Journal of Contemporary Studies in Epidemiology and Public Health
2026, 7(1), ep26015
e-ISSN: 2634-8543
https://www.jconseph.com

MODESTUM

Original Article

OPEN ACCESS

The forgotten threat? Perception of malaria risk and knowledge levels among European university students

Viera Peterková [1], Ivan Iľko [1]*, Alexandra Maruniaková [1], Júlia Tarabová [1], Katarína Imreová [1]

[1] Department of Biology, Faculty of Education, Trnava University in Trnava, Trnava, SLOVAKIA
***Corresponding Author:** ivan.ilko@truni.sk

Citation: Peterková V, Iľko I, Maruniaková A, Tarabová J, Imreová K. The forgotten threat? Perception of malaria risk and knowledge levels among European university students. J CONTEMP STUD EPIDEMIOL PUBLIC HEALTH. 2026;7(1):ep26015. https://doi.org/10.29333/jconseph/18115

ARTICLE INFO

Received: 14 Sep. 2025

Accepted: 03 Feb. 2026

ABSTRACT

Malaria, once considered a tropical disease, is re-emerging as a concern for Europe due to climate change and increasing global mobility. University students are a key group for assessing awareness and preparedness, as their knowledge and attitudes influence future societal responses. This study surveyed 202 Slovak and Czech students using a structured online questionnaire assessing knowledge of malaria's etiology, transmission, mortality, prevention, and risk perception, alongside demographic and experiential variables. Results revealed substantial gaps: 44% misidentified a virus as the causative agent, and 23% believed malaria is not fatal. While 95% recognized mosquito bites as the main transmission route, misconceptions persisted. Gender significantly influenced perceptions of prevalence and prevention, age was associated with awareness and climate-related impacts, and field of study shaped perceived risk and access to information. Students with travel or Erasmus experience expressed greater fear of infection. Targeted malaria education in higher education could strengthen preparedness and reduce misinformation in Europe.

Keywords: malaria, disease perception, student knowledge, Europe, travel health, epidemiological awareness

INTRODUCTION

Malaria is among the most significant parasitic diseases transmitted to humans by *anopheles* mosquitoes infected with *plasmodium* parasites [1]. Although malaria was historically present in Europe, including the territory of present-day Slovakia where the last case was recorded in 1960 [2], current global conditions once again increase the risk of its reintroduction. In 2015, Europe was officially declared a "malaria-free region" [3]; however, the rising number of imported cases underlines the need for vigilance even in non-endemic areas.

Climate change plays a crucial role in this context by altering the geographic distribution of mosquitoes and extending their activity season. Higher temperatures, increased humidity, and more intense rainfall create conditions that enable the survival of *anopheles* mosquitoes in areas that were previously unsuitable, such as parts of southern and southeastern Europe [4-6]. At the same time, the incubation period of the parasite inside the mosquito is shortened, which further increases the risk of transmission [7].

This environmental factor is closely linked to the phenomenon of increased human mobility, travel to endemic regions, migration, and globalized trade. Each year, large numbers of people from non-tropical countries travel to malaria-endemic areas, and thousands of them bring malaria back to Europe [8]. The significant rise in imported cases is also associated with insufficient prevention and poor awareness among travelers [9]. Particularly alarming is the phenomenon of so-called "airport" or "baggage" malaria, where infectious mosquitoes are introduced into Europe through air transport and transmit the disease locally without the need for international travel [10-12].

University students represent a particularly important group, not only because they frequently travel abroad for study or volunteer programs, but also because they will, in the future, assume professional roles in healthcare, education, research, and public administration, thereby influencing societal attitudes towards public health issues. They represent a target group with high potential for health education; however, the uneven level of their knowledge and attitudes can directly affect the effectiveness of preventive strategies [13]. Malaria, as the most widespread vector-borne disease globally [14], is not only a concern for tropical countries, its prevention and control require a comprehensive approach in Europe as well. For effective public health protection, it is essential not only to monitor climatic and epidemiological trends but also to understand how individuals perceive the risk of the disease, how they respond to recommended preventive measures, and which factors shape their attitudes and behaviors.

The present study focused on analyzing differences in risk perception according to age, field of study, and prior travel experience. Furthermore, it aimed to assess the level of knowledge and risk perception of malaria among university students, and to explore the extent to which demographic and experiential factors influence their awareness, willingness to protect themselves, perception of risk, and ability to respond appropriately in the event of symptoms during or after

returning from endemic regions. The study also evaluates the potential of preventive education at universities as a tool for improving health awareness within this target group.

SUBJECTS AND METHODS

Study Design

This cross-sectional study was based on a structured online questionnaire to assess perceptions of the risk of malaria transmission to Europe among university students. The questionnaire was distributed electronically via social networks, student mailing lists and university groups, primarily targeting students from Slovak and Czech universities. Data collection took place over a defined period and was completed voluntarily and anonymously. Participants were informed about the study objectives and data confidentiality before participation.

