	
Age in years	Category	Coded	NO	YES
	17-19 y.o.	0	61 (82.4%)	13 (17.6%)
	20 y.o.	1	46 (71.9%)	18 (28.1%)
	21 y.o.	2	43 (63.2%)	25 (36.8%)
	22 y.o.	3	24 (58.5%)	17 (41.5%)
	23 y.o.	4	24 (34.8%)	45 (65.2%)
	24-25 y.o.	5	34 (49.3%)	35 (50.7%)
			Chi-cuadrado de Pearson 41.278; p<0.001	
Program of Study				
	College of Agriculture & Natural Resources; College of Art & Built Environment; College of Engineering	1	108 (80.6%)	26 (19.4%)
	College of Health Sciences	2	21 (16.5%)	106 (83.5%)
	College of Humanities and Social Sciences	3	75 (90.4%)	8 (9.6%)
	College of Science	4	28 (65.1%)	15 (34.9%)
			Chi-cuadrado de Pearson 155.936; p<0.001	
Year of Study				
	1 st & 2 nd Year	0	104 (77.0%)	31 (23.0%)
	3 rd Year	1	76 (76.0%)	24 (24.0%)
	4 th – 6 th Year	2	55 (35.3%)	101 (64.7%)
			Chi-cuadrado de Pearson 66.845; p<0.001	
Faith				
	Christian	0	205 (58.4%)	146 (41.6%)
	Muslim	1	27 (81.8%)	6 (18.2%)
			Chi-cuadrado de Pearson 6.914; p=0.009	

*Relationship status: No significant association found

Table 2d. Associations between demographics and general knowledge, attitudes, and practice			Have you ever heard of Testicular self-examination (TSE)?	
			Value (%)	
Age in years	Category	Coded	NO	YES
	17-19 y.o.	0	61 (82.4%)	11 (15.3%)
	20 y.o.	1	49 (77.8%)	14 (22.2%)
	21 y.o.	2	46 (68.7%)	21 (31.3%)
	22 y.o.	3	21 (51.2%)	20 (48.8%)
	23 y.o.	4	31 (44.9%)	38 (55.1%)
	24-25 y.o.	5	35 (51.5%)	33 (48.5%)
			Chi-cuadrado de Pearson	37.650; p<0.001
Program of Study				
	College of Agriculture & Natural Resources; College of Art & Built Environment; College of Engineering	1	110 (82.1%)	24 (17.9%)
	College of Health Sciences	2	39 (30.7%)	88 (69.3%)
	College of Humanities and Social Sciences	3	67 (81.7%)	15 (18.3%)
	College of Science	4	26 (65.0%)	14 (35.0%)
			Chi-cuadrado de Pearson	90.322; p<0.001
Year of Study				
	1 st & 2 nd Year	0	102 (77.9%)	29 (22.1%)
	3 rd Year	1	78 (78.0%)	22 (22.0%)
	4 th – 6 th Year	2	64 (41.3%)	91 (64.1%)
			Chi-cuadrado de Pearson	53.527; p<0.001

*Relationship status, religion: no significant association found

Table 2e. Associations between demographics and general knowledge, attitudes, and practice			Do you perform a TSE? Value (%)	
Age in years	Category	Coded	NO	YES
	17-19 y.o.	0	68 (94.4%)	4 (5.6%)
	20 y.o.	1	60 (95.2%)	3 (4.8%)
	21 y.o.	2	57 (85.1%)	10 (14.9%)
	22 y.o.	3	38 (92.7%)	3 (7.3%)
	23 y.o.	4	52 (76.4%)	16 (23.5%)
	24-25 y.o.	5	56 (81.2%)	13 (18.8%)
			Chi-cuadrado de Pearson	17.563; p=0.004
Program of Study				
	College of Agriculture & Natural Resources; College of Art & Built Environment; College of Engineering	1	126 (94.0%)	8 (6.0%)
	College of Health Sciences	2	95 (75.4%)	31 (24.6%)
	College of Humanities and Social Sciences	3	76 (92.7%)	6 (7.3%)
	College of Science	4	35 (87.5%)	5 (12.5%)
			Chi-cuadrado de Pearson	23.068; p<.001
Year of Study				
	1 st & 2 nd Year	0	121 (92.4%)	10 (7.6%)
	3 rd Year	1	94 (94.0%)	6 (6.0%)
	4 th – 6 th Year	2	120 (77.4%)	35 (22.6%)
			Chi-cuadrado de Pearson	19.995; p<.001

