RISING TRENDS IN CURRENT TOBACCO USE AMONG ACTIVE-DUTY PERSONNEL OF THE ROYAL THAI ARMY IN THAILAND FROM 2017 TO 2022 AND ITS ASSOCIATED METABOLIC RISK FACTORS FOR CARDIO-VASCULAR DISEASE IN 2022

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Abstract

Background: Tobacco use is a well-established risk factor for developing cardiovascular disease (CVD). In recent years, the prevalence of metabolic risk factors for CVD has been increasing among Royal Thai Army (RTA) personnel in Thailand. Despite a decline in tobacco use, an essential life-style risk factor, among Thai civilians from 2015 to 2020, it is unclear how common it is among RTA personnel.

Objectives: This study aimed to determine the trends of current tobacco use among active-duty RTA personnel from 2017 to 2022 and to evaluate the association between tobacco use and metabolic risk factors for CVD among this population in 2022.

Methods: A serial cross-sectional study was carried out using data from the annual health examination database of RTA personnel from 2017 to 2022. The study included 614,198 active-duty RTA personnel aged 20-60. Current tobacco use was defined as smoking within the previous 12 months. Each year's adjusted current tobacco use prevalence was estimated using direct standardization to the 2022 study population as a reference. The multivariable logit model was used to evaluate the association between tobacco use and metabolic risk factors for CVD in 2022, presented as an adjusted prevalence ratio (APR) and 95% confidence interval (CI).

Results: The age- and sex-adjusted prevalence of current tobacco use among RTA personnel increased from 28.4% (95% CI: 28.1-28.7) in 2017 to 33.2% (95% CI: 33.9-33.4) in 2022, *p* for trend = 0.021. In men, the age-adjusted prevalence of current tobacco use was 31.8% in 2017 and increased to 36.5% in 2022, *p* for trend = 0.032. For women, it was 1.1% in 2017 and rose to 5.7% in 2022, *p* for trend = 0.032. A significant association between current tobacco use and the prevalence of metabolic risk factors for CVD was observed, including diastolic blood pressure ≥ 90 mmHg (APR 1.04; 95% CI 1.01-1.07), fasting plasma glucose ≥ 126 mmHg (APR 1.26; 95% CI 1.18-1.34), and triglyceri-demia ≥ 150 mg/dL (APR 1.28; 95% CI 1.25-1.31).

Conclusion: The prevalence of current tobacco use among active-duty RTA personnel increased from 2017 to 2022. Additionally, a significant association between tobacco use and metabolic risk factors for CVD was observed. Tobacco cessation should be facilitated in this population to attenuate the risk of CVD later.

Keywords: tobacco use, prevalence, blood pressure, hyperglycemia, hypertriglyceridemia

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Introduction

Tobacco use is one of the significant shared risk factors for noncommunicable diseases (NCDs)[1], including cardiovascular diseases (CVD)[2], diabetes[3], cancer[4], and chronic respiratory diseases.[5] The World Health Organization (WHO) indicated that tobacco usage has steadily declined over the past 20 years.[6] Globally, tobacco use prevalence was 32.7% in 2000 and dropped to 22.3% in 2020. Decreased tobacco use prevalence was discovered in both men and women.[6] Men's rates fell from 49.3% in 2000 to 36.7% in 2020, while women's rates were 16.2% in 2000 and 7.8% in 2020.[6] Furthermore, regarding the WHO regions, the Southeast Asia region is estimated to have the highest average rate of tobacco use compared to all other regions, with almost 50% in 2000 and falling to 29% in 2020.[6]

In Thailand, the National Health Examination Survey (NHES) V and VI demonstrated decreasing trends in the prevalence of current tobacco use among Thai adults, from 19.5% in 2014-2015[7] to 18.7% in 2019-2020.[8] Among Thai men, the prevalence of current tobacco use was 37.5% in the NHES V[7] and declined to 35.5 % in the NHES VI.[8] At the same time, current tobacco use prevalence among Thai women was 2.6% and 2.8% in the NHES V and VI.[7, 8]

Recent studies in Thailand unveiled that active-duty Royal Thai Army (RTA) personnel faced a high risk for CVD[9,10], especially metabolic risk factors, such as high blood pressure (BP) [11], hyperglycemia [12], high total cholesterol (TC) [13], and hypertriglyceridemia.[14] Furthermore, RTA personnel have seen a noticeable increase in the predicted 10-year CVD risk from 2017 to 2021.[15] This trend was highlighted in a study by Sakboonyarat et al. in 2023. The study reported that the prevalence of intermediate-to-high predicted 10-year CVD risk among RTA personnel rose from 24.9% in 2017 to 29.5% in 2021.[15] The authors hypothesized that tobacco use significantly contributes to this rising trend. However, more detailed information on tobacco use among RTA personnel must be provided. Across the country, approximately 100,000 active-duty RTA personnel participate in an annual health examination. In the present study, we aimed to estimate current tobacco use prevalence trends among active-duty RTA personnel using a large dataset from the RTA's health examination database from 2017 to 2022. Furthermore, we also determined the association between tobacco use and metabolic risk factors for CVD among this population using data from 2022.

