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KNOWLEDGE, ATTITUDE, AND BEHAVIOUR REGARDING MOLES AMONG HEALTH-SCIENCES AND NON-HEALTH UNDERGRADUATE STUDENTS

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ABSTRACT
Melanoma is the deadliest skin cancer, and Asian patients are often diagnosed at an advanced stage. Because many melanomas arise in or near existing moles, recognising mole changes is essential for early detection, yet naevus-specific evidence among Indonesian young adults is lacking. To assess mole-related knowledge, attitude, and behaviour among undergraduate students, compare health-sciences and non-health students, and examine the association of knowledge with attitude and behaviour. An analytical cross-sectional online survey was conducted at Universitas Sumatera Utara, Medan, Indonesia, in December 2025 using convenience sampling. A 30-item questionnaire (content validity reviewed by a dermatovenereologist; pilot test in 30 students: item–total r = 0.410–0.845, Cronbach's α = 0.688–0.861), with negatively worded items reverse-scored, was analysed for 183 eligible students (92 health-sciences and 91 non-health; mean age 20.3 ± 1.9 years) using the χ^2 test, Mann–Whitney U test, and multivariable logistic regression adjusted for faculty cluster, age, and sex. Good knowledge, attitude, and behaviour were found in 60.1%, 49.7%, and 26.2% of students, respectively. Health-sciences students scored higher in all domains ($p < 0.001$). The behaviour gap was confined to mole-specific surveillance, such as skin self-examination (53.3% vs 16.5%). Good knowledge was independently associated with a good attitude (adjusted OR 3.62; 95% CI 1.12–11.68), but its association with good behaviour was imprecise (adjusted OR 4.02; 95% CI 0.98–16.43). Knowledge appears necessary but insufficient for protective behaviour. Campus programmes for non-health students should combine education on melanoma warning signs with practical training in skin self-examination.

Keywords: health knowledge; melanoma; naevus; skin self-examination; students

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INTRODUCTION

Cutaneous melanoma is the skin cancer with the highest mortality. An estimated 325,000 new cases and 57,000 deaths occurred worldwide in 2020, and more than 500,000 new cases and close to 100,000 deaths per year are projected by 2040 (Arnold et al., 2022). The GLOBOCAN 2022 update recorded approximately 332,000 new cases and 59,000 deaths (Bray et al., 2024). Although incidence in Asia is lower than in populations of European descent, Asian patients tend to be diagnosed with thicker, more advanced tumours, often because of limited access to dermatological care and the perception that melanoma does not affect darker skin (Nadelmann et al., 2025). Early detection is therefore a priority even in countries with a relatively low incidence, such as Indonesia.

A pigmented naevus, or mole, is a benign proliferation of melanocytes that usually appears during the first two decades of life. In an Indonesian clinicopathological series, naevi were most frequent in people aged 21–30 years (Pratama et al., 2021). A high naevus count and atypical naevi are the

strongest phenotypic risk factors for melanoma, and tumour thickness at diagnosis is its most important prognostic determinant (Long et al., 2023). Naevi can also be the direct site of transformation: in a cohort of 2,227 patients with invasive melanoma, 22.86% of tumours were naevus-associated and were thinner at diagnosis than de novo melanomas (Bosch-Amate et al., 2021). Recognising changes in one's own moles, summarised in the ABCDE criteria, is therefore central to early detection.

Skin self-examination is inexpensive and does not depend on health facilities, but performing it correctly requires knowledge, confidence, and skills. A survey of 2,326 adults in the United States found that about 63% had ever examined their skin, yet only about 7% felt very confident doing so, and melanoma knowledge together with self-efficacy was the strongest correlate of self-examination (Leachman et al., 2023). High knowledge does not automatically translate into protective action: Lebanese university students were well informed about ultraviolet risks but used sunscreen inadequately, with cost as the main barrier (Afiouni et al., 2024), and only 22.6% of students in Pakistan used sunscreen regularly despite knowing its benefits (Shahzad et al., 2022).

University students are a strategic target because long-term health habits are formed at this age, and comparing students with and without health training can reveal where the chain from knowledge to behaviour breaks. In Peru, medical students had higher photoprotection knowledge than non-medical students, but their photoprotective practices did not differ (Chavez et al., 2025). In Indonesia, medical students also had higher photoprotection knowledge, and better knowledge was associated with better photoprotective behaviour, although overall practice was low (Roren et al., 2022). The only naevus-specific Indonesian study, conducted among 40 adults in Semarang, reported good knowledge in 50%, a positive attitude in 55%, and good behaviour in 47.5%, with no significant association between knowledge or attitude and behaviour (Riyanto et al., 2025).

