RESEARCH ARTICLE

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Thai Teachers' Knowledge, Attitude, and Awareness of E-Cigarette Use among Youth: A Sex-Based Comparative Analysis

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Abstract

Background: The rising prevalence of e-cigarette use among adolescents in Thailand poses significant public health concerns, particularly due to its association with increased risks of nicotine addiction and potential progression to traditional tobacco use. Educators play a pivotal role in tobacco prevention efforts; however, disparities in their knowledge, attitudes, and awareness may influence the effectiveness of such interventions. Objective: To assess sex-based differences in knowledge, attitudes, and awareness regarding e-cigarette use among secondary school teachers in Thailand, aiming to inform targeted educational strategies. **Methods:** A cross-sectional study was conducted involving 498 secondary school teachers from Bangkok and central Thailand. Participants completed a validated questionnaire assessing their knowledge, attitudes, and awareness related to e-cigarette use (Cronbach's alpha 0.80–0.88). Statistical analyses included descriptive statistics, independent t-tests to evaluate sex differences, and linear regression to identify predictors of awareness. **Results:** Female teachers exhibited significantly higher mean scores in knowledge (M=11.03, SD=2.03), attitudes (M=3.98, SD=0.56), and awareness (M=4.09, SD=0.44) compared to male teachers (knowledge: M=10.51, SD=2.47; attitudes: M=3.68, SD=0.60; awareness: M=3.93, SD=0.53), with all differences reaching statistical significance ($p<0.05$). Regression analyses revealed that both knowledge ($\beta = 0.606$ for females, $\beta = 0.597$ for males) and attitudes ($\beta = 0.151$ for females, $\beta = 0.191$ for males) were significant predictors of awareness for both males and females ($R^2 = 0.547$ for males; $R^2 = 0.519$ for females). **Conclusion:** The study observed noteworthy sex differences in teachers' perceptions and understanding of e-cigarette use, with female teachers demonstrating greater knowledge, more positive attitudes, and higher awareness. These findings underscore the need for sex-sensitive educational interventions to enhance the role of all educators in tobacco prevention efforts among youth.

Keywords: e-cigarettes- knowledge- attitudes- awareness- tobacco prevention

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Introduction

The prevalence of electronic cigarette (e-cigarette) use among adolescents has emerged as a salient public health issue both globally and within the context of Thailand [1, 2]. E-cigarettes, defined as battery-operated devices that administer nicotine and various other chemicals via inhaled aerosol, are frequently promoted as ostensibly safer alternatives to conventional tobacco products. Nonetheless, a substantial body of evidence underscores their detrimental health impacts, encompassing respiratory illnesses, nicotine dependence, and a heightened risk of progression to the use of traditional cigarettes [2, 3]. This progression increases the likelihood of long-term tobacco use, which is directly linked to cancer risk due to exposure to carcinogenic compounds [4]. These substances contribute to oxidative stress, DNA damage, and inflammation biological processes associated with the development of cancers, particularly those affecting the lungs and oral cavity [4, 5]. If left unaddressed, adolescent e-cigarette use may contribute to rising rates of oral and lung cancers in Thailand through prolonged nicotine exposure and subsequent tobacco use [6].

Recent national surveys have indicated an upward trajectory in the incidence of e-cigarette usage among Thai youths aged 15 to 24 years, with the highest prevalence observed in urban and central regions [7, 8]. Factors contributing to this escalating trend include enhanced accessibility via online platforms, the availability of flavored products, and widespread misinformation surrounding their safety profile. These developments present significant challenges for educational institutions, where educators assume a critical role in promoting health, modeling behavioral norms, and facilitating early intervention strategies [9].

