



Research article

Students' safety culture at tertiary level academic institutes in Bangladesh: A cross-sectional study

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ABSTRACT

This study aims to investigate the safety culture of tertiary-level students in Bangladesh and identify the factors that influence it. A cross-sectional survey was conducted among 1676 students from 16 universities and medical colleges in Bangladesh to gather data. The survey consisted of a paper-based structured questionnaire with three scales: a 17-item safety beliefs and values scale, a 10-item safety perception and awareness scale, and a 14-item safety attitudes scale. The results showed that tertiary-level students generally exhibit moderate levels of safety beliefs and values, safety perception and awareness, and safety attitudes. Female students had better safety perception and awareness [$\beta = -0.083$; 95%CI = $-0.140, -0.025$] and safety attitudes [$\beta = -0.173$; 95%CI = $-0.230, -0.117$], while male students had stronger safety beliefs and values [$\beta = 0.047$; 95%CI = $0.005, 0.089$]. Students with physical disabilities and those who had experienced accidents had significantly higher levels of safety perception and awareness, as well as safety attitudes, compared to their peers. Additionally, students in private institutions had lower levels of safety perception and awareness [$\beta = -0.130$; 95%CI = $-0.189, -0.070$] as well as safety attitudes [$\beta = -0.058$; 95%CI = $-0.116, -0.001$], than public institution students. Age, gender, and type of institute were significantly associated with all three components of safety culture. Accident experience was also significantly linked to safety perception and awareness [$\beta = 0.054$; 95%CI = $0.002, 0.105$], and safety attitudes [$\beta = -0.093$; 95%CI = $-0.143, 0.043$]. Based on these findings, it is recommended that tertiary educational institutions in Bangladesh develop intervention strategies that consider the age, gender, and physical disability of students to enhance their safety culture.

1. Introduction

Safety culture refers to the values, perceptions, and competencies of individuals and groups that affect the safety environment of an organization [1]. The concept of safety culture was first introduced by the OECD Nuclear Agency in 1987 after the Chernobyl disaster [2]. Turner et al. describe safety culture as a set of concepts, norms, behaviors, roles, and social and technical procedures designed to reduce the risk of hazardous circumstances for employees, supervisors, clients, and the general public [3]. Safety culture has become

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Acronyms and abbreviations:

OECD	Organization for Economic Co-operation and Development
OSHA	Occupational Safety and Health Administration
SBV	Safety Beliefs and Values
SPA	Safety Perception and Awareness
SA	Safety Attitudes
ANOVA	One-way Analysis of Variance
MLR	Multiple Linear Regression

increasingly important for organizations in high-risk industries to create secure environments and prevent catastrophic events on a large scale [4]. Safety culture is particularly relevant for nuclear power plants, workplace security, and organizational safety [5,6], but it is also being adopted in hospitals, educational institutions, and essential businesses.

Like any other type of organization, academic institutions prioritize the safety and health culture of their community. From undergraduate to postdoctoral researchers, students at many educational levels must take responsibility for safety and serve as role models as they progress in their academic careers [7]. Mengolini and Debarberis [8] argue that the current emphasis on safety culture has grown because it is believed that assessing it may indicate the level of safety within the company. This concept is also highly applicable to students. Regular safety training and education can shape safety behaviors, highlighting the need for ongoing activities to increase students' preparedness at universities [9]. Given the shortcomings in emergency response and hazard detection, especially in developing and under-developed countries, Walters et al. suggest that universities should provide additional guidance to students to enhance their safety culture [10].

Positive perceptions of the safety culture may encourage the desired safety behaviors. On the other hand, negative safety culture beliefs can impede safety behavior and cause accidents [11,12]. A study on safety culture among Chinese private university students found that several factors, such as gender, majors, hometown, and one-child families, significantly impacted the overall safety culture [13]. Another study on undergraduate engineering students' safety awareness found that respondents' knowledge of the five domains of OSHA guidelines (PPE, lockout, SDS, machine guarding, emergency action plan) was insufficient [14]. According to previous studies, academic laboratories have been found to be hazardous environments for students to learn and conduct research [15–17]. In addition, empirical evidence suggests that an effective safety culture has an impact on safety compliance and the adherence of individuals to regulations and guidelines designed to ensure an environment of safety [18,19]. Institutions need to pay more attention to their capacity to establish and sustain secure environments because the quantity and complexity of safety and security issues faced by educational institutions are increasing [20].

Historical evidence suggests that the development of the current tertiary learning and teaching approach in Bangladesh originated during the British colonial period in India [21]. In 2023, Bangladesh documented 7902 fatalities resulting from car accidents, with 697 of them being students [22]. Establishing a strong safety culture is vital to prevent unintended accidents in all settings. Currently, there are several safety concerns due to the large student population and inadequate living conditions both on and off campus. A recent study conducted in Bangladesh found that students who reside in university dormitories tend to lead less healthy lifestyles than those who live at home. Such students tend to experience greater levels of depression and anxiety and fail to maintain a balanced diet [23].

Furthermore, a recent study conducted in Bangladesh found that while students perceived their level of disaster preparedness was moderate, their actual preparedness level was relatively low [24]. This suggests that tertiary education institutions in the country may lack proper safety management systems and may not prioritize safety among students. It is worth noting that previous research on safety culture among university students in Bangladesh has been primarily focused on Dhaka University students [25].