The PRECEDE-PROCEED model offers a framework for interpreting these discrepancies by distinguishing predisposing factors, such as knowledge and attitudes, from enabling factors, such as skills and access, and reinforcing factors, such as social support (Ghaffari et al., 2021). Existing Indonesian studies have examined photoprotection rather than naevus-specific knowledge, attitude, and behaviour, have not compared health-sciences and non-health students while accounting for their differences in age and sex, and have not included data from North Sumatra. This study therefore aimed to describe mole-related knowledge, attitude, and behaviour among undergraduate students at Universitas Sumatera Utara, to compare them between health-sciences and non-health students, and to examine the association of knowledge with attitude and behaviour after adjustment for faculty cluster, age, and sex.

METHOD

Study design and setting. This analytical cross-sectional study was conducted at Universitas Sumatera Utara (USU), Medan, North Sumatra, Indonesia, through an online Google Form open from 15 to 26 December 2025. The design measures exposures and outcomes at a single time point and is suited to estimating distributions and testing associations, but not to establishing causality (Figueiredo et al., 2025; Savitz & Wellenius, 2023). Reporting follows the STROBE statement for cross-sectional studies (von Elm et al., 2007).

Participants and sampling. The source population was active undergraduate students at USU (approximately 31,600). The planned minimum sample size was 396, calculated with Slovin's formula at a 5% margin of error, while recognising that this formula is appropriate only for estimating a proportion in a population of known size (Santoso, 2023). Participants were recruited by convenience sampling: the questionnaire link was shared through student WhatsApp groups and social-media channels, and any student who received the link could respond. Inclusion criteria were

active undergraduate enrolment at USU, electronic consent, and a fully completed questionnaire; postgraduate students and responses without a stated faculty were excluded. Faculties were grouped a priori into a health-sciences cluster (Medicine, Dentistry, Pharmacy, and Psychology) and a non-health cluster (all other faculties). Because recruitment depended on self-selection within online networks, the findings apply to students reached by these networks rather than to all USU students (Andrade, 2021). The final sample of 183 provides a margin of error of about ±7.2% for a proportion of 50% at 95% confidence.

Questionnaire, content validity, and reliability. The self-administered questionnaire contained items on age, sex, year of entry, and faculty, followed by 30 dichotomous items: 10 on knowledge (true/false), 10 on attitude (agree/disagree), and 10 on behaviour (ever/never). It was developed following recommended steps for knowledge–attitude–practice surveys, namely a literature review, item drafting for the target population, expert review, and piloting (Mousavi et al., 2025). Content validity was assessed qualitatively by a board-certified dermatovenereologist (IBP), who reviewed each item for relevance, clarity, and coverage of naevus biology, melanoma warning signs, ultraviolet protection, and help-seeking; no formal content validity index was computed. The instrument was piloted in 30 students, a sample adequate for preliminary reliability estimation (Bujang et al., 2024). In the pilot, all items showed item–total correlations above the critical value ($r = 0.410–0.845$; critical $r = 0.361$), and Cronbach's α was 0.831 for knowledge, 0.688 for attitude, and 0.861 for behaviour. In the main sample, after reverse-scoring, Kuder–Richardson 20 (KR-20) coefficients were 0.68, 0.60, and 0.64, respectively. Values of 0.60–0.70 are commonly regarded as acceptable for short dichotomous scales in exploratory research, but they indicate modest internal consistency, particularly for the attitude scale, whose items combine educational exposure, beliefs, and emotional responses (Taber, 2018).

Scoring and categorisation. Each item was scored 1 for the desirable response and 0 otherwise, giving a score of 0–10 per domain. Four negatively worded items were reverse-scored: knowledge item 5 ("all moles should be removed to prevent skin cancer", correct answer false), attitude items 7 ("moles have a special meaning that affects my life") and 8 ("moles must be removed to prevent malignancy"), for which disagreement was desirable, and behaviour item 7 ("tried home remedies for a changing mole"), for which "never" was desirable. Behaviour item 8 (considering or undergoing mole removal for aesthetic or medical reasons) has no unambiguous desirable direction; it was retained as originally keyed and its influence was examined in a sensitivity analysis. Scores were categorised with Arikunto's percentage criteria (Arikunto, 2013) as good (≥76%, score 8–10), moderate (56–75%, score 6–7), or poor (<56%, score 0–5). Table 3 lists all items with their keying.