Methods

Study design and subjects

We conducted a series of cross-sectional studies from 2017 to 2022. After receiving approval from the RTA medical departments (RTAMED) in Thailand, information was gathered from the RTA personnel health examination database. Details of the study were published by Sakboonyarat et al. elsewhere.[10] Briefly, RTAMED conducts physical health examinations for active-duty RTA personnel annually through the Army Institute of Pathology, the Armed Forces Research Institute of Medical Sciences, and 37 RTA hospitals across the country.[10] Active-duty RTA personnel aged 18 to 60 who took part in the health examination were included in the current study. The study aimed to estimate the prevalence of current tobacco use; therefore, RTA personnel who did not have information on tobacco use were excluded from the

analysis (**Figure 1**). The sample size was calculated based on the prevalence of current smokers among Thai adults (18.7%) from the NHES VI [8], according to $\alpha = 0.05$ and error (d) = 5% of the prevalence. Therefore, the minimum calculated sample size in the present study was 6,681 individuals.[16] Furthermore, the data were collected for all eligible RTA personnel to enhance the generalizability and represent the prevalence of current tobacco use among the RTA personnel.

Data sources

Active-duty RTA personnel used self-reported data to provide details on demographic traits and risk factors related to lifestyle during the physical health examination session. Demographic characteristics consist of sex, age, and health scheme, while lifestyle risk factors include smoking status, alcohol use, and exercise. Additionally, qualified healthcare providers followed the Thai Guidelines for treating hypertension (HTN) when measuring blood pressure (BP).[17] For RTA personnel aged 35 and over, laboratory tests, like fasting plasma glucose (FPG), total cholesterol (TC), and triglyceride (TG), were also tested. Before the health examination, RTA personnel fasted for 12 hours.

Outcomes variables

RTA personnel who reported smoking within the previous 12 months were considered current tobacco use. In contrast, those who had previously used tobacco but had quit more than 12 months earlier were considered ex-smokers.[8,13] Current alcohol use was defined as having reported a history of alcohol consumption within the previous 12 months. A minimum of three days per week and 30 minutes per day of exercise were considered regular.[13] High systolic blood pressure (SBP) was defined as an SBP of 140 mmHg or more, while high diastolic blood pressure (DBP) was defined as a DBP of 90 mmHg or more.[17] High FPG was determined as an FPG level of 126 mg/dL or higher.[12] High TC was identified as a serum TC level of 240 mg/dL or higher[13], while hypertriglyceridemia was indicated by a TG level of 150 mg/dL or higher.[14]

Statistical analysis

All data analyses were performed using StataCorp. 2021, *Stata Statistical Software: Release 17*, College Station, TX: StataCorp LLC. Descriptive statistics were used to describe the characteristics of study participants, with categorical data presented in percentages and continuous data displayed as mean and standard deviation (S.D.). We estimated the prevalence of current tobacco use among active-duty RTA personnel for each year from 2017 to 2022 and represented it as percentages along with a 95% confidence interval (CI). To calculate the age- and sex-adjusted prevalence of current tobacco use, we used the direct standardization method. To do this, we categorized individuals into sixteen age and sex categories: men aged 18–24, 25–29, 30–34, 35–39, 40–44, 45–49, 50–54 and 55–60 years, and women aged 18–24, 25–29, 30–34, 35–39, 40–44, 45–49, 50–54 and 55–60 years, using the 2022 study population as a reference. Furthermore, we calculated the age-adjusted current tobacco use prevalence, stratified by sex, and the age- and sex-adjusted current tobacco use prevalence, stratified by geographic region. We used a generalized linear model to examine the trends in the prevalence of current tobacco use from 2017 to 2022. We treated the adjusted prevalence over six years as the dependent variable and the year as the independent variable (total observations in the model, n = 6). We initially added a quadratic term to the model to assess the presence of a nonlinear trend. We tested for a linear trend if the result was not statistically significant.

We assessed the distribution of tobacco use across the risk factors for CVD among RTA personnel in 2022; the *Chi*-square test was used for categorical variables, while the analysis of variance (ANOVA) was tested for continuous variables. We also utilized a logit model with margins command (adjrr) to estimate the prevalence ratio (PR) and 95% CI, both adjusted and unadjusted, to determine the association between tobacco use and metabolic risk factors for CVD, including high SBP, high DBP, high FPG, high TC, and high TG in 2022. The analysis had three models.

Model 1 was a univariable analysis, while model 2 was a multivariable analysis adjusted for age and sex. Model 3 included the variables in Model 2 and the health scheme, regions, alcohol use, and exercise. Therefore, individuals with missing data on variables adjusted in model 3 were excluded, approximately 4.4%, 4.2%, 4.0%, and 3.4% for high BP, high FPG, high TC, and high TG models, respectively. All statistical tests were two-sided, and a *p*-value less than 0.05 was considered statistically significant.

Ethics consideration

The present study was reviewed and approved by the Institutional Review Board, Royal Thai Army Medical Department, following international guidelines, including the Declaration of Helsinki, the Belmont Report, CIOMS guidelines, and the International Conference on Harmonization of Technical Requirements for Registration of Pharmaceuticals for Human Use–Good Clinical Practice (ICH–GCP) (approval numbers S067h/64 and S056h/65). The Institutional Review Board, Royal Thai Army Medical Department, approved an informed consent waiver due to the use of secondary data.

Results

Characteristics of study participants

The study included 614,198 active-duty RTA personnel between 2017 and 2022. **Table 1** illustrates the characteristics of the study participants. In all, 90.8% were men, and the average age was 38.0 ± 11.3 years. Approximately one-third of the participants (34.9%) resided in the central region of Thailand. Most participants (97.5%) were under the civil servant medical benefit (CSMB).