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Teachers are ideally positioned to influence students' knowledge, attitudes, and awareness regarding e-cigarette risks [10, 11]. Their understanding and perceptions of e-cigarette use can significantly shape the effectiveness of school-based prevention programs[3]. Although this critical role has been acknowledged, there remains a paucity of research examining the extent to which educators' demographic characteristics particularly gender—impact their engagement in tobacco prevention initiatives [12]. Existing literature has documented sex-based disparities in domains such as health communication, information-seeking behaviors, and receptivity to public health campaigns [13]. For example, female educators may demonstrate heightened health awareness or possess stronger protective attitudes towards the well-being of their students. Comprehending the existence of such disparities within the framework of e-cigarette prevention is imperative for the formulation of inclusive and effective intervention strategies.

Prevention efforts must therefore begin early and extend into schools, where teachers serve as key influencers. It is essential to equip educators with current knowledge and awareness about the risks associated with e-cigarette use, as this can significantly contribute to reducing the future incidence of tobacco-related cancers. In this context, "awareness" encompasses teachers' understanding of the health risks, legal regulations, and the necessity for effective prevention strategies related to e-cigarette usage. This research aims to investigate the disparities in knowledge, attitudes, and awareness concerning the e-cigarette issue among secondary school teachers in Bangkok and the central region of Thailand. The results will provide empirical evidence that can inform the creation of gender-responsive health education strategies and strengthen the role of teachers as key contributors to preventing e-cigarette use among youth. Furthermore, by equipping educators with evidence-based knowledge, schools can function as pivotal environments for early cancer prevention through initiatives aimed at reducing tobacco-related risks among young people.

Materials and Methods

Study Design and Setting

This study employed a cross-sectional descriptive design and used the data from prior research [14] to examine sex-based differences in knowledge, attitude, and awareness of secondary school teachers toward the e-cigarette problem among youth. Data were collected from teachers working in schools under the jurisdiction of the Office of the Basic Education Commission (OBEC) in Bangkok and the central region of Thailand. Bangkok and the central region were chosen due to their higher prevalence of e-cigarette use, urban school density, and access to technology for online surveys. However, findings may not fully represent rural or southern provinces, where health literacy, access to prevention programs, and digital access may differ significantly.

Participants and Sampling

The study sample was secondary school teachers teaching grades 7 to 12. Participants were selected using multi-stage sampling. First, 23 provinces and districts were identified, comprising educational service areas in Bangkok and the central region. Then, schools were randomly selected from each area. Teachers from the selected schools were invited to participate through an online questionnaire distributed via Google Forms.

Sample size calculation was performed using G*Power version 3.1, targeting a medium effect size (Cohen's d = 0.3) [15], a significance level of 0.05 [16], and a power of 0.91. The minimum required sample size was 404; to account for potential non-response or incomplete data, 25% was added, yielding a final target sample size of 505. In total, 505 responses were collected; however, seven were excluded due to incompleteness, resulting in 498 valid responses included in the final analysis.

Research Instrument

The instrument used was a self-administered questionnaire developed through a literature review and adapted from previously validated tools focused on e-cigarette knowledge, attitudes, and awareness. Five experts in health education and tobacco control reviewed the content for validity. A pilot test with 30 secondary school teachers was conducted to ensure clarity and cultural appropriateness, leading to minor refinements prior to full-scale administration.

Demographic Information: sex, age group, education level, and province

Knowledge

The assessment consists of 15 true/false questions designed to evaluate individuals' understanding of e-cigarettes, their health impacts, and the relevant legal regulations surrounding them. Participants' scores on this assessment can range from 0 to 15, where a higher score reflects a more comprehensive knowledge of the subject matter.

Attitudes

The tool was assessed using a 15-item inventory, with each item rated on a 5-point Likert scale, where 1 indicates strong disagreement and 5 signifies strong agreement. The items included a combination of positively and negatively phrased statements to capture a comprehensive range of attitudes. The resulting scores were categorized into three distinct interpretations: low (1.00–2.60), moderate (2.61–3.40), and high (3.41–5.00), thus providing a nuanced understanding of respondents' attitudes.