Variables. The outcomes were attitude and behaviour, each analysed as good versus moderate or poor. The main exposure was knowledge (good versus moderate or poor). Covariates were faculty cluster (health-sciences versus non-health), age in years, and sex. Faculty cluster was also examined as the comparison variable for the descriptive objectives.

Statistical analysis. Categorical variables are reported as frequencies and percentages and continuous variables as mean ± standard deviation or median (interquartile range). Differences between faculty clusters in the distribution of categories were tested with Pearson's χ^2 test, with Cramér's V as the effect size; all expected cell counts were at least 5 (Egbuchulem, 2024). Domain scores were compared with the Mann–Whitney U test, with effect size $r = Z/\sqrt{N}$ interpreted as small (≥0.1), medium (≥0.3), or large (≥0.5) (Fiel Peres, 2026). Associations between domain scores were assessed with Spearman's ρ. Binary logistic regression estimated crude and adjusted odds ratios (ORs) with 95% confidence intervals (CIs) for good attitude and good behaviour, with good knowledge, faculty cluster, age, and sex entered simultaneously. Model fit was assessed with the likelihood-ratio test, Nagelkerke R^2, and the Hosmer–Lemeshow test; variance inflation factors

were all below 2.2, and there were 22.8 and 12.0 outcome events per predictor for the attitude and behaviour models, respectively. Sensitivity analyses entered knowledge as a continuous score and, for behaviour, excluded the directionally ambiguous item 8 (score 0–9, good ≥ 7). Analyses were performed in Python 3.13 with NumPy, SciPy, and pandas, and two-sided $p < 0.05$ was considered statistically significant.

Informed consent and confidentiality. Participation was voluntary and anonymous, and all respondents gave electronic informed consent on the first page of the form before answering. Respondents could decline or stop at any time without consequence, and names and addresses collected by the form were removed before analysis.

RESULT

Of 188 responses received, 5 were excluded (2 postgraduate students, 2 without a stated faculty, and 1 incomplete questionnaire), leaving 183 students for analysis: 92 in the health-sciences cluster and 91 in the non-health cluster (Figure 1). Medicine (77 students) and Engineering (73 students) together accounted for 82.0% of the sample. The mean age was 20.30 ± 1.90 years (range 18–24), and 81 participants (44.3%) were female. Health-sciences students were older than non-health students (21.53 ± 1.35 vs 19.05 ± 1.52 years; $p < 0.001$) and more often female (68.5% vs 19.8%; $p < 0.001$) (Table 1).

