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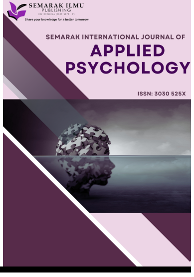

Understanding What Medical Students Know—but Don't Do—about Thalassemia: A Behavioural Perspective on Socioeconomic Influences

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ABSTRACT

Thalassemia is a widespread hereditary blood disorder in Vietnam, yet public engagement in preventive behaviours remains limited. This study assessed the knowledge, attitudes, and practices (KAP) related to Thalassemia among 1,124 undergraduate healthcare students during the 2024–2025 academic year, with a focus on identifying key demographic and socioeconomic determinants. A structured questionnaire, adapted from validated sources, was used to measure KAP and related factors. While 94.6% of students had heard of Thalassemia and 70.6% demonstrated good knowledge, only 61.9% exhibited positive attitudes and 18.9% reported good preventive practices. Multivariate analysis revealed that gender, academic year, and field of study significantly influenced knowledge and attitudes, with medical students and those in higher years performing better. Socioeconomic factors such as household income, parental education, and parental occupation were strongly associated with KAP outcomes. Students from higher-income families or with more educated parents were more likely to engage in preventive actions such as screening, health-seeking behaviour, and peer communication. In contrast, those from lower socioeconomic backgrounds were disproportionately represented among poor practice scores. These findings highlight the persistent gap between awareness and action and underscore the need for inclusive, equity-focused health education strategies to enhance Thalassemia prevention and literacy among future healthcare professionals in Vietnam.

1. Introduction

Thalassemia represents a group of inherited hemoglobin disorders characterized by reduced or absent production of globin chains, leading to chronic anemia and related complications [1]. Globally, it is estimated that around 1.5% of the population are carriers of beta-Thalassemia, and

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approximately 300,000 to 400,000 children are born annually with severe forms of the disease [2]. The burden is particularly pronounced in the "Thalassemia belt," which includes the Mediterranean region, South Asia, and Southeast Asia [3].

In Vietnam, Thalassemia is a significant public health concern, with a national carrier rate estimated at 13.8% [4]. Each year, approximately 8,000 children are born with Thalassemia-related disorders, posing substantial burdens on families and the healthcare system [5]. The cost of lifelong treatment, including blood transfusions and iron chelation therapy, often exceeds the average annual income of affected families. Consequently, prevention through education, genetic counseling, and premarital or antenatal screening is recognized as the most effective approach [6].

Despite these challenges, knowledge and awareness of Thalassemia among the general population remain limited. Studies conducted in Vietnam have found that only 11% of women in a rural Vietnamese district had adequate knowledge of Thalassemia [7,8]. Among urban university students, knowledge levels are similarly low, with less than 10% demonstrating comprehensive understanding of transmission, prevention, and management [9]. Medical students, as future healthcare professionals, are uniquely positioned to contribute to community awareness and screening efforts. Their own understanding, attitudes, and behaviors toward Thalassemia can influence both patient education and peer discourse. However, evidence suggests that even among medical trainees, knowledge and engagement levels are often insufficient [10,11]. Understanding the socioeconomic and demographic factors that shape students' health-related knowledge, attitudes, and practices (KAP) is therefore critical.

In previous studies, gender, academic year, field of study, and personal or family disease history have significantly influenced students' KAP in health-related contexts (e.g., COVID-19 in Sudan [12], face-mask use in Vietnam [13], awareness of hereditary diseases in South Africa [14]. By identifying such correlates in the context of Thalassemia, targeted educational strategies can be designed to bridge knowledge gaps and foster preventive behaviors among future health workers.

This study investigates the levels and socioeconomic determinants of KAP toward Thalassemia among students at a public medical university in northern Vietnam. It aims to inform curriculum design and health education interventions in academic settings where future health communicators are trained.

2. Methodology

2.1 Study Design and Setting

A descriptive cross-sectional study was conducted between November 2024 and February 2025 at a public medical university in northern Vietnam. The primary objective was to assess the levels and sociodemographic determinants of KAP related to Thalassemia among undergraduate healthcare students. The survey instrument and methodology were designed in accordance with the established guidelines for KAP studies [15,16].