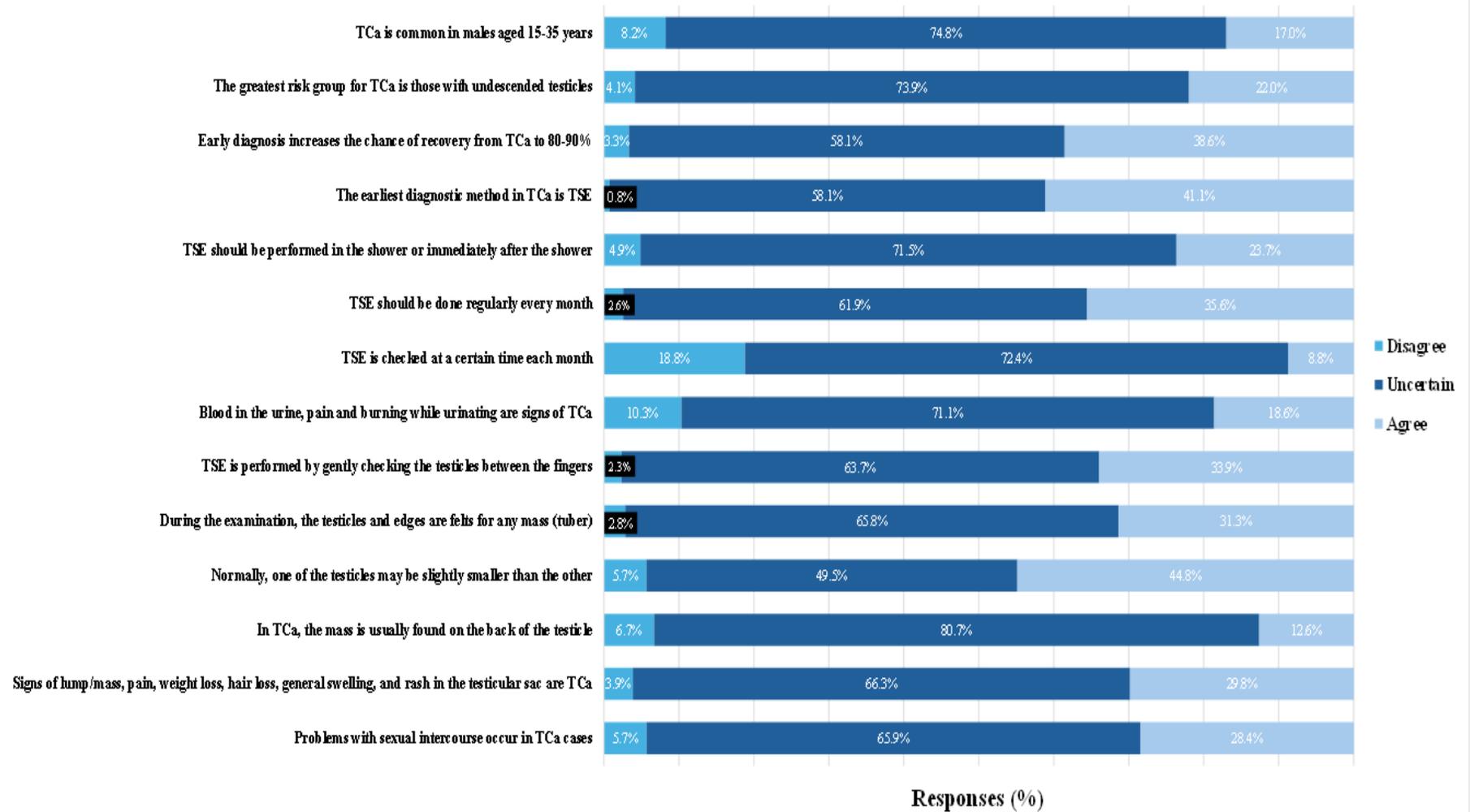
*Relationship status, religion: no significant association found