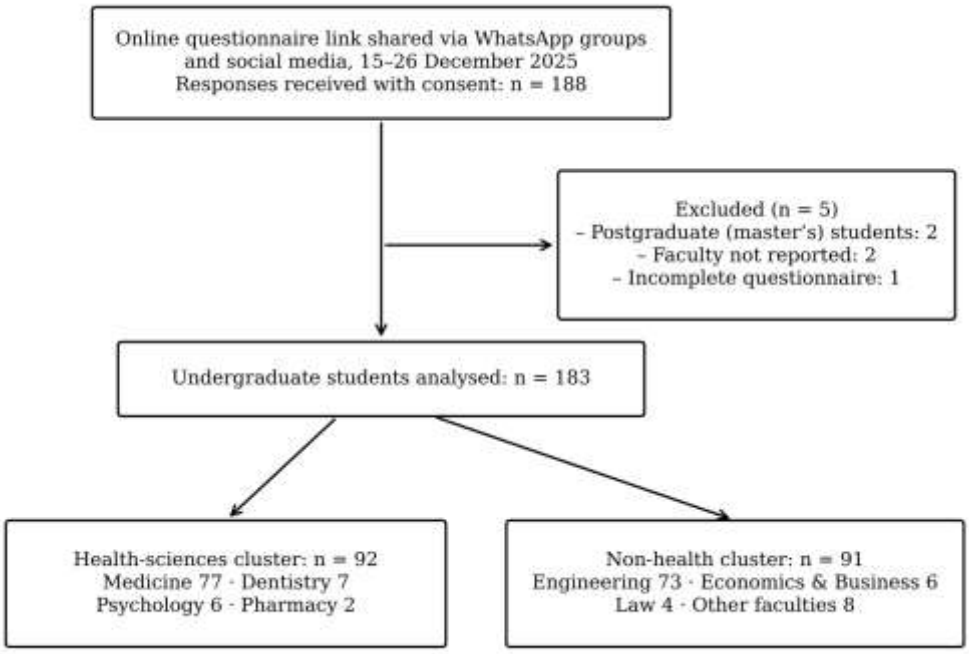

Figure 1. Flow of participants through the study

Overall, 110 students (60.1%) had good knowledge, 46 (25.1%) moderate, and 27 (14.8%) poor knowledge (Table 2). Good knowledge was found in 83 of 92 health-sciences students (90.2%), none of whom had poor knowledge, compared with 27 of 91 non-health students (29.7%), among whom the same number (29.7%) had poor knowledge. The distribution differed between clusters ($\chi^2(2) = 72.55$; $p < 0.001$; $V = 0.63$), and median scores were 10 (9–10) and 7 (5–8), respectively ($U = 852$; $Z = 9.51$; $p < 0.001$; $r = 0.70$). The largest item-level differences concerned whether moles can turn into melanoma (90.2% vs 35.2% correct), the protective effect of sunscreen (97.8% vs 54.9%), and the value of routine mole checks (96.7% vs 56.0%) (Table 3).

Table 1.
Characteristics of participants by faculty cluster

Characteristic	Health-sciences (n = 92)	Non-health (n = 91)	Total (n = 183)	p
Age, years, mean ± SD	21.53 ± 1.35	19.05 ± 1.52	20.30 ± 1.90	< 0.001[a]
18–19	10 (10.9)	77 (84.6)	87 (47.5)	
20–22	60 (65.2)	8 (8.8)	68 (37.2)	
23–24	22 (23.9)	6 (6.6)	28 (15.3)	
Female sex, n (%)	63 (68.5)	18 (19.8)	81 (44.3)	< 0.001[b]
Faculty, n (%)				
Medicine	77 (83.7)	–	77 (42.1)	
Dentistry	7 (7.6)	–	7 (3.8)	
Psychology	6 (6.5)	–	6 (3.3)	
Pharmacy	2 (2.2)	–	2 (1.1)	
Engineering	–	73 (80.2)	73 (39.9)	
Economics and Business	–	6 (6.6)	6 (3.3)	
Law	–	4 (4.4)	4 (2.2)	
Mathematics and Natural Sciences	–	3 (3.3)	3 (1.6)	
Agriculture	–	2 (2.2)	2 (1.1)	
Social and Political Sciences	–	2 (2.2)	2 (1.1)	
Computer Science and IT	–	1 (1.1)	1 (0.5)	

SD, standard deviation. Faculty percentages in cluster columns are relative to the cluster total. [a]Mann–Whitney U test. [b]Pearson's χ^2 test.

Table 2.
Knowledge, attitude, and behaviour categories by faculty cluster

Domain / category	Health-sciences n (%)	Non-health n (%)	Total n (%)	Test statistics
Knowledge				
Poor (0–5)	0 (0.0)	27 (29.7)	27 (14.8)	$\chi^2(2) = 72.55$; $p < 0.001$; V = 0.63
Moderate (6–7)	9 (9.8)	37 (40.7)	46 (25.1)	
Good (8–10)	83 (90.2)	27 (29.7)	110 (60.1)	
Score, median (IQR)	10 (9–10)	7 (5–8)	7.93 ± 1.98[a]	U = 852; Z = 9.51; $p < 0.001$; r = 0.70
Attitude				
Poor (0–5)	0 (0.0)	55 (60.4)	55 (30.1)	$\chi^2(2) = 107.60$; $p < 0.001$; V = 0.77
Moderate (6–7)	13 (14.1)	24 (26.4)	37 (20.2)	
Good (8–10)	79 (85.9)	12 (13.2)	91 (49.7)	
Score, median (IQR)	8 (8–9)	5 (4–7)	6.91 ± 2.06[a]	U = 605; Z = 10.14; $p < 0.001$; r = 0.75
Behaviour				
Poor (0–5)	23 (25.0)	65 (71.4)	88 (48.1)	$\chi^2(2) = 50.66$; $p < 0.001$; V = 0.53
Moderate (6–7)	26 (28.3)	21 (23.1)	47 (25.7)	
Good (8–10)	43 (46.7)	5 (5.5)	48 (26.2)	
Score, median (IQR)	7 (5.75–9)	5 (4–6)	6.01 ± 1.92[a]	U = 1,939.5; Z = 6.36; $p < 0.001$; r = 0.47

Categories follow Arikunto's criteria: good ≥76%, moderate 56–75%, poor <56% of the maximum score. χ^2, Pearson's test (all expected counts ≥5); V, Cramér's V; U, Mann–Whitney U test on domain scores; $r = Z/\sqrt{N}$; IQR, interquartile range. [a]Mean ± SD for the total sample.