2.2 Study Population and Sampling

The study population consisted of undergraduate students enrolled across all academic years and major disciplines at the university. A convenient sampling technique was employed, whereby students who were present and willing during data collection sessions were invited to participate. Inclusion criteria included being a full-time student and providing informed consent. Students absent during data collection or unwilling to participate were excluded. The minimum sample size was calculated using Cochran's formula for estimating a population proportion with a 95% confidence level and 5% margin of error [17]. Assuming a 50% proportion for maximum variability, the required sample was 384. To enhance statistical power and account for possible nonresponse, the sample size increased, yielding 1,124 completed responses.

2.3 Data Collection Instrument

A structured, self-administered questionnaire was used to assess the KAP regarding Thalassemia. The instrument was adapted primarily from previously validated KAP surveys conducted among adolescents and university students in Southeast Asia, Bangladesh and Pakistan [18-21]. The questionnaire was modified for cultural relevance and linguistic clarity within the Vietnamese context through expert review and pilot testing with 30 students not included in the final sample. Feedback from this pilot led to refinements in wording, layout, and response scaling to ensure face and content validity. The final questionnaire consisted of four sections:

Demographic and Socioeconomic Information (14 items): Included age, gender, ethnicity, year and field of study, marital status, parental occupation, parental education level, average household monthly income, and health insurance type.

Knowledge (14 items): Multiple-choice and true/false questions evaluated understanding of Thalassemia symptoms, causes, inheritance patterns, types, complications, diagnostic procedures, and treatment options. Each correct answer was scored 1; incorrect or “don’t know” responses were scored 0. A total score from 0–14 was computed.

Attitudes (10 items): Measured on a 4-point Likert scale (1 = strongly disagree to 4 = strongly agree), these items assessed participants’ beliefs about Thalassemia screening, premarital testing, patient stigma, and personal relevance. Cumulative scores ranged from 10–40 and were categorized as negative (<30) or positive (≥30) attitudes based on modified Bloom’s cut-off [22,23].

Practices (6 items): Combined Likert-scale and binary questions assessed participants’ personal engagement in Thalassemia prevention activities, including blood donation, screening, information sharing, and participation in awareness programs. Scores ranged from 5–27, with ≥21 indicating good practice.

The modified Bloom’s taxonomy cut-off points of 75% were employed to dichotomize each KAP domain into poor or good categories. This approach aligns with widely accepted practices in health behavior research [22-24]. For the knowledge domain, participants received one point for each correct response, while incorrect answers or “don’t know” options were scored as zero. Total knowledge scores ranged from 0 to 14, with scores of 9–14 classified as “good knowledge” and scores of 0–8 as “poor knowledge”, using a 75% cut-off. Attitude and practice items were measured using a four-point Likert scale (1 = strongly disagree to 4 = strongly agree). For attitudes, total scores ranged from 10 to 40 and were categorized as “positive” (≥30) or “negative” (<30). Similarly, practice scores ranged from 5 to 27, with scores ≥21 indicating “good practice” and scores <21 indicating “poor practice”.

2.4 Data Collection Procedure

After obtaining ethical approval and administrative permissions, trained data collectors distributed printed questionnaires in classrooms and common student areas. Participation was voluntary and anonymous. Respondents were instructed on how to complete the form and return it immediately upon completion. Respondents could withdraw at any point without penalty.

2.5 Data Analysis

The questionnaire was administered both online via Google Forms and in printed format, depending on student access and preference. All questionnaires were reviewed for completeness and consistency. Responses from paper-based forms were double-entered into EpiData version 3.1 to minimize data entry errors, while responses collected via Google Forms were exported directly. After cleaning and merging, the final dataset was analyzed using IBM SPSS Statistics Version 28 for Windows (IBM Corp., Armonk, NY, USA). Descriptive statistics (frequencies, percentages, means) summarized demographic characteristics and KAP scores. KAP levels were categorized into three tiers (low, moderate, high) using standard cutoff scores. Bivariate analysis (chi-square tests and t-tests) identified initial associations. To identify independent predictors of good knowledge, positive attitude, and good practice, multivariable logistic regression analyses were performed, adjusting for relevant covariates such as gender, field and year of study, family income, and parental education. Statistical significance was set at $p < 0.05$. All tests were two-tailed.