Table 3. Mean Scores, Levels of Knowledge, and Attitudes towards TCa and TSE

	Mean	Standard Deviation
3a. Students' Level of Knowledge on TCa and TSE		
<ul style="list-style-type: none"> • TCa is most common in males aged 15–35 years. • The greatest risk group for TCa is those with undescended testicles. • TSE should be performed in the shower or immediately after the shower. • TSE is checked at a certain time each month. • TSE should be done regularly every month. • Blood in the urine, pain, and burning while urinating are signs of TCa. • TSE is performed by gently checking the testicles between the fingers. • In TCa, the mass is usually found on the back of the testicle. • Where there is TCa, there are signs of lump/mass, pain, weight loss, hair loss, general swelling, and rash in the testicular sac. • Problems with sexual intercourse occur in TCa cases. • During the examination, it is tried to feel if there is any mass (tuber) in the testicles and on the edges 	1.90 – 2.33 (uncertain)	0.495 – 0.532
<ul style="list-style-type: none"> • Early diagnosis increases the chance of recovery from TCa to 80–90% • The earliest diagnostic method in TCa is TSE • Normally, one of the testicles may be slightly smaller than the other 	2.35 – 3.0 (agree)	0.507 – 0.544
3b. Students' Attitudes towards TCa and TSE		
<ul style="list-style-type: none"> • It is embarrassing for me to do monthly examinations. • TSE can be painful. • TSE can be time-consuming. • Family will make fun of me if I do TSE 	1.29 – 1.52 (disagree)	0.632
<ul style="list-style-type: none"> • My physical health makes it more likely for TCa if I fail to perform TSE. • Chances of getting TCa in the future increase if I fail to perform TSE. • The thinking of TCa fears me • If I had TCa, my career would be endangered. • TCa would endanger my marriage. • TCa would be more serious than other diseases. 	1.70 – 2.21 (neutral)	0.661 - 0.899

• Monthly TSE helps to find lumps before they are discovered by a health check-up		
• TSE can help to find lumps in the testicles	2.38 (agree)	0.654