Awareness

This tool comprises 15 items, each rigorously evaluated on a 5-point Likert scale designed to measure individuals' awareness regarding e-cigarette-related health risks, legal regulations, and the necessity for effective prevention and control strategies. This definition was applied consistently across all sections of the study to reflect a comprehensive understanding of awareness within the school context. The resulting scores were categorized into five distinct interpretations: very low (1.00–1.80), low (1.81–2.60), moderate (2.61–3.40), and

high (3.41–5.00), thus providing a nuanced understanding of respondents' awareness.

Content validity was reviewed by five experts in health education and tobacco control, yielding an Item-Objective Congruence (IOC) index of 0.70–1.00. Internal consistency reliability was assessed using Cronbach's alpha: 0.80 for the attitude section and 0.81 for the awareness section. The knowledge section had a KR-21 reliability coefficient of 0.88.

Data Collection

Data collection occurred over a 30-day period. Participants provided informed consent electronically before completing the questionnaire. Ethical approval was obtained from the Human Research Ethics Committee of Chiang Mai Rajabhat University (IRB No. IRBCMRU 2022/224.26.09). Participants were informed of their right to withdraw at any point without penalty. All data were anonymized and stored securely to ensure confidentiality.

Data Analysis

The data analysis was conducted using SPSS software, specifically version 28, to ensure accurate and reliable statistical evaluation. Descriptive statistics were employed to effectively summarize the demographic characteristics of the participants, as well as their scores related to knowledge, attitude, and awareness. To assess differences between male and female participants, independent sample t-tests were utilized, allowing for a thorough comparison of mean scores across sexes. The threshold for statistical significance was established at $p < 0.05$, indicating the level at which the results would be considered statistically meaningful.

Results

Participant Characteristics

Of the 498 secondary school teachers who participated, 212 (42.6%) were male and 286 (57.4%) were female. The majority of participants were aged 21–30 years (51.81%), held an undergraduate degree (71.29%), and were from the northern region (73.29%). There were no statistically significant differences in education level or geographic location by sex; however, age distribution differed significantly ($p = 0.015$), with a higher proportion of younger female teachers (see Table 1).

Sex Differences in Levels of Knowledge, Attitude, and Awareness

Female teachers had significantly higher mean scores than males in all three areas: knowledge ($p = 0.010$), attitude ($p < 0.001$), and awareness ($p = 0.004$), suggesting that sex plays a role in shaping perceptions and readiness to address the e-cigarette problem among youth (see Table 2).

Factors Predicting Awareness of Secondary School among Teachers

Table 3 presents the results of linear regression models predicting awareness scores among male and female teachers, using knowledge, attitude, education level, and geographic location as independent variables. For both groups, knowledge and attitude were significant predictors. Among males, attitude ($\beta = 0.597$, $p < 0.001$) and knowledge ($\beta = 0.191$, $p = 0.005$) were significant predictors of awareness. Among females, attitude ($\beta = 0.606$, $p < 0.001$) and knowledge ($\beta = 0.151$, $p = 0.008$) were also significant predictors. Education level and geographic location were not significant predictors in either group.

Discussion

The results of this study provide valuable insights into the sex-based disparities in knowledge, attitude, and awareness regarding the e-cigarette issue among secondary school teachers in Thailand. Female teachers demonstrated significantly higher scores across all domains compared to their male counterparts. These findings are consistent with prior research showing that female educators tend to be

Table 1. Participants' Demographics by Sex

Variables		Total (n = 498) n (%)	Male (n = 212) n (%)	Female (n = 286) n (%)	P-value
Age (year)					
	21 – 30	258 (51.81)	96 (45.28)	159 (55.59)	0.015[a]
	31- 40	162 (32.53)	73 (34.43)	93 (32.52)	
	41 – 50	51 (10.24)	31 (14.62)	19 (6.64)	
	> 50	27 (5.42)	12 (5.66)	15 (5.24)	
Education Level					
	Diploma	10 (2.01)	4 (1.89)	6 (2.10)	0.245[b]
	Undergraduate degree	355 (71.29)	144 (67.92)	211 (73.78)	
	Master's degree	125 (2.10)	62 (29.25)	63 (22.02)	
	Doctoral Degree	8 (1.61)	2 (0.94)	6 (2.10)	
Geographic locations					
	Northern Region	365 (73.29)	163 (76.89)	202 (70.63)	0.724[a]
	Central Region	133 (26.71)	49 (23.11)	84 (29.37)	