3. Results

3.1 Participant Characteristics

A total of 1,124 undergraduate students participated in the study. The majority were female (67.5%), with a male-to-female ratio of approximately 1:2. Most participants belonged to the Kinh ethnic group (92.3%), and nearly all were unmarried (98.0%). In terms of academic distribution, students represented all six academic years, with the highest proportion in the first year (28.7%) and the lowest in the sixth year (3.3%). The medical major accounted for the largest group (41.7%), followed by traditional medicine (17.4%), pharmacy (16.5%), laboratory technology (12.3%), nursing (9.5%), and preventive medicine (2.6%).

Regarding parental occupation, many students reported that their fathers (63.4%) and mothers (56.7%) worked in farming or freelance labor. Educational attainment of parents varied, with 37.5% of fathers and 32.4% of mothers having completed high school. Only 9.5% of fathers and 9.2% of mothers held postgraduate degrees. Most students (55.3%) came from households with a monthly income under 15 million Vietnamese Dongs (VND). The most common type of health insurance reported was compulsory student insurance (80.8%).

Table 1
Characteristics of participants (N = 1124)

Variable	N	%
Gender		
Female	759	67.5
Male	365	32.5
Academic Year		
Year 1	323	28.7
Year 2	198	17.6
Year 3	236	21.0
Year 4	202	18.0
Year 5	128	11.4
Year 6	37	3.3
Major		
Medicine	469	41.7
Pharmacy	185	16.5
Traditional Medicine	195	17.4
Laboratory	138	12.3

Table 1 (*Continued)*

Nursing	107	9.5
Preventive Medicine	29	2.6
Household Monthly Income		
< 15 million VND	622	55.3
15–25 million VND	362	32.2
> 25 million VND	140	12.5
Ethnicity		
Kinh	1037	92.3
Other	87	7.7
Marital Status		
Single	1102	98.0
Married	22	2.0
Father's Occupation		
Farmer, freelancer	713	63.4
Medical staff	40	3.6
Public servant	218	19.4
Business	115	10.2
Other	38	3.4
Father's Education		
Primary school	17	1.5
Secondary school	345	30.7
High school	422	37.5
College/University	233	20.7
Postgraduate	107	9.5
Mother's Occupation		
Farmer, freelancer	637	56.7
Medical staff	56	5.0
Public servant	253	22.5
Business	161	14.3
Other	17	1.5
Mother's Education		
Primary school	14	1.2
Secondary school	375	33.4
High school	364	32.4
College/University	268	23.8
Postgraduate	103	9.2
Health Insurance		
Compulsory Insurance	908	80.8
Other/None	216	19.2
Heard of Thalassemia	1063	94.6

3.2 KAP Regarding Thalassemia

Among the 1,124 students surveyed, 94.6% (n = 1,063) reported having heard of Thalassemia, who were included in the KAP analysis. School (88.8%), social networks (46.9%), and healthcare professionals (46.4%) were the most frequently cited sources of information. Other sources such as television/radio (25.3%) and newspapers/posters (21.5%) were less commonly mentioned. Only 5.8% (n = 62) had undergone a Thalassemia screening test. Furthermore, only 1.4% (n = 16) of participants self-reported being Thalassemia-positive or carriers of the gene, while 1.6% (n = 18) reported having family members with a confirmed Thalassemia diagnosis or carrier status. Table 2 presents the overall distribution of KAP related to Thalassemia among the participants.

Table 2
Thalassemia status and KAP scores regarding Thalassemia (N = 1063)

Category	N	%
Heard of Thalassemia	1063	100
Thalassemia screening test done	62	5.8
Thalassemia positive/latent	16	1.4
Family's Thalassemia positive/latent	18	1.6
Good knowledge (10~14 points)	751	70.6
Positive attitude (30~40 points)	658	61.9
Good practice (21~27 points)	201	18.9

3.2.1 Knowledge about Thalassemia

Many participants demonstrated a good level of knowledge, with 70.6% (n = 751) scoring between 10 and 14 points on the knowledge scale. This suggests that awareness of Thalassemia is relatively widespread, likely reflecting the impact of academic exposure in medical and allied health programs. The majority correctly identified Thalassemia as a genetic blood disorder affecting red blood cells (94.1%), its hereditary nature (89.7%), and its classification as a hematological disease (92.9%). However, significant gaps were evident in specific areas. Only 42.5% were aware that Thalassemia does not always manifest with anemia, and exactly 50.0% were unsure whether gene therapy or bone marrow transplantation could cure the disease (Table 3).