Graph 1a. Students' Level of Knowledge on TCa and TSE



Graph 1b. Attitudes towards TCa and TSE

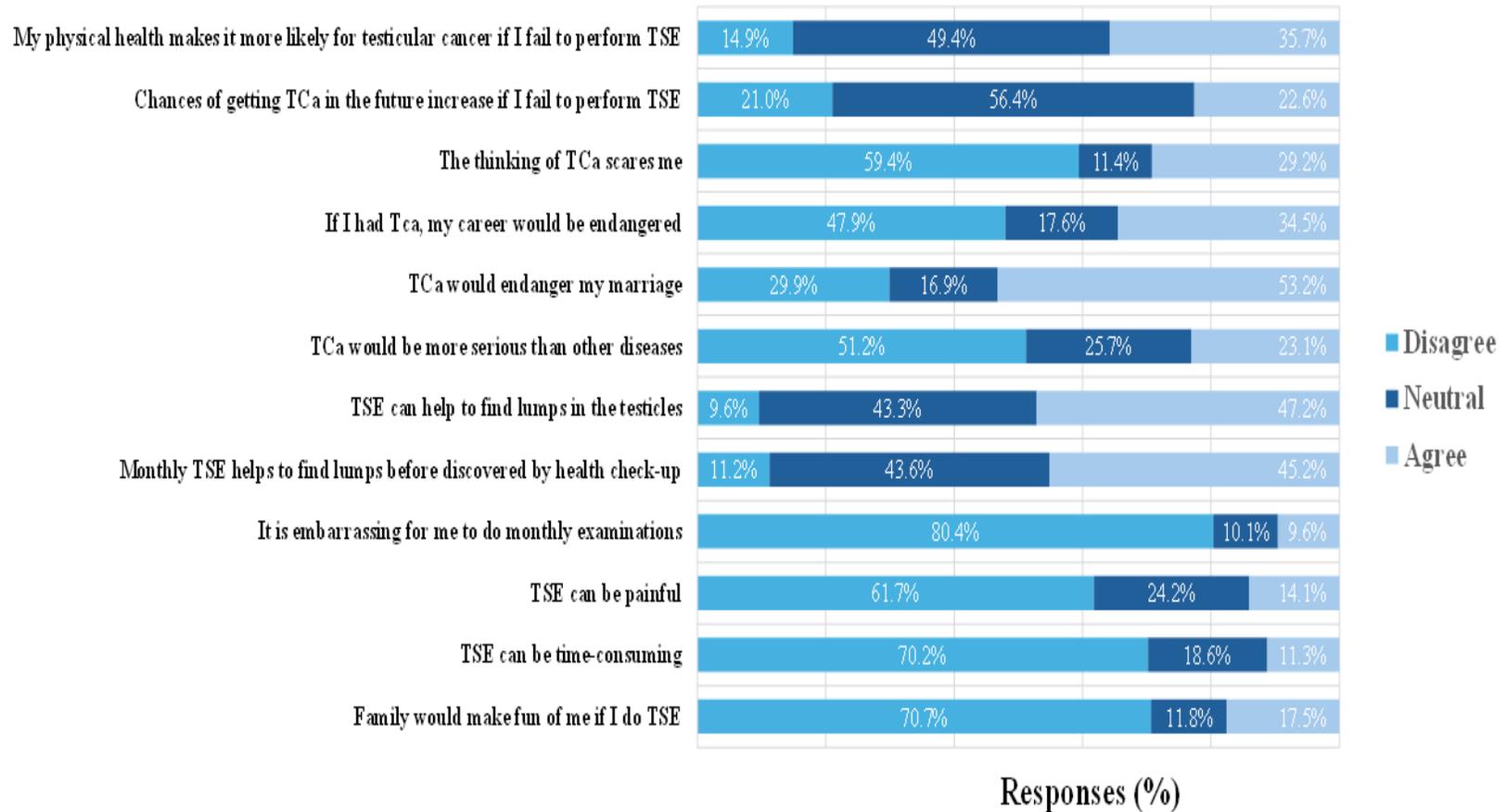


Table 4. Predictors of Level of Knowledge (4a) and Attitudes (4b) on TCa & TSE			
4a. Predictors on Students' Level of Knowledge on TCa and TSE			
WHOLE MODEL	<i>R</i>²	<i>F</i>	<i>p</i>
	0.350	17.443	0.000
Variables	Beta	95% CI	<i>p</i>
Program of Study	-0.004	-0.027 – 0.019	0.869
Academic year	0.156	0.118 – 0.194	0.000
Age Group	0.20	0.01 – 0.39	0.278
4b. Predictors on Attitudes towards TCa and TSE			
WHOLE MODEL	<i>R</i>²	<i>F</i>	<i>P</i>
	0.38	3.675	0.06
Variables			
Program of Study	0.003	0.025 – 0.031	0.92
Academic year	0.45	-0.03 – 0.093	0.349
Age Group	0.42	0.019 – 0.065	0.071

Table 5: TSE Practice	Response	Value (%)
Have you ever examined your testis before?		
	No	282 (72.1%)
	Yes	109 (27.9%)
At what age did you begin performing a TSE?		
	< 15 years old	41 (10.5%)
	> 15 years old	138 (35.3%)
What time do you perform a TSE?		
	Anytime, other than shower time	104 (25.5%)
	Before/after the shower	78 (19.9% ^o)
What techniques do you employ when performing a TSE?		
	I do not use a technique	34 (8.7%)
	Inspection	100 (25.6%)
	Inspection + Palpitation	81 (20.7%)
How regularly do you perform a TSE?		
	Hardly ever/irregularly	4 (1.0%)
	Once a year	61 (15.6%)
	Twice a year	11 (2.8%)
	Four times a year	21 (5.4%)
	Sometimes twice a month	1 (0.3%)
	One a month	42 (11.0%)
	Daily to weekly	33 (8.4%)
Where do you perform a TSE?		
	In front of a mirror	23 (5.9%)
	In the bathroom	111 (28.4%)
	Lying in bed	45 (11.5%)
	Wherever	2 (0.5%)

Discussion

To our knowledge, this is the first study to investigate TCa and TSE awareness, knowledge, and practice in male Ghanaian university students. The results from this study are consistent with the literature that has shown an overall lack of TCa and TSE knowledge, awareness, and practice across male populations (Alnizari et al., 2023; Beebe et al., 2022; Ryszawy et al., 2022; Wardle et al., 1994), particularly among male university students (Avci & Altinel, 2018; Demir & Türkben Polat, 2022; Evans et al., 2006; Ramim et al., 2014; Rovito et al., 2011), and most particularly amongst African, male, university students (Gutema et al., 2018; Peltzer & Pengpid, 2015; Ugwumba et al., 2016; Zeleke et al., 2019). The study showed that exposure to information about TCa increased the likelihood of knowing about TSE.