A good attitude was found in 91 students (49.7%), a moderate attitude in 37 (20.2%), and a poor attitude in 55 (30.1%). Among health-sciences students, 79 (85.9%) had a good attitude and none a poor attitude, whereas 55 non-health students (60.4%) had a poor attitude and 12 (13.2%) a good attitude ($\chi^2(2) = 107.60$; $p < 0.001$; V = 0.77; U = 605; Z = 10.14; r = 0.75). Attitude showed the largest between-cluster difference of the three domains. Agreement that mole education had been received on campus differed most (77.2% vs 4.4%), whereas the two reverse-scored items showed the opposite pattern: disagreement that moles have a special personal meaning (40.2% vs 73.6%)

and that moles must be removed to prevent malignancy (59.8% vs 79.1%) was less frequent among health-sciences students (Table 3).

Good behaviour was found in only 48 students (26.2%), moderate behaviour in 47 (25.7%), and poor behaviour in 88 (48.1%). Good behaviour was reported by 43 health-sciences students (46.7%) and 5 non-health students (5.5%) ($\chi^2(2) = 50.66$; $p < 0.001$; $V = 0.53$; $U = 1{,}939.5$; $Z = 6.36$; $r = 0.47$) (Figure 2). The difference was concentrated in mole-specific surveillance: examining all one's moles (53.3% vs 16.5%), routinely monitoring changes in size or colour (73.9% vs 6.6%), and consulting a health professional about a mole (33.7% vs 3.3%). General sun-protection behaviours were similar or more frequent among non-health students, including avoiding peak-hour sun (85.9% vs 90.1%) and wearing protective clothing (90.2% vs 100.0%), and fewer non-health students had tried home remedies (19.6% vs 5.5%). Only half of all students (50.3%) reported reapplying sunscreen every 2–3 hours outdoors (Table 3).

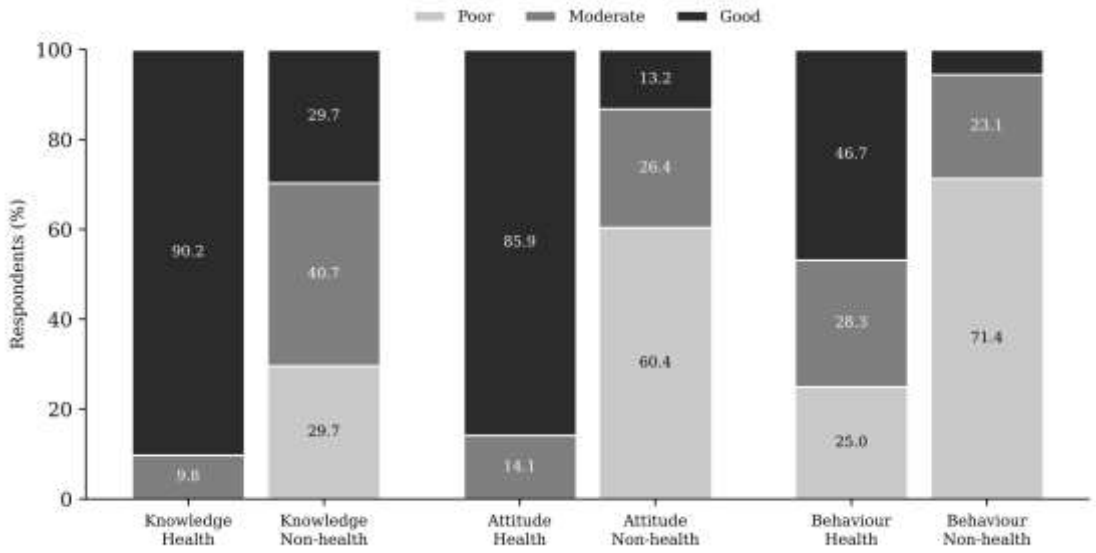

Figure 2. Distribution of knowledge, attitude, and behaviour categories by faculty cluster (n = 183)

