Research Square

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

# Latent profiles of artificial intelligence ethical awareness and their association with professional identity among nursing interns: A multicentre cross-sectional study

**Zhenni Xie**
The First Affiliated Hospital of Anhui Medical University
**Dan Tong**
The First Affiliated Hospital of Anhui Medical University
**Xiaoxia Shen**
ICU Ward, The First Affiliated Hospital of Anhui Medical University
**Xinxin Xie**
The First Affiliated Hospital of Anhui Medical University
**Chenxia Liao**
The First Affiliated Hospital of Anhui Medical University
**Xiaoyun Zhao**
The First Affiliated Hospital of Anhui Medical University
**Ruiqi Wang**
The First Affiliated Hospital of Anhui Medical University
**Jiangying Han**
yfy2845690@fy.ahmu.edu.cn

The First Affiliated Hospital of Anhui Medical University

**Research Article**

**Keywords:** AI ethical awareness, professional identity, nursing interns, latent profile analysis, nursing education

**Posted Date:** November 17th, 2026

**DOI:** https://doi.org/10.21203/rs.3.rs-11356999/v1

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

**Additional Declarations:** No competing interests reported.

## Abstract

Background: As artificial intelligence (AI) becomes increasingly integrated into nursing education and clinical practice, nursing interns need to recognise and address ethical issues associated with its use. However, heterogeneity in their AI ethical awareness remains poorly understood. This study aimed to identify latent profiles of AI ethical awareness among nursing interns, examine factors associated with profile membership, and compare professional identity across profiles.

Methods: A multicentre cross-sectional study was conducted among 550 nursing interns from 12 hospitals in China between September and October 2026. Data were collected on sociodemographic characteristics, AI ethical awareness, attitudes towards AI use in nursing, ethical sensitivity, and professional identity. Latent profile analysis was performed using the mean scores of six AI ethical awareness domains. Profile characteristics were compared using chi-square tests and Welch's analysis of variance. Factors associated with profile membership were examined using R3STEP multinomial logistic regression, while differences in professional identity were assessed using the Bolck–Croon–Hagenaars method.

Results: Three profiles were identified: consistently low awareness (C1; n = 152, 27.6%), autonomy–education salient (C2; n = 232, 42.2%), and consistently high awareness (C3; n = 166, 30.2%). The three-profile model demonstrated the lowest AIC, BIC, and sample-size-adjusted BIC, with an entropy of 0.876. Educational level, prior AI-related education, AI familiarity, AI tool-use frequency, attitudes towards AI use in nursing, and ethical sensitivity were associated with profile membership in at least one pairwise comparison ($p < 0.05$). Attitudes towards AI use in nursing and ethical sensitivity were associated with all three pairwise comparisons. Professional identity scores were lowest in C1 (59.06 ± 7.77), intermediate in C2 (61.15 ± 8.14), and highest in C3 (63.33 ± 7.89). Significant differences were observed across profiles (Wald $\chi^2 = 23.739$, $p < 0.001$), with all pairwise comparisons remaining significant after Holm adjustment.

Conclusions: A one-size-fits-all approach to AI ethics education may not adequately address nursing interns' diverse learning needs. Nursing educators could consider tailored educational strategies that emphasise critical evaluation of AI-generated information and ethical issues related to transparency, accountability, and algorithmic fairness. Further longitudinal research is warranted to clarify the relationship between AI ethical awareness and professional identity.

Clinical trial number: Not applicable.


## 1. Introduction

Artificial intelligence (AI) is increasingly used in clinical risk prediction, decision support, health monitoring, and documentation, reshaping how information is used in healthcare (1). Its growing use raises ethical concerns regarding the reliability of AI-generated information, patient privacy, informed consent, algorithmic fairness, and accountability for clinical decisions (2–4). The World Health Organization has identified autonomy, safety, transparency, accountability, and equity as core principles for the ethical use of AI in healthcare (5). These concerns are particularly relevant to nursing interns, who are transitioning from classroom learning to supervised patient care. During clinical placements, students begin to apply ethical principles to decisions involving patient rights, safety, and professional responsibilities (6). Nursing ethical awareness involves recognising the ethical dimensions of nursing care, remaining sensitive to ethical concerns, and exercising ethical judgement in practice (7). As AI becomes integrated into nursing care, this awareness extends beyond established principles of respect, autonomy, confidentiality, and safety to emerging concerns involving algorithmic transparency, data governance, bias, professional accountability, and sustainable AI use.

However, AI ethical awareness may not be uniform across different ethical concerns. Nursing interns may readily recognise issues involving patient privacy and autonomy while being less attentive to the transparency, accountability, or fairness of AI-supported decisions. Such differences may be obscured when AI ethical awareness is assessed using an overall score. Latent profile analysis (LPA), a person-centred approach, can identify subgroups characterised by distinct patterns across multiple continuous indicators (8). Previous research has demonstrated heterogeneity in nursing students'

AI literacy. Yang et al. identified three AI literacy profiles among nursing undergraduates, including a subgroup characterised by passive AI use and low ethical vigilance (9). However, previous research has primarily focused on general AI literacy rather than the patterns of AI ethical awareness itself. Whether nursing interns exhibit distinct configurations of AI ethical awareness remains unclear. Identifying these patterns may provide a more nuanced understanding of their ethical awareness and inform targeted AI ethics education.

Clinical internships are also a formative period for nursing professional identity. Through interactions with clinical role models and participation in patient care, nursing students gradually internalise the values, standards, and responsibilities of the nursing profession (10). The International Society for Professional Identity in Nursing identifies values and ethics as a core domain of nursing professional identity (11). As AI becomes integrated into nursing care, professional judgement and accountability remain essential to nurses' roles in technology-supported practice. Previous studies have explored the relationship between AI ethical awareness and professional development among nursing students. Won and Han found that AI ethical awareness was positively correlated with nursing professionalism (12), while Seo reported a positive correlation between AI ethical awareness and nursing professional values (13). However, whether nursing interns with distinct profiles of AI ethical awareness differ in professional identity remains unclear.

Therefore, we conducted a multicentre cross-sectional survey to identify latent profiles of AI ethical awareness among nursing interns and examine their associations with professional identity. By identifying distinct patterns of ethical awareness and their relationships with professional identity, this study aims to provide evidence for more targeted AI ethics education during the transition from classroom learning to clinical practice.

## 2. Methods

# 2.1. Study design

A multicentre cross-sectional survey of nursing interns was conducted across 12 hospitals in China. The study aimed to identify latent profiles of artificial intelligence (AI) ethical awareness, examine factors associated with profile membership, and compare professional identity across profiles. Reporting was guided by the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement (14).

# 2.2. Setting and participants

# 2.2.1. Participants

Nursing interns were recruited from 12 hospitals in China between September and October 2026 using convenience sampling. Eligibility criteria were: (1) current enrolment in a nursing programme; (2) participation in a clinical internship at a hospital for more than three months at the time of the survey; (3) ability to read, understand, and complete the questionnaire independently; and (4) informed, voluntary agreement to participate. Students who were not undertaking their normal clinical internship because of a leave of absence or prolonged absence were excluded.

# 2.2.2. Sample size considerations

According to Kendall’s sample size estimation method (15), the required sample size should be 5–10 times the number of variables. Based on the 66 variables considered in the study and allowing for a 20% invalid-response rate, the estimated sample size was 413–825 participants. Ferguson et al. (16) suggested a sample size of approximately 300–500 participants for latent profile analysis. Ultimately, 550 valid responses were included in the analysis, meeting the estimated sample size requirement.

# 2.3. Measures

# 2.3.1. Demographic questionnaire

A questionnaire developed by the research team on the basis of the study aims and previous literature collected demographic characteristics, clinical learning background, and exposure to AI. Variables included age, sex, educational level, internship duration, prior AI-related education, AI familiarity, and frequency of AI tool use during the preceding three months.

## 2.3.2. AI ethical awareness measure

AI ethical awareness was assessed using the Chinese version of the Nurse Artificial Intelligence Ethical Awareness Scale (NAIEAS), originally developed by El-Sayed et al. (17) and translated and validated by Tang et al. (18). The Chinese version comprises 21 items across six domains: data privacy and confidentiality (4 items), informed consent and autonomy (3 items), transparency and accountability (4 items), bias and fairness (3 items), safety and professional integrity (4 items), and education and sustainability (3 items). Each item was scored on a five-point scale ranging from 1 to 5, with higher scores indicating greater self-reported AI ethical awareness. The total score was calculated by summing all 21 items, yielding a possible range of 21–105, while domain mean scores were calculated separately, each ranging from 1 to 5. As the Chinese version was originally validated among clinical nurses, its applicability to nursing interns was assessed through the pilot survey and measurement assessment in the study sample. In the present study, Cronbach's α was 0.938 for the overall scale and ranged from 0.765 to 0.893 across its six domains. Confirmatory factor analysis (CFA) using the weighted least squares mean and variance adjusted (WLSMV) estimator demonstrated good fit for the correlated six-factor model ($\chi^2 = 380.039$, $df = 174$, $\chi^2/df = 2.184$, CFI = 0.988, TLI = 0.985, RMSEA = 0.046, SRMR = 0.032). Discriminant validity was assessed using the heterotrait–monotrait ratio (HTMT); the highest HTMT between domains was 0.798.