Table 3
Responses to knowledge items (N = 1063)

Item		Correct (n)	%
1	Thalassemia causes abnormal red blood cells	1000	94.1
2	Thalassemia is the same as leukemia	615	57.9
3	Thalassemia is a hematological disease	988	92.9
4	It is hereditary (passed from parents)	954	89.7
5	Consanguineous marriage increases risk	900	84.7
6	Carriers show same symptoms as patients	709	66.7
7	Always manifests anemia	452	42.5
8	Blood transfusion and iron chelation are treatments	775	72.9
9	Gene therapy/bone marrow transplant as cure	532	50.0
10	Thalassemia is preventable	712	67.0
11	Prenatal screening during pregnancy possible	880	82.8
12	Detectable through blood test	794	74.7
13	Number of types of Thalassemia known	741	69.7
14	Preventive measures known	956	89.9

3.2.2 Attitudes toward Thalassemia

Positive attitudes toward Thalassemia were observed in 61.9% (n = 658) of respondents, as defined by scores ranging from 30 to 40 points. This indicates that while students may understand the disease conceptually, a significant proportion may not perceive its social or public health relevance with the same conviction. A large majority supported population-wide screening (93.7%) and premarital testing (96.8%). However, only 23.9% believed they could personally be a Thalassemia carrier, indicating a disconnect between awareness and perceived personal risk (Table 4).

Table 4
Attitudinal statements and responses (N = 1063)

Item		Agree/Strongly Agree (n)	%
1	I think I might be a carrier of Thalassemia	254	23.9
2	Everyone should do Thalassemia screening	996	93.7
3	Screening before marriage is necessary	1029	96.8
4	Carriers can marry while being aware of risks	733	69
5	Thalassemia is inherited from both parents	990	93.1
6	It is necessary to learn about Thalassemia	1009	94.9
7	A relationship with a patient is acceptable	924	86.9
8	Screening should be in national programs	950	89.5
9	Thalassemia is a public health problem	1009	94.9
10	Education in Thalassemia is necessary	1023	96.2

3.2.3 Preventive practices

The most concerning gap appeared in the practice domain: only 18.9% (n = 201) reported engaging in good preventive practices, including screening, counseling others, or participating in awareness activities. Despite high awareness and interest in Thalassemia, actual preventive behaviors remained markedly low among respondents. Only 5.8% (n = 62) of students reported having been screened for Thalassemia, while 94.2% (n = 1001) had never undergone screening. Similarly, just 16.6% (n = 176) of students had encouraged others to get screened, whereas 83.4% (n = 887) had not done so.

By contrast, more passive or indirect forms of engagement showed higher participation. For instance, 76.9% (n = 817) had previously sought information about Thalassemia, indicating a strong level of informational interest, even if not coupled with active practice. However, only 15.2% (n = 162) had donated blood for Thalassemia patients, and 15.4% (n = 164) had taken part in awareness campaigns. This disparity highlights the knowledge–practice gap and suggests that while students may be informed and interested, this does not consistently translate into action (Table 5).

Table 5
Preventive practices reported by participants (N = 1063)

Item		Yes (n)	%
1	Ever screened for Thalassemia	62	5.8
2	Ever encouraged others to screen	176	16.6
3	Ever learned about Thalassemia	817	76.9
4	Ever donated blood for patients	162	15.2
5	Participated in awareness programs	164	15.4
6	Would accept marriage with Thalassemia patient	449	42.2

3.3. Factors associated with KAP

Bivariate analyses revealed significant associations between multiple demographic and socioeconomic variables and each KAP component (Table 6).