Trends in current tobacco use among RTA personnel from 2017 to 2022

Growing trends in age- and sex-adjusted prevalence of current tobacco use from 2017 to 2022 were detected (**Table 2**). The prevalence of age- and sex-adjusted current tobacco use among participants enlarged from 28.4% (95% CI: 28.1-28.7) in 2017 to 33.2% (95% CI: 32.9-33.4) in 2022, with *p* for trend = 0.021. **Figure 1** explains rising trends in the sex-specific prevalence of current tobacco use over a six-year study period in both men and women. In 2017, the age-adjusted current tobacco use prevalence was 31.8% in men and 1.1% in women and escalated to 36.5% and 5.7% in 2022, respectively (*p* for trend = 0.032). Younger RTA personnel, notably those between the ages of 25 and 29, had a higher rate of current tobacco usage (**Figure 2**). Additionally, over six years, all age groups, except those aged 40-44 and 55-60, showed increasing trends in tobacco usage (**Figure 2**). Notably, among RTA personnel aged 30-34, the sex-adjusted prevalence of current tobacco use jumped by 7% from 2017 to 2022 (**Table 2**). From 2017 to 2022, there was a general upward trend in the age- and sex-adjusted prevalence of current tobacco use among RTA personnel dwelling in the central, northeast, and south. This trend was most pronounced in the south, which escalated by 17.7% over six years. At the same time, those in the north declined from 33.7% in 2017 to 25.4% in 2022, with *p* for trend of 0.003 (**Table 2**).

Association between tobacco use and metabolic risk factors for CVD among RTA personnel in 2022

Table 3 presents the distribution of tobacco use across risk factors for CVD among RTA personnel. After adjusting for several covariates such as age, sex, health scheme, regions, alcohol use, and exercise, the association between tobacco use and the prevalence of risk factors for CVD among RTA personnel was observed (Table 4). The results indicate that active-duty RTA personnel who use tobacco currently are more likely to have a higher prevalence of high DBP compared to those who never smoked, with an APR of 1.04 (95% CI: 1.01-1.07). Among RTA personnel, both individuals who previously smoked and those who currently use tobacco have a higher prevalence of high FPG compared to those who never smoked. The former group has an APR of 1.22 (95% CI: 1.14-1.32), while the latter group has an APR of 1.26 (95% CI: 1.18-1.34). Moreover, RTA personnel who previously smoked and those who currently smoke are more likely to experience high TG compared to individuals who

