



## Prevalence of e-cigarette use among tobacco smokers in six states and regions of Myanmar



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### ABSTRACT

**Background:** Emergence of electronic cigarettes (e-cigarettes) in the past decade has the potential to undermine the global tobacco control efforts and undo the successes achieved to date. There are also concerns that e-cigarettes may become a gateway for future tobacco use and its use is increasing globally. There is no published evidence on this issue from Myanmar. Hence, we aimed to assess prevalence of e-cigarette use among tobacco smokers and its associated socio-demographic factors in six states and regions of Myanmar.

**Methods:** This was a secondary analysis of data collected as part of a programme evaluation conducted by the National Tobacco Control Programme of Myanmar in 2018, which involved sampling 100 smokers from each state/region. We used modified Poisson regression to measure associations.

**Results:** There were 629 tobacco smokers included in the programme evaluation. Among them, 246 (39.2%, 95% CI: 24.0%–56.7%) smokers reported that they had heard of e-cigarettes and 73 (11.6%, 95% CI: 5.1%–24.3%) reported having ever used e-cigarettes. There was no e-cigarette use among female smokers. The prevalence of e-cigarette use was significantly higher among males, students, young adults aged 18–29 years, heavy smokers (greater than 20 cigarettes per day) and those who lived in the Mandalay region.

**Conclusion:** Our study provides preliminary evidence about e-cigarette use in Myanmar and fills an important knowledge gap. One limitation was small sample size, which is reflected by wide confidence intervals around the estimate. We recommend a national survey to obtain precise and nationally representative information.

### 1. Introduction

Tobacco use is a global pandemic with about 1.1 billion smokers living in 2018 (Drope et al., 2018; World Health Organization, 2019). Being a risk factor for many non-communicable and communicable diseases, tobacco use is a major cause of mortality, morbidity and disability. More than eight million people die every year due to tobacco with 1.2 million of these deaths occurring among non-smokers exposed to second-hand smoke (Drope et al., 2018; World Health Organization, 2019). Most of these deaths are premature and they cause severe financial distress for individuals, families and societies.

To address this deadly public health threat, the World Health Organization (WHO) developed a Framework Convention for Tobacco Control (FCTC) in 2003 and as on date, 181 parties covering 90% of the world's population have signed up to this (World Health Organization, 2003). To facilitate the country-level implementation of FCTC, the WHO developed the 'MPOWER' package which lists six practical measures to reduce tobacco use (World Health Organization, 2013). Strengthening the implementation of WHO FCTC in all countries is one of the United Nations Sustainable Development Goals (United Nations, 2015).

There has been great progress in tobacco control globally. The

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prevalence of daily smoking has been declining – by 28% for men and 34% for women between 1990 and 2015 (GBD 2015 Tobacco Collaborators, 2017). Nearly two-thirds of the countries, covering 65% of the population, have at-least one of the MPOWER measures in place at best-practice level (World Health Organization, 2019). This is a four-fold improvement since 2007 when only 15% of world's population was covered by best-practice level. Several decades of advocacy, communication and social mobilization has led to a state of de-normalization of tobacco use at a population level (Antin, Lipperman-Kreda, & Hunt, 2015).

Emergence of electronic cigarettes (e-cigarettes), more formally termed as electronic nicotine delivery systems (ENDS) or electronic non-nicotine delivery systems (ENNDS) in the past decade has the potential to undermine the global tobacco control efforts and undo the successes achieved till date (WHO FCTC, 2016). E-cigarettes are electronic devices that heat a solution (e-liquid) and create an aerosol which is inhaled by the user, thus mimicking the sensory feeling of smoking. The liquids used are complex mixtures of nicotine, flavourants, glycols, aldehydes, heavy metals and other chemicals and close to 8000 unique flavours have been reported (Trivers et al., 2019; Walley, Wilson, Winickoff, & Groner, 2019; Zhu et al., 2014).