Table 6
Factors associated with KAP (N = 1063)

Factor	Good Knowledge (%)	Knowledge (p-value)	Positive Attitude (%)	Attitude (p-value)	Good Practice (%)	Practice (p-value)
Gender (Female)	73.5*	0.021	63.4*	0.045	19.5	0.312
Gender (Male)	65.2*		58.9*		17.8	
Academic Year (1~3)	66*	0.032	58.2*	0.018	15.9*	0.041
Academic Year (4~6)	77.9*		69.3*		22.4*	
Major: Medicine	80.8**	0.001	72.5**	0.003	25.7**	0.006
Major: Other	66.3**		59.1**		16.6**	
Household Income > 25 mil VND	79.3*	0.014	70.2*	0.017	26.3**	0.002
Household Income ≤ 25 mil VND	67.5*		60.4*		17.1**	
Father Education: College+	74.2*	0.045	68*	0.031	21.5*	0.04
Father's Education: ≤High School	68.5*		60.2*		17.3*	
Mother's Education: College+	75.1*	0.038	72.9**	0.008	23.8*	0.019
Mother's Education: ≤High School	66.8*		59**		17.5*	
Father's Occupation: White Collar	72.9*	0.048	64.3*	0.042	20.2*	0.036
Father's Occupation: Labor	66.3*		58.7*		16.1*	
Mother's Occupation: White Collar	72.8*	0.037	67.5*	0.026	21.3*	0.046
Mother's Occupation: Labor	66.4*		59.2*		16.7*	
Ethnicity: Kinh	71.2	0.054	62	0.051	19.1	0.067
Ethnicity: Minority	60		54.3		13.3	
Marital: Single	71*	0.027	62.3*	0.049	18.9	0.411
Marital: Married	63.8*		58*		17.4	
Insurance: Student Compulsory	73.2*	0.017	65.9*	0.021	21.7*	0.033
Insurance: Other/None	63.7*		55.1*		15*	

Chi-square test ($p < 0.05$ = *, $p < 0.01$ = *).

3.3.1 Knowledge

Gender, academic year, field of study, and household income were all significantly associated with knowledge levels ($p < 0.05$). Female students (73.5%) had slightly higher rates of good knowledge than males (65.2%). Students in later academic years—particularly Year 4 and above—were significantly more likely to score within the "good knowledge" category. Medical students exhibited the highest knowledge levels (80.8%), followed by students in Traditional Medicine and Pharmacy. Additionally, students from households earning over 25 million VND per month reported higher knowledge rates (79.3%) than those from lower-income groups.

3.3.2 Attitudes

Positive attitudes were significantly more prevalent among students in advanced academic years, those majoring in Medicine, and students with parents holding college or postgraduate degrees ($p < 0.01$). Students whose mothers were employed in non-agricultural professions demonstrated more supportive views toward population-wide screening and premarital testing. Parental education emerged as a particularly strong predictor of attitude formation.

3.3.3 Practices

Preventive practices were consistently poor across all groups but showed modest improvement among students from higher socioeconomic backgrounds. Those with monthly household incomes above 25 million VND had significantly higher odds of engaging in screening, blood donation, and awareness activities ($p < 0.05$). Students with personal or familial exposure to Thalassemia also demonstrated higher practice scores. No significant association was found between gender and good practice, indicating that socioeconomic factors played a more influential role than sex in behavior adoption.

3.4 Multivariate analysis of factors associated with KAP

Multivariate logistic regression analysis revealed distinct predictors for each domain of Thalassemia-related KAP among healthcare students (Table 7). For knowledge, higher academic year significantly increased the odds of possessing good knowledge (OR = 3.30; 95% CI: 2.55–4.26; $p < 0.001$), suggesting a strong cumulative educational effect. Similarly, students under compulsory student insurance had over twice the odds of having good knowledge compared to others (OR = 2.04; 95% CI: 1.58–2.63; $p < 0.001$). In contrast, maternal education level (OR = 1.06; 95% CI: 0.82–1.37; $p = 0.645$) and having a family member with Thalassemia (OR = 1.19; 95% CI: 0.44–3.18; $p = 0.735$) were not significant predictors.

Regarding attitudes, both gender and academic year showed strong positive associations. Female students had nearly double the odds of expressing positive attitudes (OR = 1.93; 95% CI: 1.49–2.50; $p < 0.001$), and students in later academic years were over three times more likely to report positive attitudes (OR = 3.51; 95% CI: 2.71–4.55; $p < 0.001$). Ethnicity also had a significant but inverse association (OR = 0.57; 95% CI: 0.36–0.90; $p = 0.017$), indicating that minority students were less likely to hold positive attitudes. Father's occupation did not significantly influence attitudes (OR = 0.94; 95% CI: 0.73–1.21; $p = 0.635$).