## 2.3.3. Professional Identity Questionnaire for Nursing Students

Professional identity was measured with the Professional Identity Questionnaire for Nursing Students (PIQNS) developed by Hao et al. (19). Widely used in Chinese nursing education, the 17-item questionnaire comprises five dimensions: professional self-concept, benefits of remaining in and risks of leaving nursing, social comparison and self-reflection, autonomy in career choice, and social persuasion. Items are rated from 1 (strongly disagree) to 5 (strongly agree); item 12 is reverse-scored. Summed scores range from 17 to 85, with higher scores indicating stronger professional identity. The original questionnaire had a Cronbach's α of 0.827; α was 0.891 in the present study.

## 2.3.4. Attitudes towards the use of AI technologies in nursing

Attitudes towards the use of AI technologies in nursing were assessed using the Chinese version of the Attitude Scale towards the Use of Artificial Intelligence Technologies in Nursing (ASUAITIN-C), originally developed by Yılmaz et al. (20) and translated and validated by Hu et al. (21). The scale comprises 15 items across two dimensions: negative attitudes (items 1–6) and positive attitudes (items 7–15). Each item was scored on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The total score was calculated by summing the 15 original item responses without reversing the negative items, yielding a possible range of 15–75. Negative and positive attitude subscale scores range from 6 to 30 and 9 to 45, respectively; higher scores indicate stronger negative and positive attitudes, respectively. As the Chinese version was originally validated among clinical nurses, its applicability to nursing interns was assessed through the pilot survey and measurement assessment in the study sample. The Chinese validation study reported an overall Cronbach's α of 0.785. In the present study, Cronbach's α was 0.858 for the overall scale and 0.867 and 0.902 for the negative and positive attitude dimensions, respectively. Confirmatory factor analysis (CFA) using maximum likelihood estimation demonstrated good fit for the correlated two-factor model ($\chi^2 = 192.674$, $df = 89$, $\chi^2/df = 2.165$, GFI = 0.954, CFI = 0.972, TLI = 0.967, RMSEA = 0.046, SRMR = 0.033). A sensitivity analysis using the WLSMV estimator for ordinal responses yielded similarly favourable fit indices ($\chi^2/df = 1.854$, CFI = 0.989, TLI = 0.987, RMSEA = 0.039, SRMR = 0.031).

## 2.3.5. Ethical sensitivity

Ethical sensitivity was assessed using the Ethical Sensitivity Questionnaire for Nursing Students (ESQ-NS), developed by Muramatsu et al. (22) and adapted into Chinese by Yu et al. (23). The 13-item questionnaire assesses nursing students'

ability to identify and judge ethical issues in nursing practice. The Chinese version comprises four dimensions: respect for individuals (four items), reasonable care (four items), distributive justice (three items), and maintaining patients' confidentiality (two items). Items are rated on a 4-point Likert scale ranging from 1 to 4. Total scores range from 13 to 52, with higher scores indicating greater ethical sensitivity. Cronbach's α was 0.886 in the present study.

## 2.4. Data collection and quality control

Data were collected using an anonymous, self-administered electronic questionnaire. Before formal data collection, a pilot survey was conducted among 15 nursing interns to assess the clarity of item wording, questionnaire logic, and completion time, and to identify any practical problems in the survey process. Minor adjustments were made where necessary based on their feedback. Data from these 15 interns were not included in the final analysis.

Before the formal survey, the principal investigator trained researchers at each centre on the study aims, eligibility criteria, consent process, questionnaire instructions, distribution procedures, and quality-control rules to promote consistent implementation. Eligible students received information about the study purpose, procedures, voluntary participation, and data protection. Those who provided informed consent completed the questionnaire independently through Wenjuanxing, a Chinese online survey platform. The survey did not request names, student identification numbers, telephone numbers, or other direct identifiers. Students were informed that participation and their responses would not affect internship grades, supervisor assessments, or other evaluations, to reduce social desirability bias.

Key questions were set as mandatory. Submitted questionnaires were screened according to prespecified quality-control criteria and excluded if they: (1) were completed in less than 1 minute; (2) showed long strings of identical responses or an obvious response pattern; or (3) contained clear logical inconsistencies. Two researchers independently checked the retained data and coded the variables, and any disagreements were resolved through re-examination and discussion.

## 2.5. Ethical considerations

The study was approved by the ethics committee of the First Affiliated Hospital of Anhui Medical University (approval no. KY2026-10-81). Before participation, students were informed of the study purpose, procedures, possible benefits, data use, and privacy safeguards, and provided informed consent. Participation was voluntary, and students could withdraw before submitting the questionnaire without adverse consequences. Data were collected anonymously without direct personal identifiers, used only for research, and stored and managed by the study team. The study followed the principles of the Declaration of Helsinki.

## 2.6. Statistical analysis

Data were analysed using Python 3.12.10 and Mplus 8.3. Approximately normally distributed continuous variables were described using means and standard deviations. Categorical variables were described using frequencies and percentages [n (%)]. Internal consistency was assessed using Cronbach's α. A correlated six-factor CFA of the NAIEAS was conducted using the weighted least squares mean and variance adjusted (WLSMV) estimator with theta parameterisation for ordinal items, and discriminant validity was examined using heterotrait–monotrait ratios. A correlated two-factor CFA of the ASUAITIN-C was estimated using maximum likelihood, with an ordinal WLSMV model fitted as a sensitivity analysis. GFI was calculated in Python from the fitted covariance matrix of the maximum likelihood model; the remaining fit indices were obtained from Mplus.

Latent profile analysis (LPA) was used to identify profiles of AI ethical awareness among nursing interns. The mean item scores for data privacy and confidentiality, informed consent and autonomy, transparency and accountability, bias and fairness, safety and professional integrity, and education and sustainability were entered as continuous indicators. Models were fitted sequentially, beginning with a one-profile model and increasing the number of profiles up to five. Parameters were estimated using robust maximum likelihood. The within-profile variances and covariances of the indicators were estimated and constrained to be equal across profiles. We specified 500 random initial starts, retained 125 for final

optimisation, and set the maximum number of initial-stage iterations to 20. Models with three to five profiles were additionally fitted using 1,000 random initial starts and 250 final optimisations to verify replication of the best log-likelihood. The bootstrap likelihood ratio test used 199 bootstrap samples.

Model fit was assessed using the Akaike information criterion (AIC), Bayesian information criterion (BIC), sample-size-adjusted BIC (aBIC), entropy, the Lo–Mendell–Rubin adjusted likelihood ratio test (LMR-LRT), and the bootstrap likelihood ratio test (BLRT). Lower AIC, BIC, and aBIC values indicate better fit, while entropy values closer to 1 indicate clearer classification. For the LMR-LRT and BLRT, $p < 0.05$ indicates that a k-profile model fits better than a (k − 1)-profile model. The final model was selected by considering fit indices, profile sizes, parsimony, and theoretical interpretability. After selecting the final model, each participant's most likely profile was identified based on the highest posterior probability. Profiles were named according to the relative patterns of mean scores across the six AI ethical awareness domains.

Chi-square tests were used to compare categorical characteristics across profiles, and Welch's analysis of variance was used for continuous variables.

Following selection of the final profile model, variables with $p < 0.05$ in univariable analyses were included in the multivariable analysis. Categorical variables were dummy-coded, and ASUAITIN-C total and ethical sensitivity total scores were standardised before modelling. After assessing multicollinearity using tolerance and variance inflation factors, multinomial logistic regression was conducted using the R3STEP method, which accounts for uncertainty in profile classification. Pairwise comparisons between the identified profiles were reported as odds ratios (ORs), 95% confidence intervals (CIs), and *p* values. An exploratory R3STEP model replaced the ASUAITIN-C total score with its standardised negative and positive attitude subscale scores, retaining the other predictors. Common method bias was preliminarily assessed using Harman's single-factor test (24). All 66 scored items across the four measures—the NAIEAS, PIQNS, ASUAITIN-C, and ESQ-NS—were entered simultaneously into an unrotated principal component analysis of the correlation matrix. The number of components with eigenvalues greater than 1 and the proportion of variance explained by the first component were recorded.