Myanmar is a lower-middle income country in South-east Asian region with a high burden of tobacco use. More than 65,000 people die due to tobacco-related diseases in Myanmar annually, which accounts for 22% of all deaths (Drope et al., 2018). As per a national STEPS survey on non-communicable disease risk factors in 2014, about 26% of adults were found to be tobacco smokers and 43% used smokeless tobacco (Latt et al., 2014). The global youth tobacco survey done in 2016 showed an increase in the prevalence of current cigarette smoking compared to 2007 (World Health Organization, Regional Office for South-East Asia, Ministry of Health and Sports, & Republic of the Union of Myanmar, 2016). Myanmar has passed a strong tobacco control law in 2006 which includes prohibiting smoking in public places, mandating graphic warning labels on cigarette packs, and banning tobacco advertising on all forms of media (Ministry of Health and Sports, 2006).

There is anecdotal evidence that e-cigarettes are available in Myanmar and their use is increasing. But, no study till date has assessed the prevalence of e-cigarette use in Myanmar. Due to this, the tobacco control law does not mention anything about regulating the use of e-cigarettes in Myanmar. In this paper, we report on the prevalence of e-cigarette use among the tobacco smokers in selected regions and states of Myanmar in 2018 and its associated sociodemographic factors.

## 2. Material and Methods

### 2.1. Study design

This was a cross-sectional study involving secondary analysis of data.

### 2.2. Setting

In 2018, Myanmar National Tobacco Control Programme (NTCP) conducted a programme evaluation in six states and regions of Myanmar – namely Naypyitaw, Yangon, Bago, Mandalay, Shan State and Kayin State – to assess the awareness and perceptions about pictorial health warnings. It was planned to sample 600 tobacco smokers to participate in the programme evaluation. These users were sampled using a multi-stage, stratified sampling method. First, one township was selected randomly from each state and region. From each township, one ward from urban areas and one village from rural areas were selected randomly. In each site, a total of 50 tobacco smokers were sampled using a systematic random sampling of households. A structured questionnaire was used to collect data after obtaining verbal informed consent from the participants. This also contained a couple of questions about e-cigarette use, which provided us an opportunity to assess the

magnitude of e-cigarette use among tobacco smokers in Myanmar. Data was collected in paper-based forms by trained programme staff. Data was double entered and validated using EpiData software (version 3.1, EpiData association, Odense, Denmark).

### 2.3. Study population

This included the sample of tobacco smokers aged 13 years or more and included in the programme evaluation mentioned above.

### 2.4. Data variables and sources

The required data variables were extracted from the EpiData database which included age, sex, marital status, highest education, monthly household income, ever tobacco smoker (yes/no), ever smokeless tobacco use (yes/no) and intensity of smoking (average number of cigarettes smoked per day). There were two questions on e-cigarettes: i) have you heard of e-cigarettes? (Yes/No) and ii) have you ever used e-cigarettes? (Yes/No)

### 2.5. Data analysis

Analysis was done using EpiData analysis (version 2.2.2.186) and Stata software (v13.0, Texas, USA). The prevalence of e-cigarette use and 95% confidence intervals (adjusted for the clustering effect of the region/state) were calculated. A modified Poisson regression with robust error variance (Zou, 2004) was conducted and adjusted prevalence ratios (with 95% CI) were calculated to measure the associations between socio-demographic factors and e-cigarette use. Factors which were statistically significant ( $P$  value < 0.05) in unadjusted analysis were included in the final model. Sex was not included in the model as there were no events in the females. Variables with variance inflation factor more than 10 were considered to be collinear and excluded from the model.

### 2.6. Ethics

Permission for conducting the study and accessing the programme data was obtained from the NTCP. Ethics approval was obtained from the Ethics review committee of Department of Medical Research under Ministry of Health and Sports in Myanmar (Ethic/DMR/2019/061) as well as Ethics Advisory Group of International Union Against Tuberculosis and Lung Disease, Paris, France (01/19). Since this was a secondary analysis, the need for informed consent was waived by the ethics committees.

## 3. Results

There was a total of 629 tobacco smokers. Among them, 546 (87%) were male and the mean age (standard deviation) was 32 (18) years. A total of 246 (39.2%, 95% CI: 24.0%-56.7%) smokers reported that they had heard of e-cigarettes. Of 629 smokers, 73 (11.6%, 95% CI: 5.1%-24.3%) reported having ever used e-cigarettes. There was no e-cigarette use among female smokers. The prevalence of e-cigarette use was higher among younger smokers aged < 30 years compared to those above 30 years. The prevalence was higher among those with higher educational and income levels. In adjusted analysis, smokers aged 18–29 years, those who were students, those who smoked 20 cigarettes or more per day and those who lived in the Mandalay region had a significantly higher prevalence of e-cigarette use (Table 1).