Population and Sample

A total of 202 university students participated in the survey. The sample consisted of 146 women (72%) and 56 men (28%) aged 19 to 27 years (mean [M] = 23 years). Participants were enrolled in full-time or part-time bachelor's and master's studies in various fields of study. Recruitment primarily included students from Trnava University, Comenius University in Bratislava, University of Economics in Bratislava, Matej Bel University in Banská Bystrica, and two Czech institutions: Masaryk University and Mendel University in Brno.

Study Variables

The study examined both independent and dependent variables. Independent variables included demographic and contextual factors such as gender, age, field of study, travel experience to malaria-endemic regions, and participation in Erasmus or other international mobility programs. Dependent variables represented students' knowledge and perceptions of malaria, including awareness of etiology, transmission routes, mortality, preventive measures, risk perception, and the perceived influence of climate change.

Operational Definition of Variables

For the purpose of this study, knowledge-related variables were defined as students' ability to correctly identify malaria's causative agent, mortality, and transmission routes, measured through multiple-choice items. Perceptions were defined as students' subjective evaluation of risk, preventive effectiveness, and the potential reintroduction of malaria to Europe, measured using a 5-point Likert scale. Demographic factors (gender, age, and field of study) were recorded as categorical variables, while experiential factors (travel frequency, Erasmus participation, attendance at seminars) were assessed as binary or ordinal measures.

Study Instrument

The questionnaire consisted of 45 items and was developed based on previously published and validated instruments used in similar studies on malaria awareness and disease risk perception [15-17]. Several items were adapted from these studies and subsequently modified to reflect the European context and the target population of university students.

The instrument included multiple formats: single- and multiple-choice items, open-ended questions, and Likert-scale items. For attitude-based questions, a 5-point Likert scale ranging from "strongly disagree" to "strongly agree", with a "don't know" option in the middle, was used to allow for neutrality of response, particularly in knowledge-related items. This design aims to minimize forced-choice bias and increase the reliability of responses.

Content validity was ensured through expert review by two researchers with expertise in public health and infectious disease education, who evaluated the relevance, clarity, and adequacy of the questionnaire items. Based on their feedback, minor wording and structural adjustments were made to improve comprehensibility and coherence.

The internal consistency of the final instrument was verified using Cronbach's alpha, which reached a satisfactory level of 0.843. The questionnaire included sociodemographic questions (age, gender, student/worker status, field of study, frequency of travel, and participation in Erasmus), as well as multiple-choice and Likert-scale questions. Individual items were grouped into thematic dimensions (knowledge, prevention and protection, perception of transmission risk, awareness of the disease, preventive measures, perceived impacts, travel risks, personal risk perception, and personal opinions).

Composite scores for each dimension were calculated as the mean of the corresponding Likert-scale items. Responses "don't know" were treated as missing values and excluded from score computation.

Data Analysis

Normality was assessed at the level of individual respondents for each composite dimension using the Shapiro–Wilk test. As most distributions deviated from normality, non-parametric statistical methods were applied in subsequent analyses. Specifically, the Kruskal-Wallis H test was used to examine differences in malaria knowledge and risk perception across key sociodemographic and experiential variables, including gender, age, field of study, frequency of travel, and participation in Erasmus programs. Effect sizes were reported using eta-squared (η^2) for Kruskal-Wallis tests. Given the exploratory nature of the study, no formal correction for multiple testing was applied; results should therefore be interpreted cautiously. The analysis focused on differences in perceptions of malaria-related mortality, etiology, transmission routes, disease incidence, prevention practices, subjective risk perception, level of awareness, perceived impact of climate change, fear of infection, and perceived potential for malaria introduction to Europe. In addition, frequency distributions were calculated for categorical variables, particularly those related to preventive behavior. All statistical tests were performed at a significance level of 0.05. Data were processed and visualized using MS Excel and Statistica software.

Research Ethics

This study was conducted in accordance with the ethical standards of the Declaration of Helsinki. Participation was voluntary and anonymous, and no personal identifying or sensitive data were collected. All respondents were informed about the purpose of the study, data confidentiality, and their right to withdraw at any time. According to the institutional guidelines of the authors' universities, formal ethical approval

Table 1. Summary of respondent characteristics and knowledge

Variable	Key findings
Field of study	48% social sciences, 19% natural sciences, 19% technical, 7% education, 3% non-medical health, 3% economics
Participation in health-related seminars	49% no, 45% yes, 7% don't know
Travel to malaria-endemic regions	74% no, 20% once, 5% multiple times
Belief that malaria is fatal	63% yes, 23% no, 14% don't know
Participation in Erasmus program	79% no, 21% yes
Most common Erasmus destinations	Spain (26%), Italy (22%), Greece (17%), UK (13%), Turkey (9%), Portugal (7%), Ireland (7%)
Belief about cause of malaria	44% virus, 39% parasite (correct), 9% don't know, 8% bacteria
Knowledge of malaria transmission modes	95% mosquito bite, 67% blood transfusion, 44% contact with infected person, 29% contaminated food/water, 5% don't know
Preferred information channels	76% seminars, 73% flyers, 64% online courses, 26% curriculum integration
Perceived effectiveness of prevention measures	72% vaccination, 66% antimalarials, 62% mosquito nets, 48% repellents, 28% hygiene

was not required for this type of non-invasive, anonymous questionnaire-based research. Therefore, no institutional review board approval or formal waiver was necessary.