General Knowledge, Awareness, and Attitudes: Despite not knowing about TSE, a majority (71.7%) of the male students expressed interest in receiving information about TSE. Our data showed that male students were more likely to be exposed to information on TCa through the media than through any close or personal encounters (i.e., family or friends). This provides insight into where prevention strategies can promote TCa in this population. Other studies also reported these findings (Alkhayal et al., 2023; Ibrahim & Zaghmir, 2024).

Although social media appears to be the most widely utilized source of TCa information, other studies have shown the importance of using a variety of materials or mixed approaches to improve knowledge and awareness (Ibrahim & Zaghmir, 2024; Khani Jeihooni et al., 2021; Rovito et al., 2011).

Interestingly, when male students were asked if they had *heard about TSE*, more than half (62.4%) reported that they had *not*. However, among this subgroup, nearly all (98.8%) reported having performed TSE. Research indicates that the mechanism of perceived susceptibility and perceived benefits, as outlined in the Health Belief Model's constructs, can be a motivator for action (Avci & Altinel, 2018; Khani Jeihooni et al., 2021). This may explain why, despite claiming to be aware or not about TCa (*'have you heard about TCa'*), most of each subgroup reported having *performed* a TSE (77.7% and 95.5%, respectively). Perhaps the fact that the media is the most commonly reported source for accessing TCa information (61.6%) indicates this discrepancy. Although male students may not recall *'hearing about'* TSE, they were likely exposed to TCa-related information through media sources, which made them aware of how to check for TCa and thus explained why so many performed a TSE despite reporting *not* having heard about it.

From a public health promotion perspective, there are several opportunities for academic careers in which TCa and TSE information can be disseminated throughout the trajectory of these cohorts. From a clinical perspective, the low percentage of TSE among this cohort constitutes a significant concern regarding the prevention and early management of TCa.

Level of Knowledge on TCa & TSE: Due to the age cohort, it was not surprising to find that, in addition to the general lack of awareness of TCa and TSE, age was a significant factor in the level of knowledge and attitudes that male students had towards TCa and TSE. This was evident by the high number of neutral ("uncertain") mean scores on questions related to TCa and TSE

knowledge, indicating a lack of adequate TCa-related health promotion and education among this cohort. Older male students reported they received most of their TCa information from professionals, which could be due to the higher number of College of Health Sciences students who participated in our study and were exposed to health information provided throughout their curricula. Compared to students from other colleges, male students in their final year of Health Sciences degrees are more likely to attribute their knowledge of TCa to their professors or health professionals. This presents an excellent opportunity to evaluate social and physical spaces, as well as alternative means of providing access to this information for students who may not encounter it within their coursework. For example, health promotion campaigns can be provided through college campuses and, of course, through social media outlets.

Attitudes Toward TCa and TSE: These data suggest that while there is an awareness of performing a TSE and a lack of stigma surrounding performing a TSE, there is a concern about the impact that a TCa diagnosis would have on their lives. This suggests a lack of awareness beyond the basic understanding of prevention and the importance of early detection of TCa outcomes and postdiagnosis. This is especially relevant in this cohort, as none of the participants reported knowing anyone—family, friend, or ‘other’—diagnosed with TCa. Although many did not think that TCa would endanger their career, more than half thought it would threaten their marriage; this was a particular concern among male students who were not in a relationship (67.2%) compared to those who reported being in some courtship (dating) or established relationship (engaged, married) (32.8%). This finding supports research suggesting that marital status has a positive influence on

the knowledge, awareness, and practice of TCa and TSE (Dhakal et al., 2021).

In this study, the majority (79.5%) of the male students reported not being embarrassed about performing a monthly examination. While our findings align with those of other studies (Zelege et al., 2019), others have shown that embarrassment was a barrier to performing a TSE (Muliira et al., 2012).