## 4. Discussion

This is the first study from Myanmar providing information on use of e-cigarettes among smokers. We found that about 39% had heard about e-cigarettes. This is higher than the level in Indonesia [11%] and

**Table 1**  
Socio-demographic characteristics associated with e-cigarette use among smokers in six states and regions of Myanmar in 2018.

Characteristics	N	(%)#	E-cig use		PR	(95%CI)	aPR	(95%CI)
			N	(%)^				
<b>Total</b>	629	(1 0 0)	73	(11.6)				
<b>Age (years)</b>								
13–17	218	(34.7)	45	(20.6)	8.99	(4.13–19.56)*	1.70	(0.64–4.49)
18–29	104	(16.5)	20	(19.2)	8.38	(3.64–19.24)*	3.68	(1.35–10.07)*
≥ 30	305	(48.5)	7	(2.3)	ref		Ref	
Missing	2	(0.3)	1	(50.0)				
<b>Sex</b>								
Male	546	(86.8)	71	(13.0)	NE		NE	
Female	71	(11.3)	0	(0.0)				
Missing	12	(1.9)	2	(16.7)				
<b>Marital Status</b>								
Single	297	(47.2)	62	(20.9)	8.19	(3.99–16.82)*	NE	
Ever married	314	(49.9)	8	(2.5)	Ref			
Missing	18	(2.9)	3	(16.7)				
<b>Student</b>								
Yes	191	(30.4)	53	(27.7)	6.08	(3.74–9.87)*	3.88	(2.00–7.56)*
No	438	(69.6)	20	(4.6)	Ref		Ref	
<b>Highest education</b>								
Primary	168	(26.7)	2	(1.2)	Ref		Ref	
Secondary	397	(63.1)	63	(15.9)	13.33	(3.30–53.85)*	3.73	(0.77–18.14)
College and above	44	(7.0)	7	(15.9)	13.36	(2.88–62.09)*	3.53	(0.61–20.32)
Missing	20	(3.2)	1	(5.0)	4.2	(0.40–44.27)	5.25	(0.40–68.58)
<b>Monthly income (MMK)</b>								
< 100,000	40	(6.4)	2	(5.0)	Ref		Ref	
100,000 to 299,000	317	(50.4)	29	(9.1)	1.83	(0.45–7.38)	0.85	(0.21–3.40)
300,000 to 499,000	145	(23.1)	12	(8.3)	1.66	(0.39–7.09)	0.46	(0.12–1.81)
≥ 500,000	47	(7.5)	17	(36.2)	7.23	(1.78–29.42)*	1.15	(0.29–4.50)
Missing	80	(12.7)	13	(16.3)	3.25	(0.77–13.71)	1.08	(0.27–4.30)
<b>Cigarettes smoked per day</b>								
1–4	362	(57.6)	35	(9.7)	Ref		Ref	
5–9	87	(13.8)	10	(11.5)	1.19	(0.61–2.31)	1.55	(0.83–2.91)
10–19	17	(2.7)	3	(17.6)	1.83	(0.62–5.34)	1.34	(0.44–4.12)
≥ 20	21	(3.3)	7	(33.3)	3.45	(1.74–6.82)*	4.70	(2.46–8.94)*
Missing	142	(22.6)	18	(12.7)	1.31	(0.77–2.24)	1.32	(0.80–2.19)
<b>Participants State/Region</b>								
Naypyitaw	102	(16.2)	6	(5.9)	Ref		Ref	
Yangon	105	(16.7)	6	(5.7)	0.97	(0.32–2.91)	0.62	(0.20–1.95)
Bago	84	(13.4)	4	(4.8)	0.81	(0.24–2.77)	0.61	(0.17–2.20)
Mandalay	117	(18.6)	29	(24.8)	4.21	(1.82–9.74)*	2.54	(1.12–5.76)*
Shan	119	(18.9)	9	(7.6)	1.29	(0.47–3.49)	0.73	(0.26–1.20)
Kayin	102	(16.2)	19	(18.3)	3.17	(1.32–7.60)*	1.35	(0.56–3.29)

E-cig = E-cigarette; # = Column percentage; ^ = Row percentage; PR = Prevalence Ratio; aPR = Adjusted Prevalence Ratio; CI = Confidence Interval; Ref = Reference group; NE = not estimated.