RESULTS

This section presents the results of the study in two main parts. The first part provides a descriptive overview of the demographic and contextual characteristics of the respondents, offering essential background for interpreting their knowledge and attitudes. The second part focuses on the thematic analysis of the collected data. It explores how various demographic and experiential factors, such as field of study, participation in seminars, travel to endemic regions, or previous exposure to information, shape university students' perceptions, knowledge, and preventive attitudes related to malaria and its potential transmission to Europe.

The results are structured according to key thematic categories reflecting both the content of the questionnaire and the research objectives.

Sample Characteristics

A total of 202 university students participated in the study. Regarding their academic background, nearly half of the respondents (48%, n = 97) reported a focus on the social sciences. Natural sciences and technical fields each accounted for 19% (n = 38), followed by education (7%, n = 15), non-medical health sciences (3%, n = 7), and economics (3%, n = 7).

When asked about previous participation in seminars related to epidemiology, public health, or climate change, 49% (n = 98) of students reported they had not attended such events, while 45% (n = 90) had, and 7% (n = 14) responded "I don't know."

In terms of travel experience to malaria-endemic regions, the majority of respondents (74%, n = 150) reported no travel experience, while 20% (n = 41) had traveled once, and 5% (n = 11) had traveled multiple times.

When assessing awareness of malaria mortality, 63% (n = 127) of students correctly identified malaria as a potentially fatal disease. However, 23% (n = 46) believed it was not fatal, and 14% (n = 29) indicated uncertainty.

Participation in international mobility programs revealed that 79% (n = 160) of respondents had not participated in the Erasmus program, while 21% (n = 42) had. Among those with Erasmus experience, the most frequently visited countries were Spain (26%, n = 12), Italy (22%, n = 10), Greece (17%, n = 8), England (13%, n = 6), Turkey (9%, n = 4), Portugal (7%, n = 3), and Ireland (7%, n = 3).

Students' understanding of the etiology of malaria varies. A plurality of respondents (44%, n = 88) incorrectly identified a virus as the cause, while 39% (n = 78) correctly identified a parasite. The remaining responses included "I don't know" (9%, n = 19) and "bacteria" (8%, n = 17).

In a multiple-response item regarding malaria transmission, 95% (n = 192) correctly selected mosquito bites as a transmission route. Other answers included transfusion of infected blood (66.80%, n = 135), contact with an infected person (44.10%, n = 89), consumption of contaminated food or water (28.70%, n = 58), and "I don't know" (4.50%, n = 9).

When asked how awareness about malaria could be improved, students most frequently endorsed organizing lectures and seminars (76.2%, n = 154), distribution of informational materials such as posters and flyers (72.8%, n = 147), development of online courses (63.9%, n = 129), and integration of the topic into university curricula (26.2%, n = 53).

Lastly, in terms of preferred preventive measures, vaccination (71.8%) and antimalarial drugs (66.30%) were perceived as the most effective. A high percentage of students also completely agreed with the efficacy of mosquito nets (61.9%). While repellents were generally seen as effective, only 48% fully agreed with their efficacy, with an additional 41.6% rather agreeing. Hygiene measures received the lowest support, only 27.7% viewed them as completely effective, and 14.9% explicitly disagreed with their usefulness. Notably, 22.3% of students selected "I don't know," indicating uncertainty or lack of knowledge in this area (**Table 1**).

Descriptive and Comparative Analysis

This section presents a thematic analysis of the variables influencing university students' perceptions and knowledge of malaria. The analysis is deliberately divided into two parts, based on the structure of the questionnaire and the nature of the assessed dimensions. The first part focuses on core factual knowledge about malaria, including perceptions of its mortality, understanding of its origin, and knowledge of transmission routes. These indicators were analyzed first, as they form the foundation of respondents' health literacy and provide essential context for interpreting subsequent attitudinal patterns.