The Bolck–Croon–Hagenaars (BCH) method was used to compare total professional identity scores across profiles. This method accounts for profile-classification error while preserving the selected latent profile model. An overall Wald $\chi^2$ test was performed first; if significant, pairwise comparisons were conducted with Holm-adjusted *p* values. Profile sizes and means ± standard deviations calculated from maximum-posterior-probability assignments were provided for description, whereas between-profile inferences were based on BCH estimates. The significance level was set at $\alpha = 0.05$.

## 3. Results

# 3.1. Common method bias

Harman's single-factor test included the 66 scored items from the four questionnaires: AI ethical awareness, attitudes towards AI use in nursing, ethical sensitivity, and professional identity. Unrotated principal component analysis of the standardised items identified nine components with eigenvalues greater than 1. The first component explained 16.26% of the total variance. No single component dominated the item variance, although shared method effects cannot be excluded on the basis of this diagnostic alone.

# 3.2. Participant characteristics

A total of 581 questionnaires were returned. Of these, 31 were excluded according to prespecified quality-control criteria: 7 were completed in less than 1 minute, 12 had identical or clearly patterned responses, and 12 contained logical inconsistencies. The final sample comprised 550 valid responses (valid-response rate, 94.7%). There were 482 women (87.6%) and 68 men (12.4%). Most participants were aged 21–22 years (n = 299, 54.4%) and were enrolled in bachelor's-

level nursing programmes (n = 367, 66.7%). The majority of nursing interns (n = 360, 65.5%) had an internship duration of > 6 to ≤ 9 months. Overall, 241 participants (43.8%) reported prior AI-related education.

Regarding AI familiarity, 262 participants (47.6%) understood general AI concepts and 175 (31.8%) were familiar with basic principles and common applications. During the preceding three months, 205 (37.3%) had used AI tools occasionally, 169 (30.7%) regularly, 93 (16.9%) frequently, and 83 (15.1%) had not used them (Table 1).

Table 1
Participant characteristics (N = 550)

| Variable | Category | n | % |
|---|---|---|---|
| Sex | Male | 68 | 12.4 |
| | Female | 482 | 87.6 |
| Age | ≤ 20 years | 130 | 23.6 |
| | 21–22 years | 299 | 54.4 |
| | 23–24 years | 98 | 17.8 |
| | ≥ 25 years | 23 | 4.2 |
| Internship duration | > 3 to ≤ 6 months | 85 | 15.5 |
| | > 6 to ≤ 9 months | 360 | 65.5 |
| | > 9 months | 105 | 19.1 |
| Educational level | Associate degree | 150 | 27.3 |
| | Bachelor's degree | 367 | 66.7 |
| | Master's degree | 33 | 6.0 |
| Prior AI-related education | Yes | 241 | 43.8 |
| | No | 309 | 56.2 |
| AI familiarity | Heard of AI; little knowledge | 113 | 20.5 |
| | Understands general concepts | 262 | 47.6 |
| | Familiar with basic principles and common applications | 175 | 31.8 |
| AI tool use in the past 3 months | Never | 83 | 15.1 |
| | Occasionally (< 1 time/week) | 205 | 37.3 |
| | Regularly (1–3 times/week) | 169 | 30.7 |
| | Frequently (≥ 4 times/week) | 93 | 16.9 |

## 3.3. Descriptive statistics for the main study variables

The mean AI ethical awareness total score was 67.15 ± 13.40, and the mean item score was 3.20 ± 0.64. Mean domain scores were 3.16 ± 0.81 for data privacy and confidentiality, 3.50 ± 0.81 for informed consent and autonomy, 2.98 ± 0.80 for transparency and accountability, 2.99 ± 0.78 for bias and fairness, 3.10 ± 0.87 for safety and professional integrity, and 3.58 ± 0.79 for education and sustainability. Education and sustainability had the highest mean score, whereas transparency and accountability had the lowest. Mean total scores were 47.91 ± 8.57 for ASUAITIN-C, 37.22 ± 5.84 for ethical sensitivity, and 61.23 ± 8.11 for professional identity. Mean negative and positive attitude subscale scores were

15.14 ± 4.63 and 32.77 ± 6.62, respectively. Among the professional identity dimensions, social comparison and self-reflection had the highest mean item score (3.64 ± 0.60), while autonomy in career choice had the lowest (3.53 ± 0.65).

## 3.4. Latent profiles of AI ethical awareness

### 3.4.1. Model fit

One- to five-profile models were fitted using the same common within-profile covariance specification (Table 2). AIC, BIC, and aBIC decreased from the one-profile to the three-profile model. The three-profile model had the lowest AIC (6117.000), BIC (6293.707), and aBIC (6163.555) among the fitted models. Compared with the two-profile solution, the respective reductions were 157.247, 127.077, and 149.299. Both the LMR-LRT and BLRT supported the addition of a third profile.

The three-profile model had an entropy of 0.876. Profile-specific mean posterior probabilities ranged from 0.928 to 0.964, and the profiles comprised 27.6%, 42.2%, and 30.2% of the sample.

For the four-profile model, neither the LMR-LRT ($p = 0.7210$) nor the BLRT ($p = 0.6884$) indicated a significant improvement over the three-profile model. The five-profile model also showed no significant improvement over the four-profile model according to the LMR-LRT ($p = 0.4717$) or BLRT ($p = 0.6482$). The four-profile solution included a profile containing nine participants (1.6%), while the five-profile solution included profiles containing nine and ten participants (1.6% and 1.8%, respectively).

Although entropy was higher in the two- and four-profile models, these models did not provide the lowest information criteria. The AIC differences between the three-profile and four- and five-profile models were small (1.004 and 1.088, respectively). Considering the information criteria, likelihood ratio tests, classification quality, profile sizes, and interpretability, the three-profile model was selected. Its ranking remained unchanged when random starts were increased for the three- to five-profile models.

Table 2
Fit statistics for latent profile models of AI ethical awareness

| Profiles | Log likelihood | AIC | BIC | aBIC | Entropy | LMR-LRT *p* | BLRT *p* | Profile proportions (%) |
|---|---|---|---|---|---|---|---|---|
| 1 | −3186.475 | 6426.950 | 6543.318 | 6457.609 | — | — | — | 100 |
| 2 | −3103.123 | 6274.247 | 6420.784 | 6312.854 | 0.902 | < 0.001 | < 0.010 | 69.6/30.4 |
| 3 | −3017.500 | 6117.000 | 6293.707 | 6163.555 | 0.876 | < 0.001 | < 0.010 | 27.6/42.2/30.2 |
| 4 | −3011.002 | 6118.004 | 6324.880 | 6172.508 | 0.891 | 0.7210 | 0.6884 | 42.0/1.6/26.9/29.5 |
| 5 | −3004.044 | 6118.088 | 6355.133 | 6180.540 | 0.872 | 0.4717 | 0.6482 | 26.9/40.2/1.6/29.5/1.8 |

Note: Each likelihood ratio test compares the specified model with a model containing one fewer profile. BLRT analyses completed 199 successful bootstrap draws; software outputs of 0.0000 are reported as $p < 0.010$. Proportions are based on most likely profile assignment.

### 3.4.2. Profile names and characteristics

The three latent profiles were labelled according to their overall levels and relative patterns across the six AI ethical awareness domains.

The consistently low awareness profile (C1; n = 152, 27.6%) exhibited consistently lower scores across all six domains, with mean scores ranging from 2.31 for safety and professional integrity to 2.66 for education and sustainability.

The autonomy–education salient profile (C2; n = 232, 42.2%) was the largest group and displayed a distinct pattern, characterised by higher scores in informed consent and autonomy (3.82 ± 0.51) and education and sustainability (3.92 ± 0.54), but lower scores in transparency and accountability (2.63 ± 0.47) and bias and fairness (2.76 ± 0.55). Data privacy and confidentiality and safety and professional integrity showed intermediate scores within this profile.

The consistently high awareness profile (C3; n = 166, 30.2%) exhibited consistently higher scores across all six domains, with mean scores ranging from 3.80 for bias and fairness to 4.06 for safety and professional integrity (Table 3 and Fig. 1).