Table 3.
Percentage of students giving the desirable response to each item

Item	Health-sciences (n = 92)	Non-health (n = 91)	Total (n = 183)
Knowledge			
K1. Moles are a type of skin tumour (T)	87.0	42.9	65.0
K2. Family history affects the risk of moles (T)	89.1	70.3	79.8
K3. Moles can increase in number over time (T)	97.8	70.3	84.2
K4. Moles can turn into skin cancer (melanoma) (T)	90.2	35.2	62.8
K5. All moles should be removed to prevent skin cancer (F)†	88.0	73.6	80.9
K6. Excessive sun exposure and sunburn are skin cancer risk factors (T)	97.8	89.0	93.4
K7. Sudden change in colour or size with itching or bleeding needs a dermatologist (T)	100.0	89.0	94.5
K8. Sunscreen can reduce the risk of skin cancer (T)	97.8	54.9	76.5
K9. Large congenital moles need closer attention (T)	83.7	75.8	79.8
K10. Routine mole checks help detect problems early (T)	96.7	56.0	76.5
Attitude			
A1. Have received education about moles on campus	77.2	4.4	41.0
A2. Knowing the moles on my body is very important	95.7	57.1	76.5
A3. Knowing the warning signs of moles is very important	98.9	68.1	83.6
A4. Daily sunscreen is important to prevent new moles	82.6	36.3	59.6
A5. Willing to see a doctor if a mole changes	98.9	86.8	92.9
A6. Would feel worried if a mole changed in shape or size	94.6	45.1	69.9

A7. Moles have a special meaning that affects my life†	40.2	73.6	56.8
A8. Moles must be removed to prevent malignancy†	59.8	79.1	69.4
A9. Self-examination can help detect skin cancer early	96.7	42.9	69.9
A10. Education campaigns about moles should be increased	100.0	42.9	71.6
Behaviour			
B1. Examined all the moles on my body	53.3	16.5	35.0
B2. Routinely monitored moles for changes in size or colour	73.9	6.6	40.4
B3. Used sunscreen when outdoors	87.0	78.0	82.5
B4. Avoided the sun at peak hours (10:00–16:00)	85.9	90.1	88.0
B5. Wore protective clothing (hat, long sleeves)	90.2	100.0	95.1
B6. Consulted a health professional about a mole	33.7	3.3	18.6
B7. Tried home remedies for a changing mole†	80.4	94.5	87.4
B8. Considered or underwent mole removal for aesthetic or medical reasons‡	32.6	5.5	19.1
B9. Reapplied sunscreen every 2–3 hours outdoors	60.9	39.6	50.3
B10. Maintained skin hygiene and routine skin care	92.4	76.9	84.7

Values are percentages giving the desirable response: correct answer for knowledge (T, true; F, false), agreement for attitude, and "ever" for behaviour unless marked. †Reverse-scored item (desirable response: false, disagree, or never, respectively). ‡Direction ambiguous; keyed "ever" and examined in a sensitivity analysis.

Knowledge was strongly correlated with attitude ($\rho = 0.71$; $p < 0.001$) and moderately with behaviour ($\rho = 0.49$; $p < 0.001$), and attitude correlated with behaviour ($\rho = 0.46$; $p < 0.001$). A good attitude was found in 74.5% of students with good knowledge, compared with 15.2% and 7.4% of those with moderate and poor knowledge ($\chi^2(4) = 89.17$; $p < 0.001$; $V = 0.49$). Good behaviour was found in 40.9% of students with good knowledge, 6.5% with moderate knowledge, and none with poor knowledge ($\chi^2(4) = 45.79$; $p < 0.001$; $V = 0.35$), although 29.1% of students with good knowledge still showed poor behaviour (Table 4).