Given the importance of promoting campus safety and reducing unsafe student behaviors, it is surprising that safety culture at tertiary-level academic institutions in Bangladesh, including medical colleges, has received little attention. Scholars in different fields conduct safety culture-related research in Bangladesh, e.g., Kibria [26] conducted on the heavy industry perspective, Brooks [27] conducted on the RMG sector, Iqbal et al. [28] on thermal power plants, Imtiaz et al. [29] and Jalil & Rabbani [30] on nuclear power plants. Hossain et al. [31] conducted a study on occupational health and safety in private universities, which ultimately covered only some of the spectrum of the safety culture concept. Hasan and Younos [25] conducted a safety culture study focusing solely on students of one public university. However, this study added a crucial component called safety beliefs and values, which comprehend the previously developed model of safety culture in the educational institutions in Bangladesh. Thus, a comprehensive study is needed, encompassing more universities, including medical colleges, to investigate students' safety culture in Bangladesh and explore the associated factors. This study fulfills this gap. Therefore, our study seeks to evaluate the level of safety culture and investigate the factors that influence students' safety beliefs and values, perceptions and awareness, and attitudes toward safety at these institutions. The findings of this study can help develop effective strategies and programs to improve safety measures and safety culture, ultimately reducing unexpected loss of lives or injuries.

2. Methods

2.1. Study design

This study followed a cross-section survey method to collect the data. Face-to-face interviews were conducted with the student respondents, and data were stored using a real-time mobile responsive survey technique.

2.2. Ethical consideration

The Ethics Committee of the Institute of Disaster Management and Vulnerability Studies at the University of Dhaka has granted ethical approval for the study, with the reference number SN: ERC (EXT) –13/272023. Moreover, according to the ethical guidelines, the researchers obtained written consent from the participants before data collection.

2.3. Settings and sampling procedure

A two-stage sampling technique was used to calculate the total sample size of the study using the following formula: $n = [(z^2) \times p \times (1-p) \times deff] / e^2 \times rr$. Assuming a 5 % margin of error (e), 4.0 design effect (deff), a response rate of 95.0 % (rr), and a z value of 1.96, the total sample size for the survey was 1618. Dhaka and Chattogram districts have the most universities and medical colleges in Bangladesh. Therefore, we chose these two districts as our study areas. Then, from each district, two private and two public medical colleges, as well as two private and two public universities, were selected randomly. Then, 105 students' data from each medical college and university were collected based on convenient sampling. Finally, 1689 student data were collected in the study. Among them, 13 incomplete respondents' data were excluded, and 1676 students' data were used in the final analysis.

2.4. Instrument and data collection

The safety culture questionnaire was developed by intensively reviewing student safety-related literature [9,13,32,33]. The safety culture questionnaire consisted of 41 items, divided into three scales: (i) 17-item Safety Beliefs and Values (SBV) scale (Cronbach's Alpha = 0.700), 10-item Safety Perception and Awareness (SPA) scale (Cronbach's Alpha = 0.770), and 14-item Safety Attitudes (SA) scale (Cronbach's Alpha = 0.820) (Table 1). The responses of the items were considered on a Likert scale ranging from 1 (indicating strong disagreement) to 5 (indicating strong agreement). In addition, the questionnaire included two other sections on socio-demographics and safety awareness activities in medical colleges and universities. In the initial phase, the questionnaire was crafted in English and subsequently translated into Bangla following a comprehensive review process. A pilot study was conducted to evaluate the questionnaire's clarity and reliability, and slight adjustments were implemented based on the feedback received prior to commencing the survey.

2.5. Data analysis

The safety culture (safety beliefs and values (SBV), safety perception and awareness (SPA), and safety attitudes (SA)) of the students were assessed using SPSS 25 (IBM SPSS, Chicago, IL, USA). To determine group differences in safety culture, an independent sample *t*-test and one-way analysis of variance (ANOVA) were conducted. Multiple linear regression (MLR) analyses were used to identify predictors of safety culture among the respondents. The Kolmogorov-Smirnov test was used to check for normality, while the correlation coefficient matrix, Variation Inflation Factor (VIF), and tolerance values (TVs) were used to assess multicollinearity in the MLR models. Only one value was found to be unacceptable. Due to the moderate correlation between safety perception and awareness (SPA) and safety attitudes (SA) ($r = 0.540$), we excluded SA from the MRL models (see Appendix, Table A1). The threshold for statistical significance was set at a *p*-value of 0.05.

3. Results

3.1. Sociodemographic characteristics of respondents

Of the 1676 respondents, 59.7 % were male, and 51.3 % were 21–23 years old. Most participants (84.5 %) identified as Muslim, and nearly all (94.9 %) were single. Around 41.6 % of the respondents did not know about safety awareness activities in their educational institutes, while one-half of the respondents (51.4 %) experienced an accident. In addition, 65.2 % of the students said they felt unsafe

Table 1
Reliability analysis of the safety culture scales.