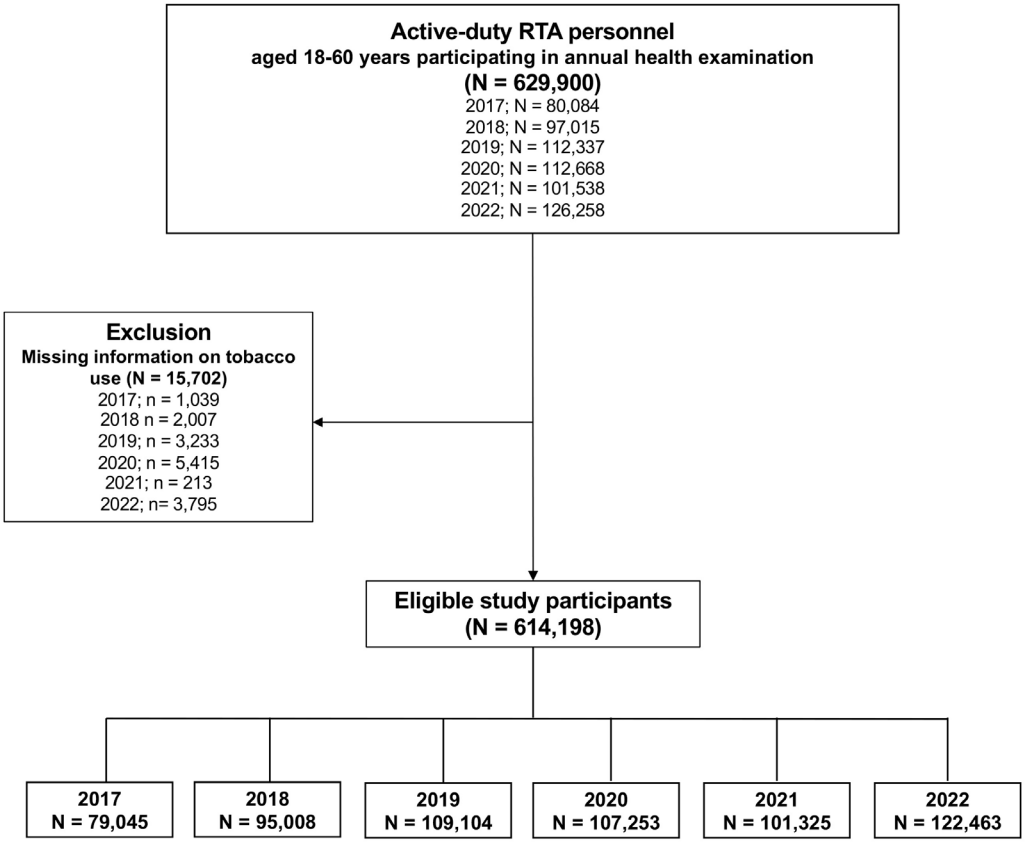

Figure 1. Study flow

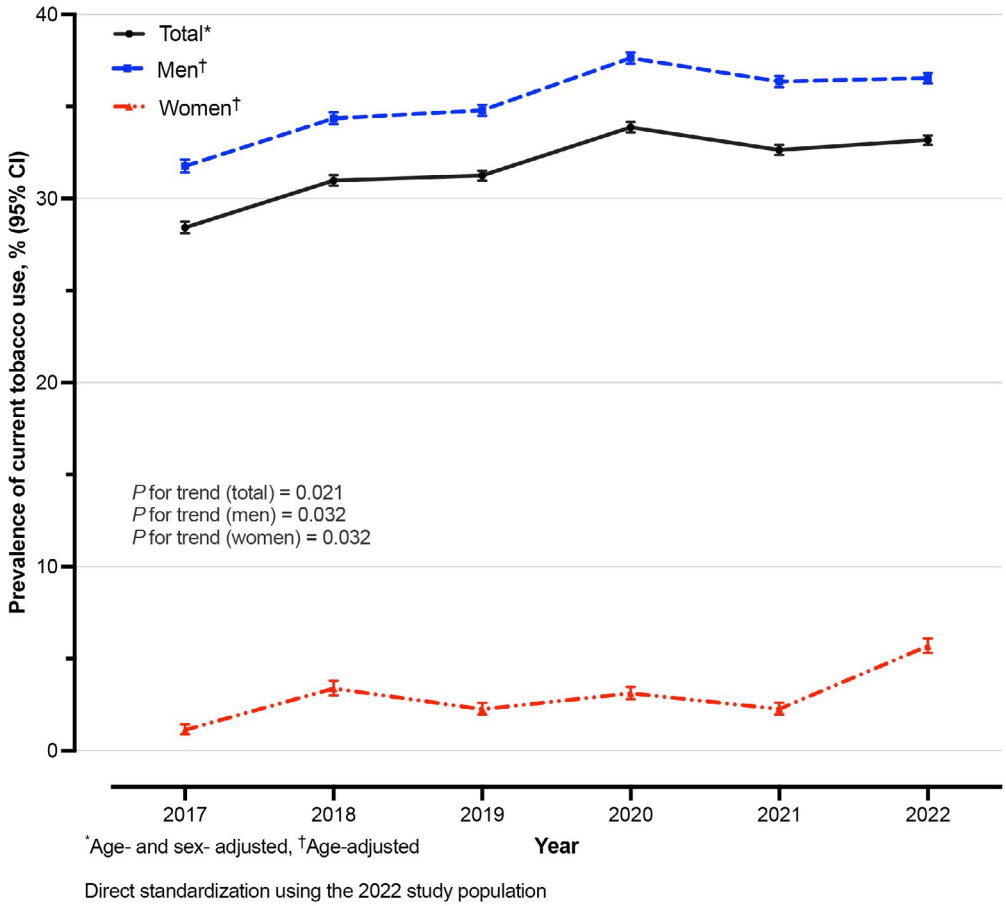

Figure 2. Trends in sex-specific prevalence of current tobacco use among active-duty Royal Thai Army personnel in Thailand from 2017 to 2022

Table 1. Characteristics of study participants (N=614,198)

Year	2017	2018	2019	2020	2021	2022	Total
N	**79,045**	**95,008**	**109,104**	**107,253**	**101,325**	**122,463**	**614,198**
Characteristics	**N (%)**	**N (%)**	**N (%)**	**N (%)**	**N (%)**	**N (%)**	**N (%)**
Sex							
Men	72584 (91.8)	86607 (91.2)	99833 (91.5)	96329 (89.8)	92909 (91.7)	109120 (89.1)	557382 (90.8)
Women	6461 (8.2)	8401 (8.8)	9271 (8.5)	10924 (10.2)	8416 (8.3)	13343 (10.9)	56816 (9.3)
Age, years							
18-24	6640 (8.4)	9220 (9.7)	10881 (10.0)	10036 (9.4)	9171 (9.1)	10465 (8.6)	56413 (9.2)
25-29	15096 (19.1)	18965 (20.0)	21985 (20.2)	21726 (20.3)	20906 (20.6)	25269 (20.6)	123947 (20.2)
30-34	12674 (16)	16152 (17.0)	18874 (17.3)	18801 (17.5)	18934 (18.7)	23970 (19.6)	109405 (17.8)
35-39	8120 (10.3)	10136 (10.7)	12039 (11.0)	12864 (12.0)	13739 (13.6)	17737 (14.5)	74635 (12.2)
40-44	8188 (10.4)	9999 (10.5)	11205 (10.3)	10220 (9.5)	9438 (9.3)	11488 (9.4)	60538 (9.9)
45-49	7001 (8.9)	7939 (8.4)	8912 (8.2)	9312 (8.7)	8980 (8.9)	11169 (9.1)	53313 (8.7)
50-54	10979 (13.9)	11161 (11.8)	11753 (10.8)	10370 (9.7)	8535 (8.4)	9447 (7.7)	62245 (10.1)
55-60	10347 (13.1)	11436 (12.0)	13455 (12.3)	13924 (13.0)	11622 (11.5)	12918 (10.6)	73702 (12.0)
mean ± SD	39.1 ± 11.5	38.2 ± 11.4	38.0 ± 11.4	38.1 ± 11.4	37.6 ± 11.1	37.4 ± 10.8	38.0 ± 11.3
Regions							
Bangkok	10923 (13.8)	14751 (15.5)	17093 (15.7)	20636 (19.2)	8716 (8.6)	22150 (18.1)	94269 (15.4)
Central	27577 (34.9)	34019 (35.8)	37379 (34.3)	34897 (32.5)	40220 (39.7)	40142 (32.8)	214234 (34.9)
Northeast	14130 (17.9)	16771 (17.7)	18903 (17.3)	21173 (19.7)	17512 (17.3)	22050 (18.0)	110539 (18.0)
North	19307 (24.4)	15187 (16.0)	23866 (21.9)	18435 (17.2)	22713 (22.4)	21121 (17.3)	120629 (19.6)
South	7108 (9.0)	14280 (15.0)	11863 (10.9)	12112 (11.3)	12164 (12.0)	17000 (13.9)	74527 (12.1)
Health insurance scheme							
Civil servant medical benefit	77519 (98.1)	92984 (97.9)	106879 (98.0)	104133 (97.1)	99378 (98.1)	114421 (96.4)	595314 (97.5)
Social security	963 (1.2)	1193 (1.3)	1402 (1.3)	2285 (2.1)	1639 (1.6)	3149 (2.7)	10631 (1.7)
Universal coverage	563 (0.7)	831 (0.9)	823 (0.8)	835 (0.8)	308 (0.3)	1149 (1.0)	4509 (0.7)