Table 3
AI ethical awareness domain scores across latent profiles

| Profile | n (%) | DPC | CA | TA | BF | SPI | ES | Mean posterior probability |
|---|---|---|---|---|---|---|---|---|
| C1 | 152 (27.6) | 2.32 ± 0.51 | 2.48 ± 0.51 | 2.45 ± 0.54 | 2.45 ± 0.56 | 2.31 ± 0.52 | 2.66 ± 0.52 | 0.954 |
| C2 | 232 (42.2) | 3.09 ± 0.49 | 3.82 ± 0.51 | 2.63 ± 0.47 | 2.76 ± 0.55 | 2.94 ± 0.57 | 3.92 ± 0.54 | 0.928 |
| C3 | 166 (30.2) | 4.01 ± 0.47 | 3.98 ± 0.50 | 3.95 ± 0.45 | 3.80 ± 0.55 | 4.06 ± 0.50 | 3.95 ± 0.57 | 0.964 |

Note: Values are mean ± SD of domain mean item scores based on most likely profile assignment. C1, consistently low awareness profile; C2, autonomy–education salient profile; C3, consistently high awareness profile. DPC, data privacy and confidentiality; CA, informed consent and autonomy; TA, transparency and accountability; BF, bias and fairness; SPI, safety and professional integrity; ES, education and sustainability.

## 3.5. Univariable comparisons across latent profiles

Educational level, prior AI-related education, AI familiarity, and frequency of AI tool use differed significantly across profiles (all $p < 0.05$). Descriptively, C3 had higher proportions of bachelor's- and master's-level education, prior AI-related education, familiarity with basic AI principles and applications, and frequent AI tool use than C1. Sex, age, and internship duration did not differ significantly across profiles (all $p > 0.05$).

Mean ASUAITIN-C total scores were 45.51 ± 8.68, 47.92 ± 8.32, and 50.11 ± 8.25 in C1, C2, and C3, respectively (Welch $F(2, 336.75) = 11.702$, $p < 0.001$). Mean ethical sensitivity scores were 35.71 ± 6.19, 37.05 ± 5.39, and 38.86 ± 5.73, respectively (Welch $F(2, 328.94) = 11.343$, $p < 0.001$) (Table 4).

Table 4
Characteristics and related scale scores across AI ethical awareness profiles

| Variable | Category | C1 (n = 152) | C2 (n = 232) | C3 (n = 166) | $\chi^2$ / *F* | *p* |
|---|---|---|---|---|---|---|
| Sex | Male | 17 (11.2) | 34 (14.7) | 17 (10.2) | 2.01 | 0.366 |
| | Female | 135 (88.8) | 198 (85.3) | 149 (89.8) | | |
| Age | ≤ 20 years | 39 (25.7) | 53 (22.8) | 38 (22.9) | 1.424 | 0.964 |
| | 21–22 years | 82 (53.9) | 128 (55.2) | 89 (53.6) | | |
| | 23–24 years | 26 (17.1) | 42 (18.1) | 30 (18.1) | | |
| | ≥ 25 years | 5 (3.3) | 9 (3.9) | 9 (5.4) | | |
| Educational level | Associate degree | 46 (30.3) | 71 (30.6) | 33 (19.9) | 12.02 | 0.017 |
| | Bachelor's degree | 102 (67.1) | 148 (63.8) | 117 (70.5) | | |
| | Master's degree | 4 (2.6) | 13 (5.6) | 16 (9.6) | | |
| Internship duration | > 3 to ≤ 6 months | 27 (17.8) | 37 (15.9) | 21 (12.7) | 7.149 | 0.128 |
| | > 6 to ≤ 9 months | 103 (67.8) | 154 (66.4) | 103 (62.0) | | |
| | > 9 months | 22 (14.5) | 41 (17.7) | 42 (25.3) | | |
| Prior AI-related education | Yes | 49 (32.2) | 95 (40.9) | 97 (58.4) | 23.462 | < 0.001 |
| | No | 103 (67.8) | 137 (59.1) | 69 (41.6) | | |
| AI familiarity | Heard of AI; little knowledge | 47 (30.9) | 48 (20.7) | 18 (10.8) | 30.624 | < 0.001 |
| | Understands general concepts | 75 (49.3) | 112 (48.3) | 75 (45.2) | | |
| | Familiar with basic principles and common applications | 30 (19.7) | 72 (31.0) | 73 (44.0) | | |
| AI tool use in the past 3 months | Never | 37 (24.3) | 36 (15.5) | 10 (6.0) | 36.926 | < 0.001 |
| | Occasionally | 61 (40.1) | 75 (32.3) | 69 (41.6) | | |
| | Regularly | 41 (27.0) | 83 (35.8) | 45 (27.1) | | |
| | Frequently | 13 (8.6) | 38 (16.4) | 42 (25.3) | | |
| ASUAITIN-C total score | | 45.51 ± 8.68 | 47.92 ± 8.32 | 50.11 ± 8.25 | 11.702 | < 0.001 |
| Ethical sensitivity score | | 35.71 ± 6.19 | 37.05 ± 5.39 | 38.86 ± 5.73 | 11.343 | < 0.001 |

Note: Percentages are calculated within profiles. Continuous scores are presented as means ± standard deviations and compared using Welch's analysis of variance. Categorical variables were compared using Pearson's chi-square tests. C1, consistently low awareness profile; C2, autonomy–education salient profile; C3, consistently high awareness profile.

## 3.6. Multivariable analysis of factors associated with latent profile membership

Six variables with $p < 0.05$ in the univariable analyses were entered into the R3STEP multinomial logistic regression model: educational level, prior AI-related education, AI familiarity, frequency of AI tool use, ASUAITIN-C total score, and ethical sensitivity. Categorical variables were dummy-coded, and ASUAITIN-C total and ethical sensitivity total scores were standardised before modelling. Variable coding is shown in Table 5.

Tolerance values ranged from 0.451 to 0.981, and variance inflation factors ranged from 1.019 to 2.219, indicating no marked multicollinearity. For each of the six variables, at least one corresponding coefficient was significant in a pairwise profile comparison, although the associations differed across contrasts (Table 6).

Compared with C1, membership in C2 was associated with familiarity with AI principles and applications (OR = 2.601, 95% CI: 1.297–5.216), regular AI tool use (OR = 2.519, 95% CI: 1.259–5.042), and frequent AI tool use (OR = 3.004, 95% CI: 1.170–7.712). Higher ASUAITIN-C total scores (OR = 1.404, 95% CI: 1.073–1.836) and ethical sensitivity scores (OR = 1.379, 95% CI: 1.062–1.789) were also associated with greater odds of C2 membership. Educational level, prior AI-related education, familiarity with general AI concepts, and occasional AI tool use were not significant in this contrast.

Compared with C1, membership in C3 was associated with bachelor's- or master's-level education, prior AI-related education, both higher levels of AI familiarity, and occasional, regular, or frequent AI tool use (all $p < 0.05$). Higher ASUAITIN-C total scores (OR = 1.966, 95% CI: 1.465–2.638) and ethical sensitivity scores (OR = 2.121, 95% CI: 1.587–2.835) were also associated with greater odds of C3 membership.

Compared with C2, membership in C3 was associated with bachelor's- or master's-level education, prior AI-related education, familiarity with AI principles and applications, and all three AI tool-use categories relative to never using AI. Higher ASUAITIN-C total scores (OR = 1.402, 95% CI: 1.108–1.774) and ethical sensitivity scores (OR = 1.539, 95% CI: 1.216–1.947) were also associated with greater odds of C3 membership. Familiarity with general AI concepts was not significant in this contrast ($p = 0.102$). In the exploratory subscale model, negative attitudes were associated with all three profile comparisons ($p = 0.015$, $< 0.001$, and 0.026 for C2 versus C1, C3 versus C1, and C3 versus C2, respectively). Positive attitudes were associated with C3 versus C1 ($p = 0.017$), but not C2 versus C1 ($p = 0.217$) or C3 versus C2 ($p = 0.131$).