Scales	Mean	Variance	SD	Items (n)	Cronbach's Alpha
Safety Belief and Values (SBV)	65.32	49.84	7.06	17	0.700
Safety Perception and Awareness (SPA)	37.11	31.68	5.62	10	0.770
Safety Attitude (AS)	54.40	61.69	7.85	14	0.820

because of student politics on campus (Table 2).

3.2. Safety beliefs and values (SBV): level and mean difference

The items of respondents' SBV scores varied from 2.69 to 4.42, with an overall mean of 3.84 and a standard deviation of 0.41, indicating a moderate Safety Beliefs and Values (SBV) level among the respondents. Students believed success in reducing accidental deaths and injury rates would come from controlling human behavior ($M = 4.42$; $SD = 0.74$), but in contravention, "Most people who never get accidents are just lucky" scored a lower mean ($M = 2.69$; $SD = 1.29$) (Table 3).

According to the results of ANOVA and independent *t*-test analyses, a significant mean difference of SVB was found in age ($F = 12.49$, $p < 0.001$), district ($F = 5.09$, $p < 0.001$), type of institute ($F = -3.95$, $p < 0.001$), physical disabilities ($F = 3.24$, $p < 0.001$), experienced accidents ($F = 2.50$, $p = 0.012$), felt unsafe due to student politics ($F = -2.41$, $p = 0.016$) and faculty ($F = 6.53$, $p < 0.001$). Results of Scheffé post hoc test showed that respondents of 18–20 years, Chottogram District, public universities, business students, students had no physical disability, and respondents who felt unsafe due to student politics had significantly higher mean SBV than their counterparts (Table 6).

3.3. Safety perception and awareness (SPA): level and mean difference

The students demonstrated a moderate safety perception and awareness (SPA) ($M = 3.71$; $SD = 0.56$), and the items of SPA scored from 3.28 to 4.04. When others bring attention to unsafe behavior, students promptly correct themselves and express gratitude for the reminder ($M = 4.04$; $SD = 0.84$), but they had a lack of awareness about emergency exits ($M = 3.28$; $SD = 1.16$) (Table 4). ANOVA and

Table 2
Sociodemographic characteristics of the respondents.

Characteristics	Frequency (f)	Percent (%)
Sex		
Female	675	40.3
Male	1001	59.7
Age (Years)		
18-20	389	23.2
21-23	859	51.3
24-26	428	25.5
Marital Status		
Ever Married	85	5.1
Single	1591	94.9
Religion		
Islam	1416	84.5
Hindu	198	11.8
Buddhist	62	3.7
Faculty		
Science	455	27.1
Humanities	198	11.8
Commerce	187	11.2
Medical	836	49.9
Type of institute		
Public	839	50.1
Private	837	49.9
District		
Chattogram	837	49.9
Dhaka	839	50.1
Type of residence		
Own House	416	24.8
Rented House	461	27.5
Hostel	212	12.6
Hall	587	35.0
Having physical disabilities		
No	1455	86.8
Yes	221	13.2
Ever had an accident		
No	824	49.2
Yes	852	50.8
Safety awareness activity experience		
	361	21.5
Yes	617	36.8
Do not Know	698	41.6
Felt unsafe due to student politics		
No	584	34.8
Yes	1092	65.2

Table 3
Level of safety beliefs and values among the respondents.

Item	Mean	SD
Success in reducing accidental deaths and injury rates will come from controlling human behavior.	4.42	0.74
Parents can have a direct effect on the behavior of their children as it relates to safe practices.	4.31	0.79
I am a safety-conscious person.	4.3	0.76
Everyone should receive safety-related instructions before participating in a new activity.	4.3	0.81
My personal values toward safety help keep me safe from accidents.	4.24	0.83
Seat belt use is only essential for long trips while driving at high speeds on highways.	4.24	1.01
When buying a new product, reading safety-related instructions is essential.	4.22	0.85
Smoking in the bedroom should be strictly forbidden.	4.18	1.15
Safety is primarily a human error.	4.03	0.92
The emotional state of an individual affects the likelihood of an accident occurring	4.01	0.87
Some individuals have a natural tendency to take risks.	3.91	0.88
There is a relationship between human behavior and accident rates.	3.82	0.98
Accident-prone people have little control over the number of accidents they are involved in.	3.45	1.10
Parents should adhere to the recommended age range when purchasing toys.	3.39	1.18
Accidents are, for the most part, an "Act of God."	2.96	1.36
It is simply a matter of bad luck when someone gets injured.	2.83	1.28
Most people who never get into accidents are just lucky.	2.69	1.29
Average Safety Beliefs and Values	3.84	0.41

Note: Likert-type scale, ranging from 1 to 5.

Table 4
Level of safety perception and awareness among the Respondents.