Table 2. Trends in prevalence of current tobacco use among active-duty Royal Thai Army personnel in Thailand, 2017-2022

Year	2017	2018	2019	2020	2021	2022	*p* for trend	*p* for quadratic trend
N	79,045	95,008	109,104	107,253	101,325	122,463		
Characteristics	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)		
Total[1]	28.4 (28.1-28.7)	31.0 (30.7-31.3)	31.2 (31-31.5)	33.9 (33.6-34.2)	32.6 (32.4-32.9)	33.2 (32.9-33.4)	0.001	0.021
Sex[2]								
Men	31.8 (31.4-32.1)	34.4 (34-34.7)	34.8 (34.5-35.1)	37.6 (37.3-37.9)	36.4 (36-36.7)	36.5 (36.3-36.8)	0.002	0.032
Women	1.1 (0.9-1.4)	3.4 (3.0-3.8)	2.3 (2.0-2.6)	3.1 (2.8-3.5)	2.3 (2-2.6)	5.7 (5.3-6.1)	0.048	0.032
Age, years[3]								
18-24	31.6 (30.5-32.7)	33.9 (32.9-34.8)	35.1 (34.2-35.9)	38.4 (37.5-39.3)	38.4 (37.5-39.4)	37.8 (36.9-38.7)	<0.001	0.003
25-29	35.4 (34.6-36.1)	36.4 (35.7-37.1)	37.6 (37.0-38.2)	40.0 (39.4-40.7)	39.5 (38.9-40.1)	39.7 (39.1-40.3)	<0.001	0.002
30-34	30.7 (30.0-31.5)	33.6 (32.9-34.3)	34.3 (33.6-34.9)	37.4 (36.8-38.1)	36.7 (36.0-37.3)	37.7 (37.1-38.3)	<0.001	0.001
35-39	27.0 (26.1-28.0)	30.6 (29.8-31.5)	29.9 (29.1-30.7)	32.0 (31.3-32.8)	31.2 (30.5-32.0)	32.8 (32.1-33.4)	<0.001	0.010
40-44	26.7 (25.8-27.6)	29.5 (28.7-30.4)	29.0 (28.2-29.8)	30.1 (29.3-31.0)	28.1 (27.2-29.0)	28.2 (27.4-29.0)	0.712	0.975
45-49	24.1 (23.1-25.1)	27.4 (26.4-28.4)	27.9 (27.0-28.8)	30.8 (29.9-31.7)	29.0 (28.1-29.9)	29.5 (28.7-30.3)	0.007	0.060
50-54	21.1 (20.4-21.9)	23.8 (23.1-24.6)	24.2 (23.5-25.0)	27.1 (26.3-28.0)	24.5 (23.6-25.3)	25.4 (24.5-26.2)	0.046	0.150
55-60	20.5 (19.8-21.3)	23.4 (22.6-24.1)	21.9 (21.2-22.6)	25.1 (24.4-25.8)	22.2 (21.5-22.9)	22.4 (21.7-23.1)	0.508	0.709
Regions[1]								
Bangkok	24.7 (23.9-25.4)	29.0 (28.4-29.7)	25.6 (25.0-26.2)	25.6 (25.1-26.2)	25.9 (25.0-26.7)	25.0 (24.5-25.5)	0.575	0.476
Central	29.8 (29.3-30.4)	31.2 (30.7-31.7)	30.5 (30.0-31.0)	35.1 (34.6-35.6)	34.9 (34.5-35.4)	36.1 (35.6-36.6)	<0.001	<0.001
Northeast	24.6 (23.9-25.4)	29.9 (29.2-30.6)	35.1 (34.4-35.7)	34.1 (33.4-34.7)	34.4 (33.8-35.1)	36.5 (35.9-37.2)	<0.001	0.014
North	33.7 (33.0-34.3)	33.2 (32.5-34.0)	36.7 (36.1-37.3)	34.8 (34.1-35.5)	27.2 (26.7-27.8)	25.4 (24.8-26.0)	0.033	0.003
South	24.6 (23.5-25.6)	33.3 (32.5-34.2)	26.9 (26.1-27.8)	41.8 (40.9-42.7)	43.2 (42.4-44.1)	42.3 (41.5-43.0)	0.001	0.004

[1]Age- and sex standardized, [2]Age-standardized, [3]Sex-standardized, Direct Standardization was performed using the 2022 study population as a reference
CI: confidence interval