The second part of the analysis shifts toward broader perceptual and behavioral aspects, such as perceived prevalence, awareness, attitudes toward prevention, fear of infection, and perceived influence of climate change. These variables go beyond basic knowledge and reflect how students

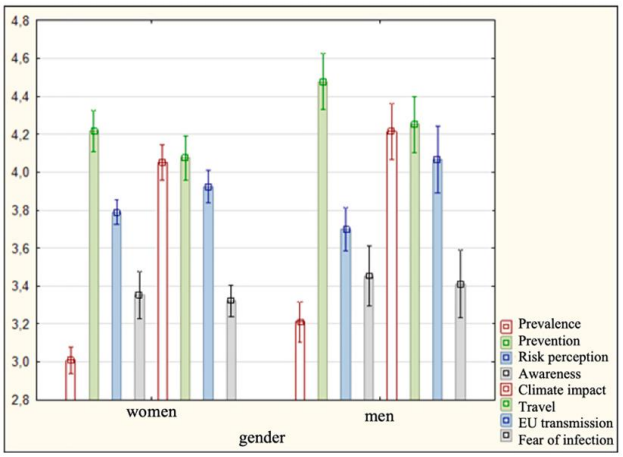

Figure 1. Gender differences in malaria-related risk perception and preventive attitudes. Bars represent mean Likert-scale scores across eight thematic dimensions, with error bars indicating standard deviation (Source: Authors' own elaboration)

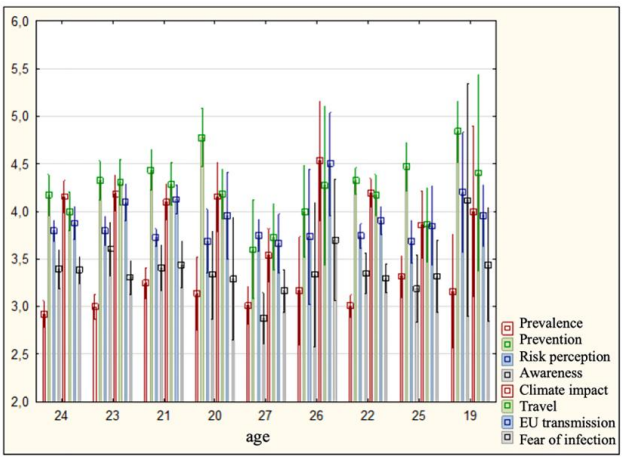

Figure 2. Differences in malaria-related perceptions across age groups. Bars represent mean Likert-scale scores across thematic dimensions, with error bars indicating standard deviation (Source: Authors' own elaboration)

interpret the issue of malaria through the lens of their experiences, academic backgrounds, and travel exposure. Dividing the analysis in this way allowed for a more nuanced understanding of the factors shaping students' preparedness, risk perception, and responsiveness to emerging infectious disease threats.

Gender differences in perceptions of malaria

The potential influence of gender on selected dimensions, namely perceived mortality, understanding of the origin, and modes of transmission of malaria, was statistically examined. The results of the Kruskal-Wallis test revealed no significant differences in responses between male and female respondents across any of these dimensions ($p > 0.05$). These findings suggest that gender did not play a determining role in shaping students' perceptions regarding the fatality, cause, or transmission pathways of malaria within the studied sample.

Beyond basic perceptions of malaria mortality and transmission, gender-based differences were also analyzed across a broader range of dimensions, including perceived disease prevalence, prevention, subjective risk perception, information level, perceived impact of climate change, travel-related experience, fear of infection, and the perceived likelihood of malaria transmission to Europe.

Statistically significant differences between male and female respondents were identified in two dimensions: perceived prevalence of malaria ($p = 0.006$) and attitudes toward prevention ($p = 0.006$), with both p-values falling below the standard significance threshold ($p < 0.05$). Additionally, the perceived risk of malaria transmission to Europe approached statistical significance ($p = 0.061$), suggesting a marginally gender-sensitive trend in this dimension. For all other variables examined, no statistically significant gender-based differences were observed ($p > 0.05$).

These results indicate that while gender does not broadly influence all aspects of malaria-related knowledge or perception, it may be a contributing factor in how students assess the prevalence of the disease and the importance of preventive actions (**Figure 1**).

The effect of age

Statistical analysis was conducted to assess the relationship between respondents' age and their knowledge regarding malaria mortality, origin, and modes of transmission. The results revealed no statistically significant differences across age groups in any of these dimensions ($p > 0.05$), indicating a comparable level of understanding regardless of age.

However, when analyzing broader dimensions such as disease occurrence, prevention, risk perception, information awareness, the impact of climate change, travel habits, perceived risk of malaria introduction to Europe, and fear of infection, several statistically significant differences emerged between age groups. Specifically, significant effects of age were observed in the following dimensions: disease occurrence ($p = 0.036$), prevention ($p < 0.001$), information awareness ($p = 0.044$), perceived impact of climate change ($p = 0.0044$), travel-related exposure ($p = 0.034$), and the likelihood of malaria transmission to Europe ($p = 0.034$), all at the $p < 0.05$ significance level.