Item	Mean	SD
When others point out my unsafe behavior, I always correct myself and express my gratitude for reminding me.	4.04	0.84
I always learn from the accidents that happened to the students.	3.84	0.89
I pay close attention to accidents relating to students in the public media.	3.83	0.91
I always remain aware of the risk factors in my educational institute.	3.79	0.91
I always carefully observe the safety instructions.	3.79	0.97
I want to participate in training, publicity campaigns, and emergency response workshops organized by my university.	3.76	0.95
When I find other students in a risky position, I politely remind them of the risk.	3.74	1.00
I often think about how to escape and respond to emergencies like fire or earthquake.	3.64	0.99
I always discuss safety issues with other students.	3.41	1.06
I always make myself well aware of the emergency exit.	3.28	1.16
Average Safety Perception and Awareness	3.71	0.56

Note: Likert-type scale, ranging from 1 to 5.

t-tests showed that significant mean differences in SPA were seen in gender ($F = 5.46$, $p < 0.001$), age group ($F = 18.50$, $p < 0.001$), district ($F = 1.95$, $p = 0.051$), type of institute ($F = 3.70$, $p < 0.001$), physical disabilities ($F = 2.53$, $p = 0.011$), religion ($F = 5.41$, $p = 0.005$), faculty ($F = 5.29$, $p < 0.001$), students residence ($F = 13.47$, $p < 0.001$) and safety awareness activity experience ($F = 5.57$, $p = 0.004$). According to the Scheff'e post hoc tests, female students, students aged group 18–20 years, private university students,

Table 5
Levels of safety attitude among the respondents.

Item	Mean	SD
While on the road, I always pay attention to the moving vehicles and move promptly when any vehicle comes close to me	4.20	0.85
I always follow the regulations on the storage and usage of hazardous elements in the laboratory	4.14	0.80
I always put the connection panel in a dry place, away from combustibles and water.	4.07	1.00
I always turn off the electronic equipment and switches before leaving my hostel or home for a long time.	4.07	1.01
I never use forbidden risky equipment.	4.06	0.99
I always follow directions when large-scale activities occur in a building.	4.05	0.81
I never use earphones or headphones while walking on the road.	4.05	1.04
When I identify hazards in the classroom, I make other students aware of them and inform my teacher	4.00	0.84
I do not engage in any intense conversation while walking on the road.	3.84	1.03
When playing sports, I always take necessary precautions and use safety equipment	3.69	1.10
In my daily life, I never disobey traffic signals and regulations	3.69	1.08
I follow all the signs while using the stairs	3.61	1.02
I never plug the mobile phone charger into the terminal board when it is not necessary	3.51	1.27
I do not engage in any intense conversation while using the stairs	3.42	1.10
Average Safety Attitude	3.88	0.56

Note: Likert-type scale, ranging from 1 to 5.

students of Chittagong district, Buddhist students, students with a humanities background, students who lived in a hostel, and students who had participated in a safety awareness activity in the educational institutes had significantly higher mean SPA than their counterparts (Table 6).

3.4. Safety attitudes (SA): level and mean difference

The mean of 14 safety attitudes (SA) items ranged from 3.42 to 4.20, with an overall average score of 3.88 (SD = 0.56), indicating that the respondents had a moderate level of SA. Students are primarily vigilant about moving vehicles and quickly react when a car approaches them while working on the roads (M = 4.20; SD = 0.85). However, their safety attitudes tend to be lacking when they engage in intense conversations while using stairs (M = 3.42; SD = 1.10) (Table 5).

The analysis of ANOVA and *t*-test revealed significant mean differences in SA between or among groups of each independent variable. Respondent's gender (F = 8.03, $p < 0.001$), age cohorts (F = 26.78, $p < 0.001$), district (F = 5.46, $p < 0.001$), type of institution (F = 2.51, $p = 0.012$), physical disabilities (F = 2.57, $p = 0.011$), experienced accidents (F = 3.71, $p < 0.001$), religion (F = 10.36, $p < 0.001$), faculty (F = 6.81, $p < 0.001$), type of residence (F = 16.78, $p < 0.001$) and experienced safety awareness activity (F = 3.4, $p = 0.034$) had a significant mean differences in safety attitudes (SA). According to Scheffé's post hoc analysis, females, the 18–20 age cohort, students of Chittagong District, private university students, students without physical disabilities, Buddhist students, humanities-background students, and students who have participated in safety awareness activities exhibited a higher mean SA than their counterparts (Table 6).

3.5. Factors influencing safety beliefs and values (SBV)

The multiple linear regression analysis revealed that respondents' gender, age, religion, faculty, district, type of institute, safety perception and awareness (SPA), and safety attitudes (SA) were statistically significantly associated with safety beliefs and values (SBV). Male students had 0.047 units higher SBV score [$\beta = 0.047$; 95%CI = 0.005, 0.089] than female students ($p = 0.027$). Among the religious groups, Buddhist students had 11.7 % [$\beta = -0.117$; 95%CI = -0.218, -0.017] lower SBV score, and Hindu students had 9.8 % [$\beta = -0.098$; 95%CI = -0.115, -0.040] lower than Muslim students. Students with an academic background in Science students had 0.073 units higher SBV scores [$\beta = 0.073$; 95%CI = -0.119, -0.027] than medical students ($p = 0.002$). In addition, private university students had 0.092 units higher mean SBV scores [$\beta = 0.092$; 95%CI = 0.049, -0.135] than public university students ($p = 0.001$). Moreover, per unit increase of SBV, SPA increased by 15 %, and SA increased by 15.6 %. Overall, the MLR model showed a statistically significant result (F (15, 1660) = 23.741, $p < 0.001$), explaining 17.7 % of the variance in SBV (Table 7).