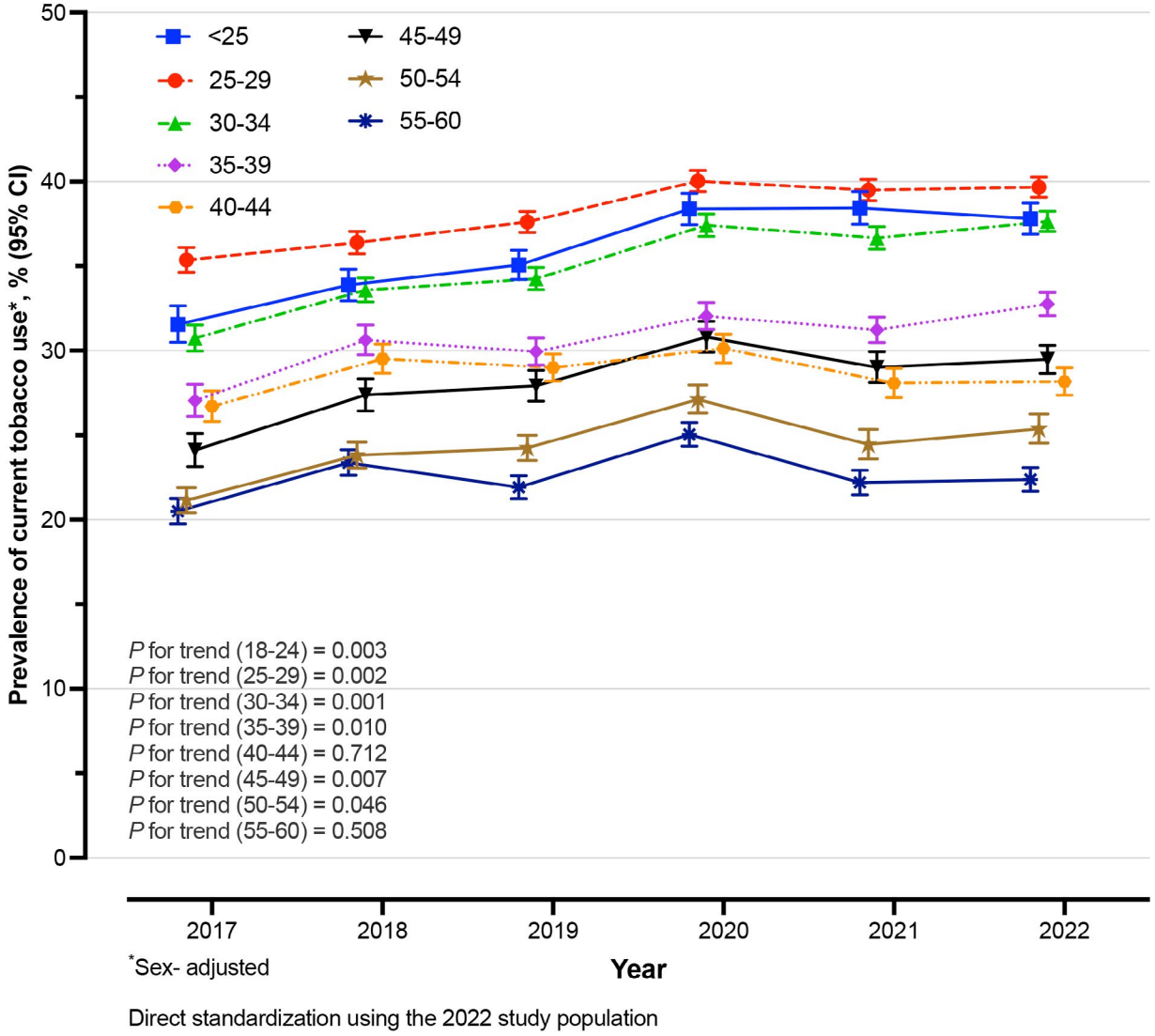

Figure 3. Trends in age-specific prevalence of current tobacco use among active-duty Royal Thai Army personnel in Thailand from 2017 to 2022

Table 3. Distribution of tobacco use across risk factors for cardiovascular disease among active-duty RTA personnel in 2022

Factors	Tobacco use			*p*-value
	Never	Former tobacco use	Current tobacco use	
	n (%)	n (%)	n (%)	
Systolic blood pressure (mmHg)				<0.001[1]
≥140, n (%)	11342 (50.2)	3758 (16.6)	7517 (33.2)	
<140, n (%)	50610 (51.6)	14646 (14.9)	32824 (33.5)	
mean ± SD	127.4 ± 15.7	128.4 ± 15.8	127.8 ± 15.4	<0.001[2]
Diastolic blood pressure (mmHg)				<0.001[1]
≥90, n (%)	8264 (49.2)	2822 (16.8)	5706 (34.0)	
<90, n (%)	53688 (51.7)	15582 (15.0)	34635 (33.3)	
mean ± SD	77.1 ± 11.4	78.0 ± 11.6	77.1 ± 11.9	<0.001[2]

Table 3. Distribution of tobacco use across risk factors for cardiovascular disease among active-duty RTA personnel in 2022 (Cont.)

Factors	Tobacco use			*p*-value
	Never	Former tobacco use	Current tobacco use	
	n (%)	n (%)	n (%)	
Fasting plasma glucose (mg/dL)				<0.001[1]
≥126, n (%)	2599 (46.1)	1035 (18.4)	2002 (35.5)	
100-126, n (%)	6952 (50.2)	2698 (19.5)	4209 (30.4)	
<100, n (%)	21449 (56.3)	6213 (16.3)	10455 (27.4)	
mean ± SD	100.7 ± 32.4	103.9 ± 33.7	105.5 ± 39.2	<0.001[2]
Total cholesterol (mg/dL)				<0.001[1]
≥240, n (%)	8557 (53.3)	3006 (18.7)	4493 (28.0)	
200-239, n (%)	12063 (56.1)	3557 (16.5)	5883 (27.4)	
<200, n (%)	13013 (54.8)	3919 (16.5)	6833 (28.8)	
mean ± SD	213.3 ± 44.9	215.7 ± 49.0	213.3 ± 51.3	<0.001[2]
Triglyceride (mg/dL)				<0.001[1]
≥150, n (%)	11395 (47.8)	4321 (18.1)	8111 (34.0)	
<150, n (%)	21351 (60.4)	5742 (16.3)	8271 (23.4)	
mean ± SD	149.7 ± 114.6	170.6 ± 134.4	190.9 ± 157.3	<0.001[2]
Alcohol consumption				<0.001[1]
Current drinker, n (%)	32449 (43.0)	10806 (14.3)	32164 (42.7)	
Former drinker, n (%)	6489 (40.9)	5328 (33.6)	4049 (25.5)	
No, n (%)	24227 (77.8)	2521 (8.1)	4410 (14.2)	
Regular exercise				<0.001[1]
No, n (%)	33411 (51.9)	10227 (15.9)	20787 (32.3)	
Yes, n (%)	29262 (51.8)	8345 (14.8)	18880 (33.4)	