In contrast, no significant age-related differences were identified in the dimensions of risk perception and fear of infection ($p > 0.05$). These findings suggest that age may play an important role in shaping certain dimensions of students' understanding and attitudes toward malaria, particularly in relation to practical exposure, awareness, and perceptions of environmental risk factors (**Figure 2**).

The effect of field of study

We examined the relationship between students' academic fields and their knowledge of malaria mortality, origin, and modes of transmission. The analysis did not reveal any statistically significant differences across fields of study in these knowledge-based dimensions ($p > 0.05$). However, when exploring broader attitudinal and perception-based dimensions, including disease prevalence, prevention strategies, risk perception, information awareness, the perceived impact of climate change, travel-related exposure, perceived risk of malaria transmission to Europe, and fear of infection, several significant differences emerged based on students' field of study.

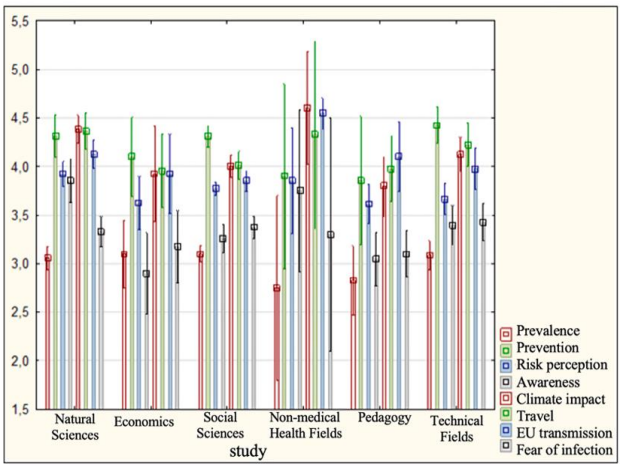

Figure 3. Differences in malaria-related perceptions across fields of study. Bars represent mean Likert-scale scores across thematic dimensions, with error bars indicating standard deviation (Source: Authors' own elaboration)

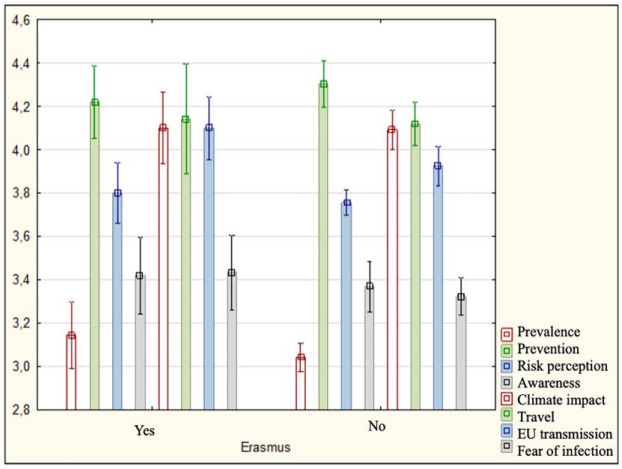

Figure 5. Differences in malaria-related perceptions based on Erasmus experience. Bars represent mean Likert-scale scores across thematic dimensions, with error bars indicating standard deviation (Source: Authors' own elaboration)

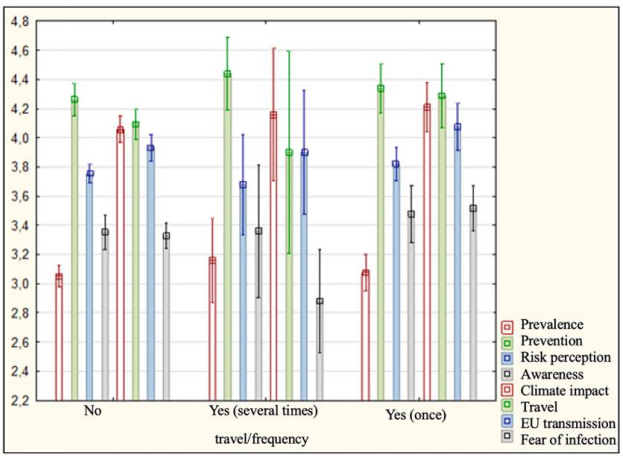

Figure 4. Differences in malaria-related risk perception and knowledge based on frequency of travel experience. Bars represent mean Likert-scale scores across thematic dimensions, with error bars indicating standard deviation (Source: Authors' own elaboration)

Specifically, differences were statistically significant for the following dimensions: risk perception ($p = 0.047$), information awareness ($p < 0.001$), climate impact ($p = 0.001$), and transmission to Europe ($p = 0.005$), all at the $p < 0.05$ significance level. The dimension of travel-related exposure showed a near-significant result ($p = 0.065$), suggesting a possible trend worth further exploration.

No significant differences were observed in the remaining dimensions, namely, prevention and fear of infection ($p > 0.05$). These findings highlight that students' academic orientation may shape how they perceive, understand, and respond to malaria-related risks, particularly regarding environmental and informational aspects (**Figure 3**).