3.6. Factors influencing safety perception and awareness (SPA)

The multiple linear regression analysis results for safety perception and awareness (SPA) showed several factors, such as gender, age, faculty, type of institute, physical disabilities, ever had an accident, and SBV, were significantly associated with safety perception and awareness (SPA). Male students had 0.083 units of lower SPA scores [$\beta = -0.083$; 95%CI = -0.140, -0.025] than their female counterparts ($p = 0.005$). Among the age groups, students aged 21 to 23 had 10.1 % [$\beta = -0.101$; 95%CI = -0.165, -0.036] lower SPA score, and students between the ages of 24 and 26 had 19.5 % [$\beta = -0.195$; 95%CI = -0.273, -0.117] lower SPA score than the students aged 18–20 years old. Students with a background in humanities had 0.094 units [$\beta = 0.094$; 95%CI = 0.003, 0.184], and medical faculty students had 0.099 units [$\beta = 0.099$; 95%CI = 0.036, 0.162] of higher SPA scores compared to the science faculty students. In addition, students from private universities had 0.130 units higher mean SPA scores [$\beta = -0.130$; 95%CI = -0.189, -0.070] than students from public universities ($p = 0.001$). Respondents with physical disabilities had 0.129 units of lower SPA score [$\beta = -0.129$; 95%CI = -0.218, -0.040] than their counterparts ($p = 0.004$). Moreover, students who had previously experienced an accident showed 0.054 units of higher SPA score [$\beta = 0.054$; 95%CI = 0.002, 0.105] than their counterparts ($p = 0.040$). In addition, per unit of increase in SBV, SPA increased by 42.6 %. Overall, the MLR model showed statistically significant results (F (14, 1661) = 20.267, $p < 0.001$), explaining 14.6 % of the variance in SPA scores (Table 7).

3.7. Factors influencing safety attitudes (SA)

The multiple linear regression analysis of safety attitudes (SA) among students showed that male students had 0.173 units of lower SA score [$\beta = -0.173$; 95%CI = -0.230, -0.117] compared to female students ($p = 0.001$). Those aged 21–23 years old had 0.127 units of lower SA score [$\beta = -0.127$; 95%CI = -0.190, -0.063], and students aged 24–26 years old had 0.179 units of lower SA score [$\beta = -0.179$; 95%CI = -0.256, -0.102] compared to the younger students (18–20 years old). In addition, Buddhist students had an 8.9 % [$\beta = 0.089$; 95%CI = 0.012, 0.116] higher SA score, and Hindu students had an 18.3 % [$\beta = 0.183$; 95%CI = 0.048, 0.318] higher SA score than Muslim students. Private university students had a 0.058-unit lower mean SA score [$\beta = -0.058$; 95%CI = -0.116, -0.001] than public universities ($p = 0.047$). Moreover, the students from Dhaka had 0.056 units of lower SA score [$\beta = -0.056$; 95%CI = -0.110, -0.002] than those from Chittagong ($p = 0.044$). Students who ever experienced an accident had 0.093 units lower SA score [$\beta = -0.093$; 95%CI = -0.143, 0.043] than those who never experienced an accident ($p = 0.001$). The MLR model showed a statistically significant result (F (14, 1661) = 25.804, $p < 0.001$) that explained 17.9 % of the variation in SA (Table 7).

Table 6
Mean differences of SVB, SPA, and SA between categories of the respondents' characteristics.