SD: standard deviation, [1]*Chi*-square test, [2]ANOVA test

Table 4. Association between tobacco use and metabolic risk factors for cardiovascular disease among active-duty RTA personnel in 2022.

Tobacco use	High SBP		High DBP		High FPG		High TC		High TG	
	PR (95%CI)	*p*-value	PR (95%CI)	*p*-value	PR (95%CI)	*p*-value	PR (95%CI)	*p*-value	PR (95%CI)	*p*-value
Model 1										
Never	Ref.		Ref.		Ref.		Ref.		Ref.	
Former tobacco use	1.12 (1.08-1.15)	<0.001	1.15 (1.11-1.20)	<0.001	1.24 (1.16-1.32)	<0.001	1.13 (1.09-1.17)	<0.001	1.23 (1.20-1.27)	<0.001
Current tobacco use	1.02 (1.00-1.04)	0.189	1.06 (1.03-1.09)	<0.001	1.43 (1.36-1.51)	<0.001	1.03 (1.00-1.06)	0.103	1.42 (1.39-1.45)	<0.001
Model 2										
Never	Ref.		Ref.		Ref.		Ref.		Ref.	
Former tobacco use	1.00 (0.97-1.04)	0.771	1.01 (0.97-1.05)	0.654	1.18 (1.10-1.27)	<0.001	1.10 (1.07-1.14)	<0.001	1.15 (1.12-1.18)	<0.001
Current tobacco use	1.04 (1.01-1.06)	0.008	1.07 (1.03-1.10)	<0.001	1.43 (1.35-1.51)	<0.001	0.99 (0.96-1.02)	0.487	1.30 (1.27-1.32)	<0.001
Model 3										
Never	Ref.		Ref.		Ref.		Ref.		Ref.	
Former tobacco use	1.06 (1.02-1.09)	0.001	1.01 (0.97-1.06)	0.520	1.22 (1.14-1.32)	<0.001	1.05 (1.01-1.09)	0.014	1.17 (1.13-1.20)	<0.001
Current tobacco use	1.02 (0.99-1.04)	0.260	1.04 (1.01-1.07)	0.040	1.26 (1.18-1.34)	<0.001	0.96 (0.93-0.99)	0.017	1.28 (1.25-1.31)	<0.001

Model 1: Univariable analysis

Model 2: Multivariable analysis adjusting for age and sex.

Model 3: Multivariable analysis adjusting for age, sex, health scheme, regions, alcohol use, and exercise.

SBP: systolic blood pressure, DBP: diastolic blood pressure, FPG: fasting plasma glucose, TC: total cholesterol, TG: triglyceride, PR: prevalence ratio, CI: confidence interval

never smoked. The APR for the former group is 1.17 (95% CI: 1.13-1.20), while the APR for the latter group is 1.28 (95% CI: 1.25-1.31).

Discussion

In the present study, rising trends in age- and sex-adjusted current tobacco use prevalence among the overall participants were noted. A similar pattern was found in men, women, and almost all age groups. Different trends in current tobacco use from 2017 to 2022 were reported in regions. In the central, northeast, and south, the age- and sex-adjusted prevalence of current tobacco use among active-duty RTA personnel tended to rise from 2017 to 2022, but not for those in the north, where it fell over six years. The results also confirmed the relationship between tobacco use and metabolic risk factors for CVD, comprising high BP, high FPG, and hypertriglyceridemia among this population.

According to the WHO's latest report, the prevalence of tobacco use worldwide is expected to diminish incrementally from 32.7% in 2000 to 22.3% in 2020 and 20.4% in 2025.[6] These global trends were also monitored in both men and women. Additionally, data from the NHES in Thailand indicates that the prevalence of current tobacco use among Thai adults experienced a notable decline, dropping from 19.5% between 2014 and 2015 to 18.7% in 2019-2020.[7,8] Surprisingly, the present study found growing trends in the age and sex-adjusted prevalence of tobacco use among active-duty RTA personnel from 2017 to 2022. Additionally, throughout six years, these escalating patterns in age-adjusted current tobacco use were seen in both men and women. These findings highlighted the fact that, in addition to the metabolic risk factors for CVD that RTA personnel already face, tobacco use was a vital lifestyle risk factor.

Our findings show that around one-third of RTA personnel reported current tobacco use, which was greater than that of Thai civilians (18.7%); conversely, in the present study, most study participants were men (90%). However, the sex-specific prevalence of tobacco use among RTA personnel in the present study was higher than in civilians in both men and women.[8] Rising trends in the prevalence of current tobacco use among RTA personnel scrutinized in the present study may be hypothesized to potentially be attributed to the stress and workload experienced by military personnel. These factors may contribute to the significant rates of tobacco use, as individuals may turn to smoking to alleviate stress and seek relaxation. Further, it is also claimed that smoking helps military troops stay attentive.[18–20] Existing literature also indicated that regarding peer groups, tobacco use is a way for military personnel to bond with one another and gain confidence.[21]

Regarding age group, we found that the prevalence of current tobacco use was higher among younger RTA personnel, which peaked among those aged 25-29 years and declined in those with older age. This pattern is compatible with the existing data from WHO[6] and the NHES[8] in Thailand. Although higher-age participants tended to have a lower prevalence of current tobacco use, our results pinpointed the rinsing trends in current tobacco use in almost all age groups among active-duty RTA personnel from 2017 to 2022. These findings highlight that tobacco use is still a critical lifestyle risk factor that is ongoing in this population.