Table 5
Variable coding

| Predictor | Coding |
|---|---|
| Educational level | Associate degree = (0, 0); bachelor's degree = (1, 0); master's degree = (0, 1) |
| Prior AI-related education | No = 0; yes = 1 |
| AI familiarity | Heard of AI = (0, 0); understands general concepts = (1, 0); familiar with principles and applications = (0, 1) |
| AI tool use in the past 3 months | Never = (0, 0, 0); occasionally = (1, 0, 0); regularly = (0, 1, 0); frequently = (0, 0, 1) |
| ASUAITIN-C total score | Continuous; total score standardised to a z-score |
| Ethical sensitivity score | Continuous; total score standardised to a z-score |

Table 6
Multivariable associations with AI ethical awareness profile membership

| Predictor | *B* | SE | Wald $\chi^2$ | *p* | OR | 95% CI |
|---|---|---|---|---|---|---|
| C2 vs C1 | | | | | | |
| Intercept | -0.734 | 0.420 | 3.045 | 0.081 | — | — |
| Bachelor's degree | 0.072 | 0.272 | 0.070 | 0.791 | 1.075 | 0.631–1.831 |
| Master's degree | 1.001 | 0.802 | 1.558 | 0.212 | 2.721 | 0.565–13.104 |
| Prior AI-related education: yes | 0.413 | 0.262 | 2.474 | 0.116 | 1.511 | 0.904–2.526 |
| AI familiarity: general concepts | 0.407 | 0.304 | 1.796 | 0.180 | 1.502 | 0.828–2.726 |
| AI familiarity: principles and applications | 0.956 | 0.355 | 7.252 | 0.007 | 2.601 | 1.297–5.216 |
| AI tool use: occasionally | 0.278 | 0.346 | 0.645 | 0.422 | 1.320 | 0.670–2.602 |
| AI tool use: regularly | 0.924 | 0.354 | 6.833 | 0.009 | 2.519 | 1.259–5.042 |
| AI tool use: frequently | 1.100 | 0.481 | 5.235 | 0.022 | 3.004 | 1.170–7.712 |
| ASUAITIN-C total (per SD) | 0.339 | 0.137 | 6.136 | 0.013 | 1.404 | 1.073–1.836 |
| Ethical sensitivity (per SD) | 0.321 | 0.133 | 5.837 | 0.016 | 1.379 | 1.062–1.789 |
| C3 vs C1 | | | | | | |
| Intercept | -3.821 | 0.570 | 44.877 | < 0.001 | — | — |
| Bachelor's degree | 0.728 | 0.321 | 5.157 | 0.023 | 2.071 | 1.104–3.885 |
| Master's degree | 2.066 | 0.834 | 6.145 | 0.013 | 7.893 | 1.539–40.473 |
| Prior AI-related education: yes | 1.152 | 0.285 | 16.338 | < 0.001 | 3.165 | 1.810–5.532 |
| AI familiarity: general concepts | 0.980 | 0.371 | 6.964 | 0.008 | 2.664 | 1.288–5.513 |
| AI familiarity: principles and applications | 1.931 | 0.405 | 22.696 | < 0.001 | 6.896 | 3.118–15.253 |
| AI tool use: occasionally | 1.692 | 0.476 | 12.645 | < 0.001 | 5.430 | 2.136–13.804 |
| AI tool use: regularly | 1.859 | 0.499 | 13.898 | < 0.001 | 6.417 | 2.413–17.065 |
| AI tool use: frequently | 2.599 | 0.573 | 20.612 | < 0.001 | 13.450 | 4.375–41.350 |
| ASUAITIN-C total (per SD) | 0.676 | 0.150 | 20.196 | < 0.001 | 1.966 | 1.465–2.638 |
| Ethical sensitivity (per SD) | 0.752 | 0.148 | 25.898 | < 0.001 | 2.121 | 1.587–2.835 |
| C3 vs C2 | | | | | | |
| Intercept | -3.088 | 0.549 | 31.618 | < 0.001 | — | — |
| Bachelor's degree | 0.656 | 0.278 | 5.555 | 0.018 | 1.927 | 1.118–3.323 |
| Master's degree | 1.065 | 0.522 | 4.170 | 0.041 | 2.901 | 1.043–8.070 |

Note: C1, consistently low awareness profile; C2, autonomy–education salient profile; C3, consistently high awareness profile. Reference categories: associate-degree education, no prior AI-related education, having only heard of AI, and never using AI tools. Continuous predictors were standardised; *B* is the log-odds coefficient per SD for these predictors. ORs and CIs were derived from rounded Mplus coefficients and SEs. Regression *p* values are unadjusted. OR, odds ratio; CI, confidence interval; SE, standard error; SD, standard deviation.

| Predictor | *B* | SE | Wald $\chi^2$ | *p* | OR | 95% CI |
|---|---|---|---|---|---|---|
| Prior AI-related education: yes | 0.740 | 0.239 | 9.548 | 0.002 | 2.096 | 1.312–3.348 |
| AI familiarity: general concepts | 0.573 | 0.351 | 2.667 | 0.102 | 1.774 | 0.891–3.529 |
| AI familiarity: principles and applications | 0.974 | 0.366 | 7.081 | 0.008 | 2.649 | 1.293–5.427 |
| AI tool use: occasionally | 1.414 | 0.462 | 9.388 | 0.002 | 4.112 | 1.663–10.171 |
| AI tool use: regularly | 0.935 | 0.472 | 3.932 | 0.047 | 2.547 | 1.010–6.425 |
| AI tool use: frequently | 1.499 | 0.490 | 9.370 | 0.002 | 4.477 | 1.714–11.698 |
| ASUAITIN-C total (per SD) | 0.338 | 0.120 | 7.958 | 0.005 | 1.402 | 1.108–1.774 |
| Ethical sensitivity (per SD) | 0.431 | 0.120 | 12.867 | < 0.001 | 1.539 | 1.216–1.947 |

Note: C1, consistently low awareness profile; C2, autonomy–education salient profile; C3, consistently high awareness profile. Reference categories: associate-degree education, no prior AI-related education, having only heard of AI, and never using AI tools. Continuous predictors were standardised; *B* is the log-odds coefficient per SD for these predictors. ORs and CIs were derived from rounded Mplus coefficients and SEs. Regression *p* values are unadjusted. OR, odds ratio; CI, confidence interval; SE, standard error; SD, standard deviation.

## 3.7. Professional identity across latent profiles

Mean professional identity scores were 59.06 ± 7.77 in C1, 61.15 ± 8.14 in C2, and 63.33 ± 7.89 in C3. The BCH overall test indicated a significant difference across profiles (Wald $\chi^2 = 23.739$, $p < 0.001$). After Holm adjustment, C2 scored higher than C1 ($p = 0.025$), and C3 scored higher than both C1 ($p < 0.001$) and C2 ($p = 0.025$) (Table 7).

Table 7
Professional identity scores across AI ethical awareness profiles and BCH comparisons

| Profile or comparison | n | Professional identity, mean ± SD | BCH mean (SE) | BCH mean difference (95% CI) | Wald $\chi^2$ | *p* |
|---|---|---|---|---|---|---|
| C1 | 152 | 59.06 ± 7.77 | 58.950 (0.660) | — | — | — |
| C2 | 232 | 61.15 ± 8.14 | 61.200 (0.577) | — | — | — |
| C3 | 166 | 63.33 ± 7.89 | 63.405 (0.634) | — | — | — |
| Overall comparison | — | — | — | — | 23.739 | < 0.001 |
| C2 vs C1 | — | — | — | 2.250 (0.451–4.049) | 6.007 | 0.025 |
| C3 vs C1 | — | — | — | 4.455 (2.662–6.248) | 23.706 | < 0.001 |
| C3 vs C2 | — | — | — | 2.205 (0.473–3.937) | 6.226 | 0.025 |

Note: C1, consistently low awareness profile; C2, autonomy–education salient profile; C3, consistently high awareness profile. Profile counts and descriptive mean ± SD values are based on most likely profile assignment. BCH means and Wald tests account for classification uncertainty. Pairwise *p* values were adjusted using Holm's method. Pairwise 95% CIs are unadjusted approximations reconstructed from the rounded BCH means and Wald statistics.

## 4. Discussion

The mean total AI ethical awareness score was 67.15 ± 13.40, with a mean item score of 3.20 ± 0.64. Among the six domains, informed consent and autonomy and education and sustainability received relatively higher scores. The higher score for informed consent and autonomy may reflect nursing students' familiarity with patient rights, informed consent, and respect for individual choices, which are consistently emphasised in nursing education and clinical practice. Al Syed et al. (25) similarly found that nursing students demonstrated high awareness of patients' rights to treatment information and informed consent. The higher score for education and sustainability may reflect nursing interns' recognition of the importance of keeping abreast of AI developments, promoting responsible AI use, and incorporating AI ethics into nursing education as they prepare for professional practice. Supporting this interpretation, Yang and Jang (26) found that nursing students emphasised the need for updated digital ethics education and practical guidelines to support responsible technology use in clinical settings.