Variables	Safety Beliefs and Values					Safety Perception and Awareness					Safety Attitudes				
	Mean	(SD)	F/t-statistics	p-value	Post hoc	Mean	(SD)	F/t-statistics	p-value	Post hoc	Mean	(SD)	F/t-statistics	p-value	Post hoc
Gender															
(a) Female	3.82	0.41	-1.131	0.258		3.8	0.54	5.469	0.001***	a>b	4.01	0.53	8.037	0.001***	a>b
(b) Male	3.85	0.41				3.64	0.56				3.79	0.55			
Age (Years)															
(a) 18-20	3.93	0.35	12.497	0.001***	a>b, c	3.85	0.5	18.509	0.001***	a>b > c	4.06	0.51	26.78	0.001***	a>b > c
(b) 21-23	3.81	0.41				3.68	0.56				3.84	0.56			
(c) 24-26	3.81	0.45				3.63	0.58				3.8	0.54			
District															
(a) Chattogram	3.89	0.39	5.091	0.001***	a>b	3.73	0.61	1.955	0.051*	a>b	3.96	0.61	5.462	0.001***	a>b
(b) Dhaka	3.79	0.42				3.68	0.5				3.81	0.49			
Types of institutes															
(a) Private	3.8	0.41	-3.952	0.001***	b>a	3.76	0.57	3.703	0.001***	a>b	3.92	0.58	2.51	0.012*	a>b
(b) Public	3.88	0.4				3.65	0.54				3.85	0.53			
Marital status															
Ever Married	3.81	0.46	-0.646	0.518		3.73	0.64	0.355	0.722		3.92	0.64	0.594	0.554	
(b) Single	3.84	0.41				3.7	0.55				3.88	0.55			
Physical disabilities															
(a) No	3.85	0.41	3.242	0.001***	a>b	3.72	0.56	2.537	0.011*	a>b	3.89	0.56	2.571	0.011*	a>b
(b) Yes	3.75	0.43				3.62	0.54				3.8	0.51			
Ever had an accident															
(a) No	3.86	0.4	2.505	0.012*	a>b	3.68	0.57	-1.888	0.059		3.93	0.55	3.716	0.001***	a>b
(b) Yes	3.81	0.42				3.73	0.55				3.83	0.56			
Felt unsafe due to student politics															
(a) No	3.8	0.4	-2.41	0.016*	b>a	3.69	0.52	-0.75	0.453		3.86	0.52	-1.269	0.205	
(b) Yes	3.86	0.42				3.71	0.58				3.89	0.57			
Religion															
(a) Islam	3.85	0.42	2.722	0.066		3.69	0.56	5.414	0.005**	c > b>a	3.86	0.56	10.366	0.001***	c > b>a
(b) Hindu	3.78	0.38				3.77	0.52				3.97	0.51			
(c) Buddhist	3.79	0.33				3.89	0.6				4.14	0.56			
Faculty															
(a) Science	3.87	0.38	6.53	0.001***	c > b>a>d	3.65	0.59	5.295	0.001***	b > d > c>a	3.84	0.6	6.811	0.001***	b > c > d>a
(b) Humanities	3.89	0.36				3.84	0.5				4.04	0.52			
(c) Commerce	3.9	0.41				3.69	0.6				3.91	0.61			
(d) Medical	3.79	0.43				3.7	0.54				3.86	0.52			
Type of residence															
(a) Own House	3.83	0.42	1.961	0.118		3.69	0.59	13.471	0.001***	c > b>a>d	3.89	0.57	16.781	0.001***	c > b>a>d
(b) Rented House	3.81	0.41				3.77	0.54				3.94	0.56			
(c) Hostel	3.89	0.42				3.86	0.48				4.04	0.55			
(d) Hall	3.85	0.4				3.61	0.55				3.76	0.52			
Safety awareness activity experience															
(a) No	3.86	0.38	2.092	0.123		3.65	0.55	5.574	0.004**	b > c>a	3.87	0.5	3.4	0.034*	b>a>c
(b) Yes	3.81	0.43				3.76	0.57				3.93	0.55			
(c) Don't Know	3.85	0.4				3.68	0.55				3.85	0.59			

Note: *P ≤ 0.05, **P ≤ 0.01, ***P ≤ 0.001.

Table 7
Factors influencing SVB, SPA, and SA among the respondents (n = 1676).

Covariables	Safety Beliefs and Values			Safety Perception and Awareness			Safety Attitudes		
	β (95 % CI)	SE	Stand. β	β (95 % CI)	SE	Stand. β	β (95 % CI)	SE	Stand. β
Gender									
Female	Reference			Reference			Reference		
Male	0.047 [0.005, 0.089] *	0.021	0.056	-0.083 [-0.140, -0.025] **	0.029	-0.072	-0.173 [-0.230, -0.117] ***	0.029	-0.152
Age (years)									
18–20	Reference			Reference			Reference		
21–23	0.059 [-0.106, -0.089] *	0.024	-0.071	-0.101 [-0.165, -0.036] **	0.033	-0.089	-0.127 [-0.190, -0.063] ***	0.032	-0.113
24–26	0.008 [-0.065, -0.050]	0.029	-0.008	-0.195 [-0.273, -0.117] ***	0.040	-0.151	-0.179 [-0.256, -0.102] ***	0.039	-0.139
Marital status									
Ever Married	Reference			Reference			Reference		
Single	0.006 [-0.079, 0.091]	0.043	0.003	-0.030 [-0.147, 0.087]	0.060	-0.012	-0.053 [-0.162, 0.061]	0.058	-0.021
Religion									
Islam	Reference			Reference			Reference		
Hindu	-0.098 [-0.155, -0.040] ***	0.029	-0.076	0.074 [-0.005, 0.153]	0.040	0.043	0.089 [0.012, 0.116] *	0.039	0.051
Buddhist	-0.117 [-0.218, -0.017] *	0.051	-0.053	0.129 [-0.009, 0.267]	0.070	0.043	0.183 [0.048, 0.318] **	0.069	0.062
Faculty									
Science	Reference			Reference			Reference		
Humanities	-0.004 [0.898, -0.070]	0.034	-0.003	0.094 [0.003, 0.184] *	0.046	0.054	0.060 [-0.029, 0.149]	0.045	0.034
Commerce	0.054 [-0.012, 0.121]	0.034	0.041	0.018 [-0.074, 0.111]	0.047	0.010	0.038 [-0.052, 0.129]	0.046	0.022
Medical	-0.073 [-0.119, -0.027] **	0.023	-0.088	0.099 [0.036, 0.162] **	0.032	0.088	0.052 [-0.009, 0.114]	0.032	0.047
Type of institute									
Public	Reference			Reference			Reference		
Private	0.092 [0.049, -0.135] ***	0.022	0.111	-0.130 [-0.189, -0.070] ***	0.030	-0.115	-0.058 [-0.116, -0.001] *	0.029	-0.052
District									
Chattogram	Reference			Reference			Reference		
Dhaka	-0.095 [-0.135, -0.055] ***	0.020	-0.114	0.049 [-0.007, 0.104]	0.028	0.043	-0.056 [-0.110, -0.002] *	0.028	-0.050
Physical disabilities									
No	Reference			Reference			Reference		
Yes	0.021 [-0.044, 0.085]	0.033	0.017	-0.129 [-0.218, -0.040] **	0.045	-0.077	-0.041 [-0.127, 0.046]	0.044	-0.024
Ever had an accident									
No	Reference			Reference			Reference		
Yes	-0.013 [-0.050, 0.024]	0.019	-0.016	0.054 [0.002, 0.105] *	0.026	0.048	-0.093 [-0.143, 0.043] ***	0.025	-0.083
Safety Beliefs and Values									
Safety Perception and Awareness	0.150 [0.111, 0.189] ***	0.020	0.203	0.426 [0.364, 0.488] ***	0.032	0.315	0.419 [0.359, 0.480] ***	0.031	0.310
Safety Attitudes	0.156 [0.116, 0.196] ***	0.020	0.211						
Model F	23.741 df (15, 1660)			20.267 df (14, 1661)			25.804 df (14, 1661)		
R²	0.177			0.146			0.179		
Adjusted R²	0.169			0.139			0.172		