In the multivariable models (Table 5), good knowledge remained associated with a good attitude after adjustment for faculty cluster, age, and sex (adjusted OR 3.62; 95% CI 1.12–11.68; $p = 0.031$), and the health-sciences cluster showed the strongest independent association (adjusted OR 13.52; 95% CI 5.10–35.86). The attitude model fitted well (likelihood-ratio $\chi^2(4) = 126.42$; Nagelkerke $R^2 = 0.665$; Hosmer–Lemeshow $p = 0.63$). For good behaviour, the crude association with good knowledge (OR 16.15; 95% CI 4.79–54.53) attenuated after adjustment (adjusted OR 4.02; 95% CI 0.98–16.43; $p = 0.053$), whereas the health-sciences cluster remained associated (adjusted OR 5.92; 95% CI 1.93–18.18). Age and sex were not independently associated with either outcome. The behaviour model explained a moderate share of variation (Nagelkerke $R^2 = 0.381$), but its Hosmer–Lemeshow test indicated imperfect calibration ($p = 0.015$).

Table 4.
Attitude and behaviour categories according to knowledge category

Knowledge category	Poor n (%)	Moderate n (%)	Good n (%)	Total
Attitude				
Poor knowledge	21 (77.8)	4 (14.8)	2 (7.4)	27
Moderate knowledge	27 (58.7)	12 (26.1)	7 (15.2)	46
Good knowledge	7 (6.4)	21 (19.1)	82 (74.5)	110
Behaviour				
Poor knowledge	21 (77.8)	6 (22.2)	0 (0.0)	27
Moderate knowledge	35 (76.1)	8 (17.4)	3 (6.5)	46
Good knowledge	32 (29.1)	33 (30.0)	45 (40.9)	110

Row percentages. Attitude: $\chi^2(4) = 89.17$, $p < 0.001$, Cramér's $V = 0.49$; Spearman ρ between scores = 0.71. Behaviour: $\chi^2(4) = 45.79$, $p < 0.001$, Cramér's $V = 0.35$; $\rho = 0.49$. All expected counts ≥5.

In sensitivity analyses, each one-point increase in knowledge score was associated with higher odds of a good attitude (adjusted OR 1.62; 95% CI 1.11–2.36) but not clearly with good behaviour (adjusted OR 1.40; 95% CI 0.96–2.04), and both of these models showed adequate calibration (Hosmer–Lemeshow $p = 0.38$ and 0.21). When the directionally ambiguous behaviour item 8 was

excluded, good knowledge was associated with good behaviour (adjusted OR 6.65; 95% CI 1.67–26.39), the association with the health-sciences cluster weakened (adjusted OR 3.16; 95% CI 1.22–8.22), and female sex became associated with good behaviour (adjusted OR 4.39; 95% CI 1.89–10.19).

Table 5.
Logistic regression of good attitude and good behaviour

Variable	Crude OR (95% CI)	Adjusted OR (95% CI)	p (adjusted)
Good attitude (events 91/183)			
Good knowledge (vs moderate/poor)	20.83 (9.18–47.24)	3.62 (1.12–11.68)	0.031
Health-sciences cluster (vs non-health)	40.01 (17.20–93.07)	13.52 (5.10–35.86)	< 0.001
Age (per year)	2.23 (1.79–2.78)	1.21 (0.91–1.61)	0.190
Female sex (vs male)	9.25 (4.68–18.27)	2.12 (0.79–5.73)	0.138
Model fit		LR $\chi^2(4) = 126.42$; Nagelkerke $R^2 = 0.665$	HL p = 0.631
Good behaviour (events 48/183)			
Good knowledge (vs moderate/poor)	16.15 (4.79–54.53)	4.02 (0.98–16.43)	0.053
Health-sciences cluster (vs non-health)	15.09 (5.61–40.63)	5.92 (1.93–18.18)	0.002
Age (per year)	1.57 (1.29–1.92)	1.04 (0.80–1.36)	0.746
Female sex (vs male)	6.00 (2.85–12.64)	2.06 (0.87–4.84)	0.099
Model fit		LR $\chi^2(4) = 55.22$; Nagelkerke $R^2 = 0.381$	HL p = 0.015

Adjusted models include all four variables simultaneously. OR, odds ratio; CI, confidence interval (Wald); LR, likelihood ratio; HL, Hosmer–Lemeshow goodness-of-fit test. Variance inflation factors ≤2.16.