Table 7
Multivariate logistic regression for factors associated with KAP (N = 1124)

Outcome	Variable	Coefficient	Odds Ratio	95% CI Lower	95% CI Upper	p-value
Good Knowledge	const	-1.0477	0.3507	0.2687	0.4579	0
	Academic Year	1.1925	3.2951	2.5504	4.2574	0
	Mother Education	0.0598	1.0616	0.8229	1.3696	0.6454
	Insurance	0.7113	2.0367	1.5767	2.6308	0
	Family's Thalassemia	0.1702	1.1856	0.4424	3.1771	0.735
Positive Attitude	const	-1.0467	0.3511	0.2695	0.4574	0
	Gender	0.6598	1.9343	1.4947	2.5032	0
	Academic Year	1.2554	3.5092	2.7067	4.5496	0
	Ethnicity	-0.5645	0.5687	0.3579	0.9034	0.0169
	Father Occupation	-0.0621	0.9398	0.7275	1.214	0.6346
Good Practice	const	-1.7676	0.1707	0.1262	0.2309	0
	Income	1.5944	4.9255	3.7384	6.4895	0
	Insurance	0.9219	2.5139	1.9139	3.3021	0
	Mother Education	0.0851	1.0889	0.8324	1.4244	0.5344
	Family's Thalassemia	-0.5106	0.6001	0.2101	1.7142	0.3403

As for practice, higher household income was a strong predictor of good preventive behavior (OR = 4.93; 95% CI: 3.74–6.49; p < 0.001), as was compulsory insurance status (OR = 2.51; 95% CI: 1.91–3.30; p < 0.001). However, maternal education (OR = 1.09; 95% CI: 0.83–1.42; p = 0.534) and family Thalassemia history (OR = 0.60; 95% CI: 0.21–1.71; p = 0.340) were not significantly associated with practice behavior. These findings highlight the importance of structural and socioeconomic factors in shaping not only awareness but also attitudes and preventive behaviors among future healthcare professionals.

4. Discussion

This study offers a comprehensive assessment of knowledge, attitudes, and practices (KAP) regarding Thalassemia among medical students in northern Vietnam and identifies several demographic and psychosocial factors that influence these domains. Despite being enrolled in health science programs, participants showed suboptimal KAP levels, with only about two-thirds demonstrating adequate knowledge, fewer than half holding positive attitudes, and less than one-fifth engaging in preventive behaviors.

Among participants reported having heard of Thalassemia, reflecting widespread basic awareness of the disorder within this healthcare student population. However, despite this universal awareness, only 5.8% (n = 62) had ever undergone a Thalassemia screening test, highlighting a significant gap between knowledge and proactive health behavior. This finding is consistent with earlier studies in low- and middle-income countries, where knowledge does not consistently lead to screening uptake due to factors such as perceived low risk, limited access to genetic testing, or lack of institutional emphasis on prevention [21,25]. Furthermore, only 1.4% (n = 16) of participants self-reported being Thalassemia-positive or carriers of the gene, while 1.6% (n = 18) reported having family members with a confirmed Thalassemia diagnosis or carrier status. These figures are likely underestimates of true prevalence, given the low rate of screening in the sample. The presence of even a small percentage of carriers in a future healthcare workforce highlights the importance of incorporating Thalassemia screening into student health programs, both to inform personal health decisions and to reinforce the importance of preventive behavior among future practitioners.

These findings are consistent with studies from similar settings, which indicate a lack of adequate Thalassemia-related education even among health trainees [10-12]. Knowledge gaps, particularly regarding genetic inheritance and asymptomatic carrier status, highlight the need to integrate structured, case-based learning and genetics content early in medical curricula [26]. This is further supported by the positive association between academic year and KAP scores, consistent with data from Indonesia, where students in clinical years exhibited better understanding and preventive intentions [18-21]. However, this trend also reflects a delayed integration of essential genetic knowledge in pre-clinical years.

Gender was another significant determinant: female students consistently outperformed males across all domains, a pattern also observed in studies from Saudi Arabia and Bangladesh [19,25]. Scholars attribute this difference to greater health-seeking behavior, empathy, and risk sensitivity among females. Addressing this gap calls for targeted strategies to better engage male students, particularly in preventive health education.