Regarding the regions of residence, the trends in the prevalence of current tobacco use among RTA personnel residing in central, northeast, and south have inflated from 2017 to 2022. Notably, among those in the south, the prevalence of current tobacco use tended to be higher than in other regions; moreover, our study reflected a notable increase of 17.8% in current tobacco use over six years, specifically in the southern region. These findings align with data from the NHES VI, which indicates that current tobacco use is the highest in the south, followed by the northeast, central, Bangkok, and north regions, respectively.[8] Fortunately, we inspected a significant decrease in tobacco use prevalence among RTA personnel residing in the north by 8.2% over six years. The difference in current tobacco use prevalence among RTA personnel across geographic regions may depend on the cultural context, which may affect their lifestyle.[22, 23]

We revealed an association between tobacco use and metabolic risk factors for CVD

among active-duty RTA personnel. In line with the literature, the direct effects of nicotine on sympathetic activity cause pathological conditions and influence BP during acute phases of cigarette use.[24,25] In the current study, it was noted that former smokers and current smokers had a prevalence of higher BP than nonsmokers,

The present study establishes a clear association between tobacco use and high FPG, which is considered a potential metabolic risk factor for CVD. When compared to RTA personnel who have never smoked, those who reported previous tobacco use and current tobacco use exhibited a 22 and 26 percentage points higher prevalence of high FPG, respectively. These findings align with robust evidence that suggests tobacco use is an independent lifestyle risk factor for hyperglycemia and type 2 diabetes.[26, 27] The substances in tobacco smoke trigger the free-radical process, impair the vascular endothelium, and worsen oxidative stress, which damages beta-cell function.[27–29] Our results emphasized that RTA personnel with a history of tobacco use, whether current tobacco use or former tobacco use, should closely monitor their FPG to receive appropriate management to control FPG levels and alleviate the risk for CVD in the future.[30, 31]

A related study in Korea proved that smoking was associated with high TG.[32] Similarly, our study revealed that RTA personnel who had previously used tobacco and those who currently use tobacco had a 17% and 28% higher prevalence of high TG, respectively, compared to those who had never smoked. This finding can be explained by the increased oxidative stress caused by the components of tobacco, which can lead to higher levels of triglycerides.[33, 34] These results suggest that individuals who have a history of tobacco use must be aware of the risk of developing high TG, and efforts should be made to reduce serum TG levels to mitigate the risk of CVD.[35] Nevertheless, another study in Iran exposed a reverse association between ex-smokers and high TG.[35]

We emphasized that tobacco use was still a crucial lifestyle risk factor among RTA personnel and underlined that tobacco use was also related to metabolic risk factors for CVD. Therefore, tobacco cessation should be facilitated in this population. A multimodality approach may be advantageous in solving this issue. For instance, community leaders as commandants in the military units should discourage tobacco use and promote cessation.[36] Furthermore, medical professionals should provide support for quitting smoking and recommendations during the annual health examination.[37] Additionally, the evidence supports that pharmacotherapy can facilitate successful tobacco cessation[38]; hence, this approach is feasible in Thailand because the health coverage scheme covers this benefit package.

Our study encountered some limitations. First, the information on tobacco use was based on self-reported data, which had room for recall errors or social desirability bias that could lead to misclassification. Second, regarding using previously collected data, some variables were collected broadly. For example, we did not know the number of cigarettes smoked daily or pack-years of previous exposure. Therefore, we could not provide valuable insight into the dose-response relationship between smoking exposure and the metabolic risk factors of CVD. A further study, such as a prospective cohort study, could address this issue. Third, because vaping and electronic cigarettes are a growing health risk, we did not have the chance to examine this sort of tobacco use in the current study. As a result, more research is needed to evaluate this issue among this demographic. Fourth, in our study, the annual health examination is a standard practice for most individuals. However, due to limitations in the confidentiality and deidentified dataset we utilized, we could not conduct a longitudinal analysis to track the tobacco use status of everyone over time. As a result, we estimated the prevalence of current tobacco use among active-duty RTA personnel who participated in the health examination separately for each year to reflect the situation for that specific year.

Additionally, our analysis relied solely on the 2022 database to assess the relationship between tobacco use and metabolic risk factors of cardiovascular disease. This approach ensured that the independent assumption of the observation was not violated. Finally, the study employed a cross

sectional design; hence, causation between tobacco use and metabolic risk factors for CVD cannot be inferred. The present study had considerable strengths. To our knowledge, it is the most extensive and most recent study conducted by RTA personnel to illustrate tobacco use trends in Thailand. As a result, our findings offer important new information about the population's ascending tobacco usage prevalence.

Conclusion

The present study identified an increasing trend in the prevalence of current tobacco use among active-duty RTA personnel from 2017 to 2022. Younger RTA personnel had a higher prevalence of current tobacco use than their older counterparts. The study also revealed the association between tobacco use and metabolic risk factors for CVD. Therefore, it is essential to promptly encourage tobacco cessation in this population during the annual health examination to reduce the metabolic risk factors and the risk of CVD in the future.

Conflict of interest

The authors have no conflicts of interest associated with the material presented in this paper.

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Author contributions

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