DISCUSSION

In this sample, most students had good mole-related knowledge and about half had a good attitude, but only about a quarter reported good protective behaviour. The proportion with good knowledge (60.1%) was higher than that reported among adults in Semarang (Riyanto et al., 2025) and far higher than the proportion with high melanoma literacy in the general US population (Leachman et al., 2023), although differences in instruments and cut-off points limit direct comparison. The large knowledge gap between clusters is consistent with studies from Indonesia and Peru (Chavez et al., 2025; Roren et al., 2022). Within the PRECEDE-PROCEED framework, knowledge is a predisposing factor acquired largely through curricular exposure, which non-health students do not receive formally (Ghaffari et al., 2021). Only about one-third of non-health students recognised that a mole can become melanoma, and only about half recognised the value of sunscreen and routine mole checks; because Asian patients tend to present with thicker melanomas, these gaps are a priority for education (Long et al., 2023; Nadelmann et al., 2025).

The attitude gap between clusters was the largest of the three domains, in contrast with the absence of an attitude difference in photoprotection reported by Chavez et al. (2025). Our attitude items were naevus-specific and included prior exposure to mole education on campus, which was reported by 77.2% of health-sciences students but only 4.4% of non-health students. The scale therefore partly measures educational exposure, and together with its modest internal consistency this calls for cautious interpretation (Taber, 2018). Health-sciences students were also less likely to reject the statements that moles carry a special personal meaning and that moles must be removed to prevent malignancy; the latter may reflect clinical exposure to excision as a diagnostic procedure or ambiguous wording, and both items should be revised.

Behaviour was the weakest domain, consistent with the low practice reported among Indonesian students (Roren et al., 2022) and with suboptimal sunscreen use despite good knowledge in Pakistan

and Lebanon (Afiouni et al., 2024; Shahzad et al., 2022). The lower proportion than in Semarang (Riyanto et al., 2025) may partly reflect that study's Likert scale and mean-based cut-off. The item-level analysis reconciles our findings with those of Chavez et al. (2025): general sun-protection behaviours were similar between clusters, and non-health students even more often avoided peak-hour sun and wore protective clothing. The gap appeared only in mole-specific behaviours, namely self-examination, monitoring of changes, and consultation, which are more likely to be taught in health-sciences curricula. Even among health-sciences students, only about half had examined all their moles, which is consistent with the low confidence in self-examination reported by Leachman et al. (2023).

Knowledge was strongly associated with attitude and moderately with behaviour in unadjusted analyses. After adjustment, the association with attitude persisted, whereas the association with behaviour attenuated and its confidence interval included the null. Much of the crude knowledge–behaviour association therefore appears to be shared with faculty cluster, which in this sample is closely related to knowledge and may also capture skills, clinical exposure, and peer norms, corresponding to enabling and reinforcing factors that were not measured directly (Ghaffari et al., 2021). This agrees with the association between photoprotection knowledge and behaviour reported by Roren et al. (2022) and differs from Riyanto et al. (2025), whose sample of 40 adults may have lacked statistical power. Because the behaviour estimate changed when the directionally ambiguous removal item was excluded and the main behaviour model was imperfectly calibrated, it should be regarded as uncertain, and none of these associations can be interpreted causally (Savitz & Wellenius, 2023).

These findings support skin health education for students outside the health sciences, delivered through orientation programmes or general education courses. Because the gap lies in mole-specific surveillance rather than general sun protection, programmes should include hands-on training in skin self-examination using the ABCDE criteria, which may build the confidence linked to self-examination, and could use health-sciences students as peer educators (Leachman et al., 2023; Long et al., 2023). Messages should also state explicitly that melanoma occurs in people with skin of colour (Nadelmann et al., 2025).

This study has several limitations. Convenience sampling through WhatsApp groups and social media may have introduced self-selection bias (Andrade, 2021), and the achieved sample of 183 fell short of the planned 396, giving a margin of error of about ±7.2%. Medicine and Engineering students made up 82.0% of the sample, and the clusters differed in age and sex, so residual confounding is likely despite adjustment. All data were self-reported, the scales had modest internal consistency (KR-20 0.60–0.68), content validity was assessed qualitatively by a single expert, some items had ambiguous direction, ethical review was sought after data collection, and the cross-sectional design precludes causal inference.

CONCLUSION

Most undergraduate students in this sample had good knowledge of moles and about half had a good attitude, but only about a quarter reported good protective behaviour. Health-sciences students scored higher than non-health students in all domains, with the largest gap in attitude and a behavioural gap confined to mole-specific surveillance rather than general sun protection. Knowledge was independently associated with attitude, but its adjusted association with behaviour was uncertain, suggesting that knowledge is necessary but not sufficient for protective behaviour. Universities should provide non-health students with skin health education that combines information on melanoma warning signs with practical training in skin self-examination.

DECLARATIONS

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