The role of family history emerged as a strong predictor of both attitudes and practices. Students with affected relatives demonstrated better understanding and higher participation in preventive behaviors, supporting psychosocial health models like the Health Belief Model, which emphasize perceived susceptibility as a driver of action [27-29]. These results are mirrored in data from various countries, where familial exposure to Thalassemia led to increased screening uptake and genetic counseling engagement [20,25,27-30].

The discrepancy between moderate attitudes and very low engagement in preventive practices (5.8% screened) reflects a common intention–behavior gap, likely shaped by structural barriers, institutional neglect of screening encouragement, or limited self-efficacy. This disconnect has been reported in Malaysia, where 60% of students supported mandatory screening, but fewer than 20% had ever been tested [31].

Moreover, cross-country comparisons reinforce these trends. Recent comparative studies among medical and non-medical university students [11] and among health college undergraduates [10,31] have underscored significant gaps in both knowledge and preventive intentions, particularly showing that students in clinical years have better understanding and higher screening uptake. These parallels suggest a widespread regional deficiency in Thalassemia-related education, even among health-literate groups.

Ethnic minority students in our sample were significantly less likely to express positive attitudes, underscoring the need for culturally tailored education and communication strategies. This is particularly important in countries with ethnolinguistic diversity, where national prevention programs risk excluding vulnerable populations without inclusive outreach [1-3,30].

Finally, the importance of institutional support cannot be overstated. Countries like Italy and Greece have successfully reduced Thalassemia burden through integrated national prevention programs, including school-based education, premarital counseling, and free screening [32]. Vietnam's screening initiatives are evolving, but our findings underscore the value of leveraging university-level interventions, particularly within medical schools, to embed both awareness and preventive action in the next generation of healthcare providers.

To bridge the gap between knowledge and action, educational institutions must implement mandatory Thalassemia modules, integrate clinical exposure, and foster community engagement initiatives. This aligns with evidence from Malaysia, where a web-based education module improved both knowledge and attitudes toward Thalassemia prevention, with sustained impact at six months [33]. Similarly, a holistic, community-oriented education program that combined classroom learning with peer and community outreach significantly increased awareness and willingness to undergo screening in a diverse population [34]. By equipping medical students not only with genetic literacy but also with practical counseling and advocacy skills, such integrated approaches help transform theoretical understanding into meaningful preventive action.

This study has several limitations that should be acknowledged. First, its cross-sectional design restricts the ability to infer causal relationships between the identified determinants and students' KAP levels. Second, although the sample size was large and diverse, the study was conducted at a single public medical university in northern Vietnam, which may limit the generalizability of findings to other regions or to non-healthcare students. Third, self-reported data may introduce social desirability and recall biases, particularly in responses related to screening behavior and family history of Thalassemia. Fourth, while the questionnaire was adapted from validated instruments, its applicability in the Vietnamese sociocultural context may require further psychometric testing for reliability and sensitivity. Future studies may benefit from longitudinal designs, multi-institutional sampling, and inclusion of qualitative data to explore deeper motivations behind preventive behavior.

5. Conclusions

This study reveals critical gaps in Thalassemia-related KAP among healthcare students in Vietnam, despite their medical education background. While awareness of the disease is nearly universal, only a minority of students demonstrate sufficient understanding, positive orientation, or engagement in preventive behaviors such as screening and advocacy. The analysis highlights that academic progression, female gender, higher household income, and having compulsory health insurance are positively associated with improved KAP outcomes. However, disparities persist among students from ethnic minorities and those without personal or familial exposure to Thalassemia. The low rate of preventive practices, despite moderate knowledge and attitude scores, points to systemic barriers and a lack of institutional mechanisms that support behavioral engagement.

These findings emphasize the urgent need to enhance Thalassemia education within medical curricula through early, structured, and experiential learning approaches. Universities and policymakers should consider embedding screening programs, community-based advocacy, and culturally sensitive interventions to close the gap between awareness and action. Empowering future healthcare professionals with both the knowledge and practical competencies to combat Thalassemia is vital to national prevention efforts and the broader goal of reducing the genetic disease burden in Vietnam and other similar low- and middle-income settings.

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