The effect of travel experience

To evaluate the impact of students' travel experience on their understanding of malaria, we first examined knowledge-based dimensions including malaria mortality, origin, and modes of transmission. The results revealed a statistically significant difference in the perception of malaria mortality based on travel frequency ($p = 0.001$), suggesting that students with different travel backgrounds may vary in their understanding of the disease's severity. However, no significant differences were found in relation to knowledge about the origin or transmission routes of malaria ($p > 0.05$).

In the second part of the analysis, we investigated the relationship between travel experience and broader perception dimensions, namely, malaria prevalence, prevention, risk perception, information awareness, climate impact, travel-related exposure, potential transmission to Europe, and fear of infection. A statistically significant difference was found only in the dimension of fear of infection ($p = 0.003$), with more experienced travelers expressing varying levels of concern. No significant associations were observed in the remaining dimensions ($p > 0.05$).

These results suggest that while travel experience may shape students' perceptions of disease severity and personal vulnerability, it does not broadly influence their general attitudes or knowledge about malaria (**Figure 4**).

Impact of international study mobility on students' awareness of malaria

The relationship between students' participation in the Erasmus exchange programme and their knowledge of malaria, specifically regarding its mortality, origin, and modes of transmission, did not show any statistically significant differences ($p > 0.05$). This suggests that Erasmus mobility alone did not affect respondents' awareness across these core dimensions.

When analysing broader aspects, namely perceived occurrence, prevention, risk perception, level of information, perceived impact of climate change, travel experience, the possibility of malaria transmission to Europe, and fear of infection a statistically significant difference was found only in fear of infection ($p = 0.003$). Respondents who had participated in the Erasmus programme showed different scores in this dimension compared to those who had not. No significant differences were identified in the remaining dimensions ($p > 0.05$) (**Figure 5**).

DISCUSSION

The findings of this study demonstrated that prior experience with traveling to endemic regions significantly influences risk perception of malaria among university students. This observation is consistent with the results of [15], which confirmed that personal experience of living in high-risk environments increases perceived vulnerability and willingness to adopt preventive measures. Similarly, the study in [17] identified that travelers with limited knowledge of malaria were more likely to underestimate the need for prevention, resulting in insufficient preparedness during their stay in endemic areas.

Our research also revealed that female students perceive malaria transmission as a more serious threat compared to male students. These gender differences in health risk perception were also described in [18], where women reported higher levels of concern and were more likely to use preventive tools. This disparity may be further shaped by social factors, including women's greater involvement in issues of personal health and safety [19].

In terms of knowledge levels, students from natural sciences and pedagogical disciplines demonstrated greater awareness of malaria transmission, symptoms, and prevention strategies. Similar outcomes were reported in [20], which found that students in health-related fields achieved higher scores in malaria knowledge assessments compared to their peers from other study areas. Our study therefore underscores the importance of integrating topics related to tropical diseases into non-medical study programs as well. This approach aligns with the insights of [21], which highlights the role of health education in improving global health and its growing significance in infectious disease prevention.

A notable finding was that a considerable proportion of respondents (71.80%) regarded vaccination as the most effective form of malaria prevention. This perception reflects a common misconception, particularly in non-endemic regions, where vaccination is often viewed as a definitive preventive solution. However, currently available malaria vaccines provide only partial protection and are primarily implemented in selected endemic countries, with limited availability in Europe.

Therefore, the high level of confidence in vaccination observed in this study likely indicates an overestimation of its real-world effectiveness and accessibility among European students. This finding highlights the need for improved health education focusing on evidence-based preventive strategies, particularly the continued importance of insecticide-treated bed nets, chemoprophylaxis, and personal protective measures, which remain the most effective interventions for malaria prevention.

Age also appeared to be a relevant factor influencing preventive behavior: older students demonstrated greater levels of concern and a stronger motivation to seek information about protective measures. These findings are in line with [16], which reported that younger travelers tended to perceive malaria risks as less severe, which resulted in lower adherence to preventive behavior despite objectively higher exposure to risk during travel. Our study further confirmed the insufficient use of pre-travel medical counseling, only a proportion of respondents reported actively seeking professional advice on malaria-related risks before visiting potentially high-risk regions. This finding echoes the results of [17], which observed that travelers frequently obtain only basic information about their destination while neglecting preventive measures, particularly when they perceive the risk as minimal.

Finally, environmental and community factors that influence malaria transmission should not be overlooked, even in the European context. As emphasized in [22, 23], both individual decisions and broader infrastructural and social conditions, such as housing quality, access to healthcare, and community engagement, play a decisive role in prevention. In this regard, the university environment represents an important platform for raising awareness and promoting education about tropical diseases, particularly in the context of increasing global student mobility. Given that students will assume important professional roles in the future, they may serve as a key channel for disseminating information on prevention and for adopting public health strategies.