Note: *P ≤ 0.05; **P ≤ 0.01; ***P ≤ 0.001; SBV = Safety Beliefs and Values; SPA = Safety Perception and Awareness; SA = Safety Attitudes.

4. Discussion

This study investigated the safety culture among students of tertiary-level academic institutions in Bangladesh, including private and public universities and medical colleges. The results indicated that Bangladeshi university and medical students possess moderate levels of safety beliefs and values (SBV), safety perception and awareness (SPA), and safety attitudes (SA). These findings underscore the necessity of promoting and implementing a safety culture in tertiary-level academic institutions in Bangladesh. Interestingly, these results align with previous studies by Gao et al. [13] and Gong [33] on Chinese private and public university students. The SBV scale revealed low scores for the statements “It is simply a matter of bad luck when someone gets injured” and “Accidents are, for the most part, an Act of God,” indicating dogmatic beliefs and values about safety among students. It can be inferred that higher education may encourage students to think beyond superstition, ultimately impacting their SBV.

Based on the SPA scale, the findings suggested that students’ awareness about following the emergency exit, thinking about escaping, and responding in case of emergencies were low. Previous studies indicate that students’ focus on fire equipment and evacuation exits during emergencies is moderate [25]. To improve student awareness and attitudes toward safety, tertiary education institutions should provide comprehensive safety training and emergency drills. Interestingly, this study also found that students who discussed safety concerns with their peers obtained relatively low scores. Specifically, the statement “When I find other students in a risky position, I remind them of the risk politely” ranked third lowest score in this research. The reluctance to express safety concerns with peers could be due to concerns of embarrassment or generating unnecessary conflicts [33].

Regarding safety attitudes, our findings indicated that engaging in intense conversation while using stairs had the lowest mean score. The second lowest mean score was unplugging the mobile phone charger into the terminal board when unnecessary, followed by not following all the signs while using stairs. These results suggested a lack of safety attitudes and motivation among students, revealing a reluctance to adhere to safety requirements. In line with previous research [34,35], we recommend implementing more safety training, mock drills, and awareness-raising programs for students in collaboration with relevant stakeholders.

When examining safety culture across genders, it has been observed that female students tend to exhibit higher levels of safety perception and awareness (SPA) and safety attitudes (SA) compared to their male counterparts. Conversely, males demonstrated higher safety beliefs and values (SBV) than females, a trend consistent with previous studies by Blair et al. and Wang et al. [36,37]. Our study also found that older students generally displayed lower SPA and SA than their younger counterparts. However, their SBV was slightly higher than younger students, which aligns with Crowe’s findings [38]. However, another study discovered that the safety culture among students in different academic years was similar [33]. Elsous et al. [39] found that elderly nursing students demonstrated a heightened sense of professional responsibility and priority for patient safety. This may be attributed to their exposure to more intricate and challenging scenarios, leading to a deeper understanding of the potential consequences. To foster a better safety culture among students, universities may consider implementing safety education through video contests, campaigns, and seminars.

Our study has revealed that Muslim students had stronger beliefs and values toward safety, whereas Hindu and Buddhist students tend to exhibit more favorable safety attitudes. Previous research has also confirmed that religion can influence safety culture [25]. The impact of religious beliefs and practices on safety culture can be pretty diverse and profound. For example, students’ safety culture might be influenced by their religious beliefs, values, and practices, such as compassion, sense of responsibility, and spiritual well-being. One must investigate how religious beliefs and practices interact with academic life and community norms to understand these influences.

We found that students of the Chittagong district showed higher SBV and SA than students of the Dhaka district. Previous studies also found a relationship between districts and student safety culture [13,25]. It is likely that students in developed cities receive a more comprehensive safety education than those in less developed regions. This is because developed cities typically face more safety concerns that require greater attention [13]. For instance, Chittagong, being a port city, has a higher level of planning development and higher safety standards than Dhaka, which is an overcrowded and unplanned city. To promote safety culture, it is recommended that community-based safety initiatives and education programs be introduced at the district level.