Note: a, chi-squared test; b, Fisher's exact test; significance level $p < 0.05$

Table 2. Sex Differences in Levels of Knowledge, Attitude, and Awareness of Secondary School Teachers

Variables	Range	Total (n = 498) Mean (SD)	Interpretation	Male (n = 212) Mean (SD)	Female (n = 286) Mean (SD)	P-value
Knowledge	2-15	10.81 (2.24)	Good	10.51 (2.47)	11.03 (2.03)	0.010*
Attitude	1-5	3.85 (0.60)	High	3.68 (0.60)	3.98 (0.56)	<.001*
Awareness	1-5	4.02 (0.49)	Very High	3.93 (0.53)	4.09 (0.44)	0.004*

Note: *significance level p< 0.05; Female teachers had significantly higher scores than male teachers across all domains

Table 3. Factors Predicting Awareness of Secondary School among Teachers

Factors	Male (N = 212)				Female (N = 286)			
	β	Std.	t	p-value	β	Std.	t	p-value
(Constant)		3.387	7.528	<.001		2.495	11.198	<.001
Education level	-0.03	2.78	-0.628	0.531	0.011	1.958	0.26	0.795
Geographic locations	0.022	0.905	0.464	0.643	-0.064	0.602	-1.555	0.121
Knowledge	0.191	0.216	2.861	0.005	0.151	0.184	2.678	0.008
Attitudes	0.597	0.057	9.072	<.001	0.606	0.043	10.885	<.001
	R^2 = 0.547, Adjusted R^2 = 0.538, F = 62.435, p-value <0.001				R^2 = 0.519, Adjusted R^2 = 0.512, F = 75.686, p-value <0.001			

more engaged in health promotion activities and possess higher health literacy levels [17, 13, 8].

One explanation for this trend may lie in gendered differences in educational engagement and emotional investment in student well-being. Female teachers may be more likely to seek health-related information or participate in professional development opportunities related to student health [1, 3]. This is particularly relevant in the context of youth-targeted public health crises [18], such as the increasing use of e-cigarettes, where early detection and intervention by educators can play a pivotal role [9, 19, 20].

The significantly higher attitude scores among female teachers suggest a greater sense of responsibility or concern toward the issue, potentially influenced by their caregiving roles and heightened sensitivity to behavioral risks in adolescents. These findings align with studies indicating that female educators often express stronger anti-tobacco sentiments and are more proactive in integrating health promotion into their teaching practices [10, 11, 2].

Awareness, defined as a teacher's recognition of the problem's scope and urgency, was also significantly higher among female teachers. This heightened awareness may enable more effective prevention efforts and policy enforcement within schools[7]. As awareness was significantly predicted by both knowledge and attitude in regression analyses for both sexes, these findings underscore the interrelated nature of these domains [21, 22]. Enhancing knowledge and fostering positive attitudes can therefore serve as critical levers for increasing awareness and, ultimately, influencing teacher-led interventions [3, 23].

The observed disparities between male and female teachers raise important considerations for public health policy and school-based intervention design. Targeted training programs should be developed to engage male teachers more effectively. These could include gender-sensitive content, interactive workshops, and peer-led initiatives that appeal to diverse learning preferences and professional motivations [9]. Additionally, integrating tobacco and e-cigarette education into existing teacher development frameworks could ensure widespread exposure to critical health information across both sexes [10].