In contrast, transparency and accountability and bias and fairness received relatively lower scores. Transparency and accountability involves documenting AI-assisted decisions, evaluating the accuracy and explainability of AI recommendations, and maintaining professional responsibility for clinical decisions. Nursing interns may have limited opportunities to participate directly in these processes during supervised clinical practice. Similarly, Yuan et al. (27) found that undergraduate nursing students expressed concerns about unclear accountability when adverse events occur during human–AI collaboration. The lower score for bias and fairness may reflect the difficulty of recognising algorithmic bias, which requires understanding how incomplete or unrepresentative training data may produce unequal recommendations across patient groups. Unlike familiar principles of equitable patient care, these risks may not be readily apparent during routine clinical practice. Rahman (28) also identified limited transparency and unrepresentative datasets as important challenges in AI tools used in nursing education. These findings highlight the need to strengthen nursing interns' understanding of AI-assisted decision-making, professional accountability, and algorithmic fairness.

The three profiles revealed differences not only in the overall level of AI ethical awareness but also in how awareness was distributed across ethical domains. This was particularly evident in the autonomy–education salient profile (C2; 42.2%), which combined relatively strong awareness of patient autonomy and support for responsible AI education with lower awareness of transparency, accountability, and algorithmic fairness. Floridi and Cowls (29) emphasised that ethical AI requires autonomy, justice, and explicability, with explicability encompassing both the understanding of AI decisions and accountability for their use. Viewed through this framework, the C2 pattern suggests that recognition of patients' rights and the importance of ethics education may not be accompanied by equally strong attention to the fairness and accountability of AI-supported care. In contrast, the consistently low awareness profile (C1; 27.6%) and consistently high awareness profile (C3; 30.2%) differed primarily in their overall awareness levels. These patterns point to distinct educational needs. Students in C1 may benefit from foundational AI ethics education, whereas those in C2 may benefit from case-based learning that connects patient autonomy with the evaluation of AI recommendations, professional accountability, and algorithmic fairness. For C3, more complex clinical scenarios involving competing ethical considerations may encourage deeper reflection on responsible AI use.

Educational level was associated with profile membership. Students in bachelor’s- and master’s-level programmes had greater odds of belonging to C3 rather than either C1 or C2, whereas educational level did not distinguish C2 from C1. Degree programmes may differ in their emphasis on evidence-based nursing, informatics, research methods, and ethical decision-making, providing different foundations for understanding algorithmic bias, privacy, accountability, and the reliability of evidence. A Chinese multicentre study found broadly similar network structures for bachelor’s and associate-degree nursing students, but a stronger connection between technical principles and transparency among bachelor’s students (30). This may reflect differences in curricula. The number of master’s students in our sample was relatively small, however, so estimates for this group warrant caution.

Prior AI-related education and familiarity with AI were both associated with latent profile membership, although their patterns of association differed. Previous AI-related education distinguished C3 from both C1 and C2, suggesting that

educational exposure may be particularly relevant to more comprehensive AI ethical awareness. Consistent with this finding, Yang (31) reported significantly higher AI ethical awareness among nursing students who had received AI-related education. Similarly, Abuadas et al. (32) found that a structured educational programme integrating AI concepts with ethical scenarios significantly improved nursing students' AI ethical awareness, positive attitudes towards AI, and intention to adopt generative AI. Lee (33) further reported positive correlations between AI ethical awareness and both AI knowledge and AI literacy among nursing students. Together, these findings suggest that meaningful engagement with AI, rather than mere exposure, may be important for recognising its ethical implications. Understanding how AI systems process data and generate recommendations may help nursing interns identify potential bias, critically evaluate the reliability of AI-generated outputs, and recognise the importance of professional oversight.

AI tool-use frequency was also associated with profile membership. Occasional use distinguished C3 from both C1 and C2, whereas regular and frequent use were associated with all three pairwise profile comparisons. Experiential learning theory (34) suggests that learning involves gaining experience, reflecting on it, developing understanding, and applying that understanding in subsequent situations. Using AI may expose nursing interns to inaccurate information, conflicting recommendations, or uncertainty about entering patient data, creating opportunities to reflect on the ethical implications of AI use. Educators can make these experiences more meaningful by encouraging students to verify AI-generated outputs against reliable evidence, justify their clinical decisions, and reflect on how their actions protect patient safety and rights. Cheng et al. (35) incorporated case analysis, reflective journals, and peer simulations into an experiential nursing education programme for advanced health assessment, which enhanced nursing students' critical thinking and self-directed learning abilities.

ASUAITIN-C total scores were associated with profile membership in all three comparisons. The subscale analysis clarified this pattern: stronger negative attitudes distinguished all three profile comparisons, whereas positive attitudes distinguished C3 from C1 only. This suggests that broader ethical awareness may coexist with both recognition of AI's benefits and concern about its risks. Bang and Hur (36) also reported an association between AI ethical awareness and attitudes towards AI among nursing students. The present subscale findings indicate that attention to ethical risks deserves consideration alongside willingness to use AI. Teaching could address both perspectives by examining when AI adds value, what safeguards are required, and when professional judgement should take priority.

Ethical sensitivity was positively associated with profile membership in all three comparisons. This finding is consistent with Lim et al. (37), who reported a significant positive correlation between moral sensitivity and AI ethical awareness among nursing students. Sensitivity to patient vulnerability, competing interests, privacy, and fairness may provide a foundation for recognising the ethical significance of AI-supported care. The distinction between C3 and C2 is informative because it connects greater sensitivity with broader awareness across ethical domains, beyond the relative strengths in autonomy and education characterising C2. Nursing ethics education could build this connection by extending familiar patient-care dilemmas to AI contexts—for example, examining whether an apparently accurate recommendation overlooks a patient's circumstances or whether an efficient information-sharing practice compromises confidentiality.

The mean professional identity score was 61.23 ± 8.11, broadly consistent with the findings reported by Zhang et al. (38). Social comparison and self-reflection had the highest mean item scores, although differences across dimensions were small. During clinical placements, interactions with clinical supervisors and staff nurses provide opportunities for nursing interns to compare their developing capabilities with professional expectations and reflect on their understanding of the nursing role. An integrative review similarly identified clinical role models and supportive learning environments as important influences on nursing students' professional identity development (39). In contrast, autonomy in career choice scored relatively lower, potentially reflecting the influence of family, institutional, and social factors on students' decisions to pursue nursing (40). Clinical workloads and discrepancies between educational expectations and clinical realities may further shape students' professional commitments (41). Clinical internships therefore represent an important period in which students develop their understanding of professional responsibilities and their identification with the nursing role.

As AI becomes integrated into clinical care, this process increasingly involves understanding how professional values and responsibilities extend to technology-supported practice.

Professional identity was highest in C3, intermediate in C2, and lowest in C1. This finding is consistent with Jeon and Oh (42), who reported a positive correlation between AI ethical awareness and professional identity among nursing students. The present study extends this evidence by identifying differences in professional identity across distinct patterns of AI ethical awareness. C2 showed an intermediate level despite relatively strong awareness of patient autonomy and AI ethics education, suggesting that broader awareness across ethical domains may be relevant to identification with the nursing profession. Johnson and Galatzan (43) discussed the need to adapt nursing professional identity and regulation as new technologies are integrated into care. Nursing interns with broader AI ethical awareness may have a clearer understanding of their responsibilities in evaluating AI recommendations, protecting patients' interests, and maintaining professional accountability. Integrating AI ethics with professional values education could help students examine these responsibilities during clinical training.

# 4.1. Limitations

First, convenience sampling from 12 hospitals in China may limit the generalisability of the findings to nursing interns in other settings. Second, the cross-sectional design does not establish the temporal direction or causality of the associations between AI ethical awareness, its related factors, and professional identity. Third, the measures relied on self-reports and may be affected by social desirability and common method bias. Although Harman's single-factor test did not identify a dominant factor, it cannot rule out such bias. Finally, the identified profiles depend on the selected indicators and modelling assumptions, and the relatively small number of master's students limits the precision of estimates for that group. Future studies should validate the profiles in independent samples, assess ethical decision-making in practice, and use longitudinal designs to examine changes during clinical training.

# 5. Conclusions

AI ethical awareness varied across the six domains, with relatively higher scores for informed consent and autonomy and education and sustainability, and lower scores for transparency and accountability and bias and fairness. Three distinct AI ethical awareness profiles were identified: a consistently low awareness profile; an autonomy–education salient profile; and a consistently high awareness profile. Educational level, prior AI-related education, AI familiarity, frequency of AI tool use, attitudes towards AI use in nursing, and ethical sensitivity were associated with profile membership in at least one pairwise comparison. Professional identity scores were highest in the consistently high awareness profile, followed by the autonomy–education salient profile, and lowest in the consistently low awareness profile. Nursing schools and clinical teaching hospitals could use these patterns to tailor learning opportunities, combining ethical knowledge with simulation, contextual decision-making, and guided AI practice. Integrating AI ethics and professional values education may also help students define their role in technology-mediated nursing care.