In terms of faculty, medical students showed lower safety beliefs and values (SBV) than science students, while both humanities and medical students demonstrated higher safety perception and awareness (SPA) than science students. However, some studies have found that science major students tend to have greater safety awareness [13,33]. Other research has shown that students who received safety education are more likely to embrace a positive safety culture [39]. Another research indicates that medical students specializing in Occupational Health and Safety (OHS) exhibit more positive safety attitudes than their peers [40]. Based on our findings, we suggested that incorporating safety modules into the tertiary education curriculum in Bangladesh could help enhance safety knowledge across all faculties.

This study found that private university students reported significantly higher levels of SBV but significantly lower levels of SPA and SA than their public university counterparts. These findings align with previous studies that have also highlighted a significant difference in the safety environment between public and private universities [9,41]. Private universities tend to cultivate a more favorable safety climate than public institutions. A comprehensive approach is necessary to ensure a greater sense of safety culture among public university students in Bangladesh. This approach should involve leveraging technology, engaging students in safety efforts, conducting frequent evaluations, and offering assistance for mental health to establish a strong safety culture in tertiary educational institutions [42].

This research has shown that students with physical disabilities may have lower safety perceptions and awareness (SPA) compared to their peers. However, this does not necessarily mean that having a physical disability has a significant impact on safety culture [25]. Individuals with disabilities face a variety of challenges, including anxiety, social isolation, and limited access to health and safety services, which can affect their overall safety [43]. To promote equality, educational institutions need to address these challenges and

facilitate the active participation of students with physical disabilities. In addition, students who have experienced accidents tend to have lower SBV and SA than those who have not. A strong safety culture is crucial to prevent accidents in educational settings. Previous studies have highlighted the importance of these measures, and they are likely to play a vital role in reducing accidents in the future [25,33,38].

4.1. Limitations of the study

The findings of this study strongly support the integration of safety education into tertiary-level curriculums to enhance the safety environment for students at educational institutions. The evidence provided by this study can be valuable for policymakers and program developers who are addressing safety concerns. However, it is essential to note that our investigation has certain limitations. The study's cross-sectional design only permits a limited understanding of the relationship between safety culture and students' characteristics, not the causality of this relationship. Additionally, the quantitative nature of the study does not allow for a comprehensive understanding of safety culture, highlighting the need for qualitative or mixed-method research to explore this aspect in greater depth.

5. Conclusion

While the study has limitations, it provides crucial insights into the safety culture among tertiary-level students in Bangladesh. It also highlights the need for improved safety measures for tertiary-level students in Bangladesh. The study emphasizes the urgency of enhancing safety beliefs and values, safety perception and awareness, and safety attitudes among students, focusing on gender, age, physical disabilities, accident victims, religion, and academic background. The study strongly advocates for implementing safety education programs within all tertiary-level educational institutions in Bangladesh, including frequent safety training, lectures, and exercises.

CRedit authorship contribution statement

Abu Hossain Muhammad Ahsan: Writing – review & editing, Project administration, Methodology, Investigation, Funding acquisition, Conceptualization. **Md. Khalid Hasan:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Maruf Hasan Rumi:** Writing – review & editing, Project administration, Methodology, Investigation, Funding acquisition, Conceptualization. **Taufique Ahmed:** Writing – review & editing, Writing – original draft, Visualization, Methodology. **Tanjim Kabir Aunto:** Writing – review & editing, Writing – original draft, Visualization, Methodology.

Data availability statement

Data will be made available on request.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.heliyon.2024.e40155>.

Appendix

Table A1
Correlation matrix of the study variables

Sl	Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Gender	1													
2	Age	0.108**	1												
3	MS	0.071**	-0.164**	1											
4	Religion	-0.156**	-0.039	0.008	1										
5	Faculty	-0.041	0.292**	-0.063**	0.036	1									
6	TEI	0.360**	-0.109**	0.112**	-0.086**	-0.057*	1								
7	District	0.070**	0.037	0.041	-0.176**	0.005	0.000	1							
8	Residence	0.422**	-0.065**	0.101**	-0.042	0.027	0.621**	0.037	1						
9	PD	-0.111**	0.154**	-0.006	-0.115**	0.096**	-0.348**	0.358**	-0.260**	1					
10	Accident	-0.073**	0.095**	-0.031	0.034	0.089**	-0.149**	0.032	-0.094**	0.045	1				
11	USP	-0.031	-0.044	0.042	-0.047	-0.076**	0.013	0.066**	0.037	0.085**	-0.018	1			
12	SBV	0.017	-0.089**	0.013	-0.052*	-0.093**	0.105**	-0.146**	0.034	-0.087**	-0.062*	0.056*	1		
13	SPA	-0.132**	-0.138**	-0.014	0.088**	0.014	-0.100**	-0.057*	-0.062*	-0.080**	0.052*	0.039	0.266**	1	
14	SA	-0.196**	-0.163**	-0.019	0.113**	-0.036	-0.079**	-0.162**	-0.112**	-0.066**	-0.094**	0.040	0.310**	0.540**	1

Note: MS = Marital Status; TEI = Type of Educational Institution; PD = Physical Disabilities; USP = Unsafe due to Students' Politics; SBV = Safety Beliefs and Values; SPA = Safety Perception and Awareness; SA = Safety Attitudes; *P ≤ 0.05; **P ≤ 0.01.

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