CONCLUSION

This study provides valuable insight into how European university students perceive the risk of malaria and how their knowledge varies based on demographic and contextual variables. Although malaria is often viewed as a distant tropical disease, increasing global mobility and climate change have reintroduced the possibility of its re-emergence in non-endemic regions such as Europe. Understanding public perceptions in this context is crucial for early awareness, preparedness, and risk communication.

The findings reveal a mixed level of knowledge: while a majority of students correctly identified mosquito bites as the primary transmission route, misconceptions remain concerning malaria's mortality and etiology. Notably, nearly half of respondents incorrectly identified a virus as the cause of malaria, and over one-fifth believed the disease is not fatal. These knowledge gaps suggest insufficient coverage of tropical and vector-borne diseases in general education. In addition, the study found statistically significant associations between variables such as gender, age, field of study, international experience and students' attitudes toward malaria. This underlines the importance of tailored educational interventions that consider students' academic and personal backgrounds.

Despite these important contributions, the study has several limitations. The sample was restricted to university students in Slovakia and the Czech Republic, which may not reflect the perceptions of the broader public or students in other European contexts. Additionally, the cross-sectional design prevents causal inference, and the use of self-reported data may be affected by recall bias or social desirability effects. The reliance on an online survey may also have excluded students with limited digital access or differing levels of engagement.

Future research should consider a more diverse and international sample, including non-student populations, to capture a wider spectrum of knowledge and risk perception. Longitudinal designs or intervention studies could help evaluate the long-term effects of educational campaigns or curriculum reforms. Furthermore, qualitative studies could explore the reasoning behind misconceptions and the emotional or cultural framing of disease risk.

From a practical perspective, integrating accurate and accessible information about malaria and other vector-borne diseases into university curricula, especially in non-medical fields, may enhance preparedness and public health responsiveness. Such educational efforts can play a key role in fostering informed global citizenship and equipping future generations with the tools to navigate complex health risks in a changing world.

Author contributions: **VP:** conceptualization, methodology, supervision, and writing–review & editing; **II:** conceptualization, formal analysis, writing–original draft, and project administration; **AM:** data curation, formal analysis, visualization, and writing–review & editing; **JT:** conceptualization; & **KI:** resources and writing–review & editing. All authors agreed with the results and conclusions.

Funding: No funding source is reported for this study.

Acknowledgments: The authors would like to thank all participating students for their time and willingness to contribute to this research.

Ethical statement: The authors stated that the study involved anonymous, voluntary questionnaire-based research among adult university students and did not collect any personally identifiable or sensitive data. Participation was entirely voluntary. Respondents were informed about the purpose of the study, data confidentiality, and their right to withdraw at any time. The authors further stated that, according to institutional guidelines and national legislation applicable to non-invasive, anonymous survey research, formal ethical committee approval was not required for this type of study. All procedures were conducted in accordance with the principles of the Declaration of Helsinki and applicable data protection regulations (GDPR).

AI statement: The authors stated that they used generative AI tools solely for language editing and improvement of academic phrasing. All scientific content, data analysis, interpretations, and conclusions were developed independently by the authors, who take full responsibility for the integrity and accuracy of the manuscript.

Declaration of interest: No conflict of interest is declared by the authors.

Data sharing statement: Data supporting the findings and conclusions are available upon request from the corresponding author.