# Declarations

**Ethics approval and consent to participate**

This study was approved by the Ethics Committee of the First Affiliated Hospital of Anhui Medical University (approval no. KY2026-10-81). All participants were informed of the study purpose, procedures, and confidentiality measures, and informed consent was obtained prior to participation. Participation was voluntary, and all data were collected anonymously. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

**Consent for publication**

Not applicable.

**Competing interests**

The authors declare no competing financial interests or personal relationships that could have influenced the work reported in this article.

# Funding

This work was supported by two University-level Quality Engineering Projects of Anhui Medical University (grant nos. 2024sx248 and 2024xjxm74).

# Author Contribution

Z.X., D.T., and J.H. conceptualized the study. Z.X., D.T., R.W., and J.H. developed the methodology. Z.X., D.T., X.S., X.X., C.L., and X.Z. conducted the investigation and curated the data. Z.X., D.T., and R.W. performed the formal analysis, and R.W. prepared the visualizations. Z.X. and D.T. wrote the original manuscript draft. J.H. supervised the study, managed the project, and acquired funding. All authors reviewed and edited the manuscript.

# Acknowledgements

The authors thank the nursing students who participated in this study and the clinical teaching staff at the participating hospitals for their support during data collection.

# Data Availability

Z.X., D.T., and J.H. conceptualized the study. Z.X., D.T., R.W., and J.H. developed the methodology. Z.X., D.T., X.S., X.X., C.L., and X.Z. conducted the investigation and curated the data. Z.X., D.T., and R.W. performed the formal analysis, and R.W. prepared the visualizations. Z.X. and D.T. wrote the original manuscript draft. J.H. supervised the study, managed the project, and acquired funding. All authors reviewed and edited the manuscript.

The datasets generated and analysed during the current study are not publicly available to protect participant confidentiality but may be obtained from the corresponding author upon reasonable request, subject to applicable ethical and institutional requirements.

## References

1. Topol EJ. High-performance medicine: the convergence of human and artificial intelligence. Nat Med. 2019;25(1):44–56. https://doi.org/10.1038/s41591-018-0300-7.
2. Ong JCL, Chang SYH, William W, Butte AJ, Shah NH, Chew LST, Liu N, Doshi-Velez F, Lu W, Savulescu J, Ting DSW. Ethical and regulatory challenges of large language models in medicine. Lancet Digit Health. 2024;6(6):e428–32. https://doi.org/10.1016/S2589-7500(24)00061-X.
3. Rony MKK, Numan SM, Akter K, Tushar H, Debnath M, Johra FT, Akter F, Mondal S, Das M, Uddin MJ, Begum J, Parvin MR. Nurses' perspectives on privacy and ethical concerns regarding artificial intelligence adoption in healthcare. Heliyon. 2024;10(17):e36702. https://doi.org/10.1016/j.heliyon.2024.e36702.

4. Obermeyer Z, Powers B, Vogeli C, Mullainathan S. Dissecting racial bias in an algorithm used to manage the health of populations. Science. 2019;366(6464):447–53. https://doi.org/10.1126/science.aax2342.
5. World Health Organization. Ethics and governance of artificial intelligence for health: WHO guidance. Geneva: World Health Organization; 2021. https://www.who.int/publications/i/item/9789240029200.
6. Zhang J, Tian L, Lin Q, Song L, Meng D, Shen C, Yu D. Informal use of generative artificial intelligence by nursing interns during clinical placement: A multi-stakeholder interpretive description. Nurse Educ Today. 2026;168:107397. https://doi.org/10.1016/j.nedt.2026.107397.
7. Milliken A, Grace PJ. Nurse ethical awareness: understanding the nature of everyday practice. Nurs Ethics. 2017;24(5):517–24. https://doi.org/10.1177/0969733015615172.
8. Ferguson SL, Moore EWG, Hull DM. Finding latent groups in observed data: A primer on latent profile analysis in Mplus for applied researchers. Int J Behav Dev. 2020;44(5):458–68. https://doi.org/10.1177/0165025419881721.
9. Yang B, Li C, Wang M, Wu Y, Yuan R, Zhao W, Guo Y, Li P, Zhang P. Unpacking the heterogeneity of AI literacy among nursing undergraduates: A latent profile analysis. Nurse Educ Today. 2026;167:107238. https://doi.org/10.1016/j.nedt.2026.107238.
10. Vabo G, Slettebø Å, Fossum M. Nursing students' professional identity development: An integrative review. Nordic J Nurs Res. 2022;42(2):62–75. https://doi.org/10.1177/20571585211029857.
11. Geoghan Marold SM, Strouse SM, Butcher D. Professional identity in nursing: A narrative review of the ISPIN definition and domains usage. SAGE Open Nurs. 2025;11:23779608251335240. https://doi.org/10.1177/23779608251335240.
12. Won HJ, Han SY. Relationship between nursing professionalism, artificial intelligence ethical awareness, and digital health literacy in nursing students. J Practical Eng Educ. 2024;16(4):415–21. https://doi.org/10.14702/JPEE.2024.415.
13. Seo H. Predictive factors influencing nursing professional values among nursing students: Focusing on nursing ethical values, bioethics awareness, and artificial intelligence ethics awareness. J Industrial Convergence. 2026;24(2):67–76. https://doi.org/10.22678/JIC.2026.24.02.067.
14. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP, Initiative STROBE. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. Lancet. 2007;370(9596):1453–7. https://doi.org/10.1016/S0140-6736(07)61602-X.
15. Kendall MG. Multivariate Analysis. London: Charles Griffin & Company; 1975.
16. Ferguson SL, Moore EWG, Hull DM. Finding latent groups in observed data: A primer on latent profile analysis in Mplus for applied researchers. Int J Behav Dev. 2020;44(5):458–68. https://doi.org/10.1177/0165025419881721.
17. El-Sayed AAI, Alsenany SA, Badoman TEA, Asal MGR. Development and validation of a scale for nurses' ethical awareness in the use of artificial intelligence: A methodological study. Nurs Health Sci. 2025;27(2):e70140. https://doi.org/10.1111/nhs.70140.
18. Tang YF, Feng YP, Wang H, Wang KX, Zhang C, Liu M, Li DY, Song WS, Li B. Chinesization of the Nurse Artificial Intelligence Ethical Awareness Scale and its reliability and validity test. Chin Nurs Res. 2026;40(18):3234–9. https://doi.org/10.12102/j.issn.1009-6493.2026.18.012.
19. Hao YF, Niu HJ, Li LP, Yue SJ, Liu XH. Measurement of professional identity in Chinese nursing students. Int J Nurs Sci. 2014;1(2):137–44. https://doi.org/10.1016/j.ijnss.2014.05.002.
20. Yılmaz D, Uzelli D, Dikmen Y. Psychometrics of the Attitude Scale towards the use of Artificial Intelligence Technologies in Nursing. BMC Nurs. 2025;24:151. https://doi.org/10.1186/s12912-025-02732-7.
21. Hu R, Ma YF, Wang CY, Li XY, Huang HP. Validity and reliability of the Chinese translation of the attitude scale towards the use of artificial intelligence technologies in nursing (ASUAITIN)- a cross-sectional study. BMC Nurs. 2025;24:782. https://doi.org/10.1186/s12912-025-03322-3.