Practice and Barriers to TSE: A lack of knowledge strongly contributes to why male students did not perform a TSE. This was evident in the differing responses of male students regarding the TSE and ‘examining their testicles.’ This could be due to unfamiliarity with the term “testicular self-examination” (TSE), which is why more male students report examining their testicles. It appears that those who perform a TSE are aware of the technique. The time of day and location where they perform a TSE (i.e., shower, in front of a mirror) provide valuable insights into how to improve TCa prevention strategies (i.e., delivering products that remind them to perform a TSE) among male students who “do not/hardly ever” perform a TSE.

Although the U.S. Preventive Services Task Force (USPSTF) recommends against routine screening for TCa in asymptomatic adolescent and adult males, our data indicate a lack of proper and adequate information about TCa and TSE among adolescent and university-aged males. The research community (Rovito et al., 2016, 2022) has urged a review of the USPSTF’s methods and evidence, as a health promotion program designed to target this cohort and encourage early detection is paramount. Access to programs that provide accurate and high-quality information can ensure the successful attainment of accurate and high-quality knowledge and awareness.

Limitations

In the effort to collect data on TCa and TSE awareness, knowledge, and practice on male university students in Ghana, a feat that had not been undertaken, and considering the limitations that COVID-19 presented, a cross-sectional design was the best option to gain a temporal understanding of the study's objectives, despite its limitations in reporting causal inferences. Access to resources and time would enable a prospective study design for future research in this cohort.

Other limitations include 1) the lack of a more robust questionnaire for understanding the cognitive, emotional, social, and cultural mechanisms involved in improving and impacting TCa knowledge and TSE practices and 2) the issue of single-site sampling. More comprehensive tools must be used to solicit information from samples, thereby maximizing the time and resources provided, most importantly, by the participants. Ultimately, it is in the best interest of future inquiries into this and related topics to include multiple sites, ensuring diversity of source populations and thereby improving the generalizability of findings.

Implications for Health Behavior Research

Our research has provided valuable insights into improving and advancing testicular cancer (TCa) awareness, knowledge, and testicular self-examination (TSE) practices among male university-aged students in the Global South, specifically Ghana. There is a pressing need for culturally sensitive programs and education tools to improve TCa awareness and TSE practices. Effective public health campaign strategies must also be developed to reach and engage the target population.

Encouraging the incorporation of TSE into regular health checks is crucial for promoting early detection. To achieve this, leveraging technology and media is essential, as these tools can enhance engagement and improve accessibility to TCa information. Furthermore, conducting longitudinal studies will help track changes in TCa awareness, knowledge, and TSE behaviors over time, thereby contributing to the refinement of educational interventions.

Identifying and overcoming the psychological and social barriers that hinder TSE performance is also essential. Advocating for the integration of TCa education into mental health policies and school curricula will ensure the proper allocation of resources for sustainable programs. Our results indicate that cultural and social barriers affect TSE performance and that media significantly provides access to TCa information, impacting awareness and knowledge. Technology and media offer effective avenues for increasing engagement and understanding young men's interaction with digital tools, which can motivate behavior change towards TSE.

Thorough and rigorous research design and evaluation support effective advocacy strategies, including the incorporation of TCa education into national health policies and school curricula, as well as the allocation of adequately funded and sustainable programs and resources.

Discussion Questions

Based on the current and available literature on TCa and TSE in African countries, specifically, and what is known from studies in other parts of the globe:

How can educational interventions be designed to be culturally sensitive and effective in increasing TCa awareness and

TSE practice among young men in different cultural contexts?

What factors influence the willingness and ability of providers to engage in conversations about TCa and TSE with young male patients, and how can healthcare providers be better trained and supported to discuss and provide TSE during routine health checks?

How can educational intervention be designed to be culturally sensitive and effective, minimizing barriers to increasing TCa awareness and TSE practices?

How can these interventions be applied to digital health tools such as mobile apps and social media to promote TSE among African university-aged males? What are the advantages and potential challenges? Moreover, how can their effectiveness be measured?

List of Abbreviations

Testicular Cancer: TCa

Testicular self-exam: TSE

Kwame Nkrumah University of Science and Technology: KNUST

Committee on Human Research, Publications, and Ethics: CHRPE

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