From a public health perspective, this study reinforces the need for comprehensive, multi-level strategies to combat youth e-cigarette use, particularly in the context of cancer prevention. Research has shown that e-cigarette usage among youth is not only associated with nicotine dependence but can also lead to an increased risk of using traditional combustible tobacco products, which are well-established risk factors for cancer [6]. Teachers are not merely facilitators of academic learning they are influential role models and frontline advocates for student health [23]. Through the dissemination of evidence-based knowledge pertaining to the hazards associated with e-cigarette utilization and its correlations with cancer, alongside the cultivation of constructive attitudes and the augmentation of situational awareness, we can engender a ripple effect that permeates among students, families, and broader communities [3, 17]. This holistic approach can significantly contribute to reducing cancer-related risks among the youth.

Although the study offers significant contributions, it is not without limitations. The reliance on self-reported data may introduce social desirability bias, and the focus on Bangkok and central Thailand may limit the generalizability of the findings. Future research should explore longitudinal impacts of teacher-based interventions and examine other demographic factors such as teaching experience or school setting that may influence outcomes.

In conclusion, the discourse underscores the pressing necessity for sex-responsive educational strategies and emphasizes the role of educators as pivotal change agents

in effectively addressing the e-cigarette epidemic among youth. It is imperative that policymakers and educational leaders consider these findings to formulate inclusive and impactful prevention initiatives that optimize the potential contributions of educators. Additionally, the findings advocate for the incorporation of sex-sensitive training modules within teacher professional development programs, which should address behavioral health risks and early prevention of tobacco use. Ministries of Education and Public Health are encouraged to integrate e-cigarette prevention curricula into school policies to enhance overall educational effectiveness and student well-being.

The findings of this study demonstrate a significant degree of robustness; however, it is essential to acknowledge several limitations inherent to the study. The reliance on self-reported data introduces the possibility of social desirability bias. Furthermore, although the sample is representative of Bangkok and central Thailand, it may not adequately reflect the perspectives of teachers in rural or other geographical contexts. The use of online surveys may introduce selection bias, favoring more tech-savvy or health-conscious respondents. Future research should consider mixed-mode data collection. Moreover, the cross-sectional design constrains causal interpretations. Notwithstanding these limitations, the findings offer significant insights into the influence of gender on educators' perceptions regarding youth e-cigarette use, thereby illuminating potential avenues for the customization of targeted interventions. Given that the sample was drawn from Bangkok and the central region, caution should be taken when generalizing findings to rural areas of Thailand. Teachers in rural communities may have different levels of digital literacy, exposure to health information, and engagement with tobacco control initiatives, which could influence their knowledge, attitudes, and awareness.

In conclusion, this study revealed significant sex differences in knowledge, attitude, and awareness regarding the e-cigarette problem among secondary school teachers in Thailand. Female teachers consistently reported higher scores across all domains, indicating greater engagement with the issue. Furthermore, both knowledge and attitude were significant predictors of awareness for male and female teachers alike. These findings underscore the importance of integrating sex-sensitive approaches into teacher training and health education programs. By addressing gaps in knowledge and strengthening attitudes toward prevention, schools can better position educators to play a proactive role in combating youth e-cigarette use. Future interventions should consider tailoring content and strategies to meet the specific needs of male and female teachers, thereby promoting equity in health promotion efforts within educational settings.

Author Contribution Statement

Conceptualization, J.S., C.T., and K.T.; methodology, J.S., and C.T.; software, C.T., and K.T; validation, T J.S., C.T., and K.T.; formal analysis, J.S., C.T., and K.T.; writing original draft preparation, J.S., C.T., and K.T.; writing review and editing, J.S., C.T., and K.T.; All authors have read and agreed to the published version of the manuscript.

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Ethical Considerations

The study received approval from the Human Research Ethics Committee of Chiang Mai Rajabhat University (IRB No. IRBCMRU 2022/224.26.09). This study was also conducted in accordance with the Declaration of Helsinki. All study participants gave their informed consent prior to data collection.

Conflicts of interest

The authors declare that they have no conflicts of interest in this work.

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