22. Muramatsu T, Nakamura M, Okada E, Katayama H, Ojima T. The development and validation of the Ethical Sensitivity Questionnaire for Nursing Students. BMC Med Educ. 2019;19:215. https://doi.org/10.1186/s12909-019-1625-8.
23. Yu H, Tong T, Gao Y, Zhang H, Tong H, Liang C. Reliability and validity evaluation of the Chinese version of the Ethical Sensitivity Questionnaire for Nursing Students. BMC Nurs. 2021;20:244. https://doi.org/10.1186/s12912-021-00768-z.
24. Tang DD, Wen ZL. Statistical approaches for testing common method bias: problems and suggestions. J Psychol Sci. 2020;43(1):215–23.
25. Al Syed S, Abou Hashish EA, Bajamal E, Abdaljabbar L, Alammari N, Alotaibi R, Alfaifi S, Alrudayni H. Knowledge of the patients' bill of rights and influencing factors among university nursing students. Cureus. 2023;15(5):e38433. https://doi.org/10.7759/cureus.38433.
26. Yang HM, Jang YE. Ethics of nursing in the digital age: perceptions and challenges among Korean nursing students. BMC Med Ethics. 2025;26:143. https://doi.org/10.1186/s12910-025-01301-6.
27. Yuan Y, Fu J, Leng L, Wen Z, Wei X, Han D, Hu X, Liang Y, Luo Q, Zhang X, Hu R. The strengths, weaknesses, opportunities, and threats of generative artificial intelligence: a qualitative study of undergraduate nursing students. Front Public Health. 2025;13:1672140. https://doi.org/10.3389/fpubh.2025.1672140.
28. Rahman MI. Algorithmic bias and transparency in artificial intelligence tools for nursing education: A scoping review. Nurse Educ Pract. 2026;92:104756. https://doi.org/10.1016/j.nepr.2026.104756.
29. Floridi L, Cowls J. A unified framework of five principles for AI in society. Harv Data Sci Rev. 2019;1(1). https://doi.org/10.1162/99608f92.8cd550d1.
30. Zeng Q, Zhu J, Wang Y, Su S, Huang Y. Artificial intelligence self-efficacy and attitudes among nursing students: a multicenter network analysis of educational stratification. BMC Med Educ. 2026;26(1):299. https://doi.org/10.1186/s12909-026-08685-y.
31. Yang Y. Influences of digital literacy and moral sensitivity on artificial intelligence ethics awareness among nursing students. Healthcare. 2024;12(21):2172. https://doi.org/10.3390/healthcare12212172.
32. Abuadas M, Albikawi Z, Rayani A. The impact of an AI-focused ethics education program on nursing students' ethical awareness, moral sensitivity, attitudes, and generative AI adoption intention: a quasi-experimental study. BMC Nurs. 2025;24:720. https://doi.org/10.1186/s12912-025-03458-2.
33. Lee HJ. An examination of the links among nursing students' awareness of AI ethics, AI literacy, attitudes, and knowledge. Int J Adv Cult Technol. 2026;14(1):307–14.
34. Kolb DA. Experiential Learning: Experience as the Source of Learning and Development. Englewood Cliffs, NJ: Prentice-Hall; 1984.
35. Cheng J, Wu Y, Huang L, Wu Y, Guan Y. Integrating Kolb's experiential learning theory into nursing education: A four-stage intervention with case analysis, mind maps, reflective journals, and peer simulations for advanced health assessment. Front Med. 2025;12:1616392. https://doi.org/10.3389/fmed.2025.1616392.
36. Bang C, Hur Y. The effects of artificial intelligence ethics awareness, digital literacy, and metacognition on nursing students' attitudes toward artificial intelligence. BMC Med Ethics. 2026;27(1):95. https://doi.org/10.1186/s12910-026-01445-z.
37. Lim SH, Yun NY, Lee SM, Jeon DY, Jeong M, Jung HS. Impact of nursing students' biomedical ethics awareness, moral sensitivity, and metacognition on artificial intelligence ethics awareness. J Korean Soc Multicult Health. 2025;15(1):53–64. https://doi.org/10.33502/JKSMH.15.1.053.
38. Zhang J, Wang L, Yang X, Yang Y, Wu X, Huang H, Li G. The mediating effect of clinical belongingness on the relationship between anxiety and professional identity in nursing interns: a cross-sectional study. Front Med (Lausanne). 2025;11:1489383. https://doi.org/10.3389/fmed.2024.1489383.
39. Vabo G, Slettebø Å, Fossum M. Nursing students' professional identity development: An integrative review. Nord J Nurs Res. 2022;42(2):62–75. https://doi.org/10.1177/20571585211029857.

40. Mao A, Lu SE, Lin Y, He M. A scoping review on the influencing factors and development process of professional identity among nursing students and nurses. J Prof Nurs. 2021;37(2):391–8. https://doi.org/10.1016/j.profnurs.2020.04.018.
41. Zhao S, Liang Q, Tao H, Fan S, Xia Y, Zeng L, Wang G, Liu H, Huang H, Xiao J. Transition shock among nursing interns and its relationship with patient safety attitudes, professional identity and climate of caring: a cross-sectional study. BMC Nurs. 2024;23:64. https://doi.org/10.1186/s12912-024-01722-5.
42. Jeon MK, Oh JW. The impact of AI literacy and AI ethical awareness on nursing students' professional identity. J Convergence Cult Technol. 2026;12(5):587–95. https://dspace.kci.go.kr/handle/kci/2427631.
43. Johnson EA, Galatzan BJ. A critical juncture: Reimagining nursing professional identity and regulation in the ethical integration of innovation and technology in healthcare. J Nurs Regul. 2025;16(1):10–6. https://doi.org/10.1016/j.jnr.2025.03.005.

## Figures

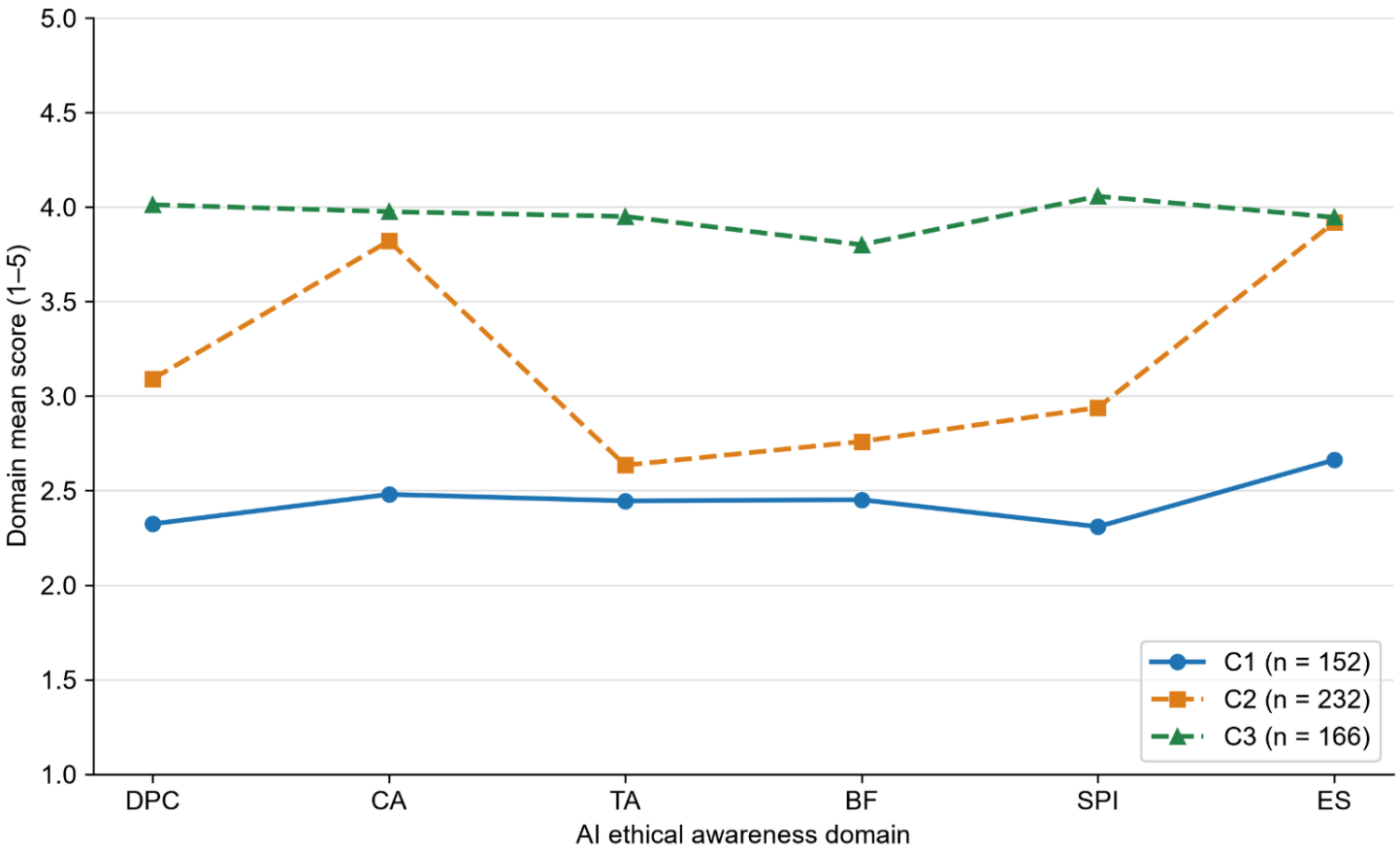



**Figure 1**

Mean scores across the six AI ethical awareness domains in the three latent profiles. Points represent descriptive means based on most likely profile assignment; corresponding SDs are reported in Table 3. C1, consistently low awareness profile; C2, autonomy–education salient profile; C3, consistently high awareness profile.