REFERENCES

1. Mulaw T, Wubetu M, Dessie B, Demeke G, Molla Y. Evaluation of antimalarial activity of the 80% methanolic stem bark extract of *combretum molle* against *plasmodium berghei* in mice. J Evid Based Integr Med. 2019;24:2515690X19890866. https://doi.org/10.1177/2515690X19890866 PMid:31793332 PMCid:PMC6891006
2. Iľko I, Peterková V, Strelková L, Obuch M, Pálešová D. Komáre a biocídy [Mosquitoes and biocides]. Pedagogická fakulta Trnavskej univerzity v Trnave; 2020.
3. WHO. World malaria report 2018. World Health Organization; 2018.
4. WHO. World malaria report 2024. World Health Organization; 2024.
5. Villena OC, Ryan SJ, Murdock CC, Johnson LR. Temperature impacts the environmental suitability for malaria transmission by anopheles gambiae and anopheles stephensi. Ecology. 2022;103(8):e3685. https://doi.org/10.1002/ecy.3685 PMid:35315521 PMCid:PMC9357211
6. Ryan SJ, Lippi CA, Villena OC, Singh A, Murdock CC. Mapping current and future thermal limits to suitability for malaria transmission by the invasive mosquito anopheles stephensi. Malar J. 2023;22(1):104. https://doi.org/10.1186/s12936-023-04531-4 PMid:36945014 PMCid:PMC10029218
7. Beck-Johnson LM, Nelson WA, Paaijmans KP, Read AF, Thomas MB, Bjørnstad ON. The effect of temperature on Anopheles mosquito population dynamics and the potential for malaria transmission. PLoS One. 2013;8(11):e79276. https://doi.org/10.1371/journal.pone.0079276 PMid:24244467 PMCid:PMC3828393
8. Mischlinger J, Rönnberg C, Álvarez-Martínez MJ, et al. Imported malaria in countries where malaria is not endemic: A comparison of semi-immune and nonimmune travelers. Clin Microbiol Rev. 2020;33(2):e00104. https://doi.org/10.1128/CMR.00104-19 PMid:32161068 PMCid:PMC7067581
9. ECDC. Malaria: Annual epidemiological report for 2014. European Centre for Disease Prevention and Control; 2014.
10. Hallmaier-Wacker LK, van Eick MD, Briët O, et al. Airport and luggage (odyssean) malaria in Europe: A systematic review. Malar J. 2024;29(41):2400237. https://doi.org/10.2807/1560-7917.ES.2024.29.41.2400237 PMid:39391992 PMCid:PMC11484919
11. Vanitha R, Abelein F, Stoyanova KP. Imported and non-travel related cases of malaria in Europe–A ten-year analytic retrospective review. Folia Med (Plovdiv). 2025;67(4).
12. Wieters I, Eisermann P, Emmerich P, et al. Airport malaria in non-endemic countries: New insights into mosquito transmission. Travel Med Infect Dis. 2019;28:59-66.
13. Carvalho GS, Vilaça T. Health promotion in schools, universities, workplaces, and communities. Front Public Health. 2024;12:1528206. https://doi.org/10.3389/fpubh.2024.1528206 PMid:39703484 PMCid:PMC11655455
14. Mugwagwa N, Mberikunashe J, Gombe NT, Bangure D, Rusakaniko S. Factors associated with malaria infection in Honde Valley, Mutasa District, Zimbabwe, 2014: A case control study. BMC Res Notes. 2015;8:829. https://doi.org/10.1186/s13104-015-1831-3 PMid:26715520 PMCid:PMC4693426
15. Asinngizwe D, Poortvliet PM, Koenraadt CJM, et al. Role of individual perceptions in the consistent use of malaria preventive measures: Mixed methods evidence from rural Rwanda. Malar J. 2019;18(1):270. https://doi.org/10.1186/s12936-019-2904-x PMid:31395048 PMCid:PMC6686450
16. Tardivo S, Zenere A, Moretti F, et al. The traveller's risk perception (TRiP) questionnaire: Pre-travel assessment and post-travel changes. Int Health. 2020;12(2):116-24. https://doi.org/10.1093/inthealth/ihz033 PMid:31294781 PMCid:PMC7057134
17. Voumard R, Berthod D, Rambaud-Althaus C, D'Acremont V, Genton B. Recommendations for malaria prevention in moderate to low risk areas: Travellers' choice and risk perception. Malar J. 2015;14:139. https://doi.org/10.1186/s12936-015-0654-y PMid:25889529 PMCid:PMC4396190
18. Quaresima V, Agbenyega T, Oppong B, et al. Are malaria risk factors based on gender? A mixed-methods survey in an urban setting in Ghana. Trop Med Infect Dis. 2021;6(3):161. https://doi.org/10.3390/tropicalmed6030161 PMid:34564545 PMCid:PMC8482108
19. Wang Y, Hunt K, Nazareth I, Freemantle N, Petersen I. (Do men consult less than women? An analysis of routinely collected UK general practice data. BMJ Open. 2013;3(8):e003320. https://doi.org/10.1136/bmjopen-2013-003320 PMid:23959757 PMCid:PMC3753483

20. Anene-Okeke CG, Isah A, Aluh DO, Ezeme AL. Knowledge and practice of malaria prevention and management among non-medical students of University of Nigeria, Nsukka. Int J Commun Med Public Health. 2018;5(6). https://doi.org/10.18203/2394-6040.ijcmph20180220
21. Rizvi DS. Health education and global health: Practices, applications, and future research. J Educ Health Promot. 2022;11:262. https://doi.org/10.4103/jehp.jehp_218_22 PMid:36325224 PMCid:PMC9621358
22. Okwa OO, Onyeaghala CI, Baruwa SM, Olayele OA, Sulaimon R. Antimalarial preference and period prevalence of malaria among students in a university in South-Western, Nigeria. Open Acc Res J Biol Pharm. 2022;5(1):16-25. https://doi.org/10.53022/oarjbp.2022.5.1.0045
23. Ibrahim AO, Bello IS, Shabi OM, Fadairo OS, Adesina OA, Akinbami OS. Malaria infection and its association with socio-demographics, preventive measures, and co-morbid ailments among adult febrile patients in rural Southwestern Nigeria. SAGE Open Med. 2022;10:20503121221117853. https://doi.org/10.1177/20503121221117853 PMid:36051785 PMCid:PMC9424889