\* = statistically significant with p value < 0.05; Marital status was not included in the adjusted analysis due to collinearity with age and student variables; smokeless tobacco use was not included as it was not statistically significant in unadjusted analysis; prevalence ratio was not estimated for sex as there were no events in female gender; 1 US Dollar = 1500 MMK.

Malaysia [21%] (Palipudi et al., 2016), but lower than in China [88%] (Wang, Zhang, Xu, & Gao, 2019). We caution the readers about these comparisons as the studies have been conducted at different time points and in populations with different demographics and socio-economic characteristics. The prevalence of e-cigarette use in our study was 11.6%, not much different from 12.8% observed in United States of America (Wilson & Wang, 2017), but lower than China where it is 25% (Wang et al., 2019).

E-cigarette use was significantly higher among males, students, young adults aged 18–29 years and in heavy smokers. The reason for higher prevalence of e-cigarette use among young people may be due to the aggressive marketing strategies of the tobacco industry targeting the youth and adolescents. These factors have also been reported by other studies in USA (Levy, Yuan, & Li, 2017), Great Britain (Brown et al., 2014) and South Korea (Lee, Lee, & Cho, 2017).

There were a number of limitations, because we relied on data from a programme evaluation which was not primarily designed to assess prevalence of e-cigarette. First, the sample size was not large enough to provide precise estimates, which is reflected by the wide confidence intervals. Second, the original evaluation was done only in six states

and regions and hence our findings are not nationally representative. Third, since the original evaluation did not collect important information on sampling sites, a weighted analysis was not possible. Fourth, since only smokers were included, we are not able to estimate e-cigarette use in the general population. Finally, important variables such as intensity of e-cigarette use, age of and reasons for starting e-cigarette use were not investigated.

Despite these limitations, there are some important implications of our findings. First, this study provides preliminary evidence about the e-cigarette use in Myanmar and fills an important knowledge gap. We recommend that a well-designed national survey with adequate sample size be urgently conducted to obtain precise and representative information about e-cigarette use. The Ministry of Health and Sports in Myanmar is indeed planning to conduct a national survey of non-communicable disease risk factors and there are plans to include questions on e-cigarette use in this survey. The estimate obtained in our study may be helpful in estimating the sample size requirements. Second, we found that e-cigarette use was significantly higher in certain subgroups such as males, students, young adults and heavy smokers. These groups should be targeted with information, education and

communication campaigns. Geographically, Mandalay region may be prioritized. Third, the policy makers in Myanmar should take note of these findings and consider developing an e-cigarette control policy to be incorporated into the national tobacco control law.

It is clear that e-cigarettes have arrived and are here to stay for the long haul. The global market estimated at about 8.6 billion USD in 2016, is expected to increase to 26.8 billion USD by 2023 (Eighth Session of Conference of the Parties to the WHO Framework Convention on Tobacco Control, 2018). The benefits and harms of e-cigarettes has been a topic of hot debate. The tobacco industry has marketed e-cigarettes positioning them as harmless and even beneficial as smoking cessation aids. But, evidence about the effectiveness of e-cigarettes as a cessation aid is limited, of low-quality and low-certainty (Kalkhoran & Glantz, 2016; McRobbie, Bullen, Hartmann-Boyce, & Hajek, 2014). While the levels of toxic substances generated by e-cigarettes is lower than in cigarette smoke, they remain higher than the levels in the background air and thus cannot be deemed 'harmless'. A recent nationwide outbreak of EVALI (e-cigarette, or vaping, product use-associated lung injury) in USA is a case in point (Moritz et al., 2019). Further, the long-term effects are unknown. Several new toxicants have been found in e-cigarettes aerosol, not found in cigarette smoke. The toxicants released vary based on composition of the e-liquid used, which remains non-standardized and unregulated. In addition, the dangers of nicotine addiction and its ill-effects such as neurodegeneration and its role as 'tumour promoter' remain (National Center for Chronic Disease Prevention & Health Promotion Office (US) on Smoking and Health, 2014). There are also concerns that e-cigarettes may become a gateway for future tobacco use. Thus, the WHO and several global organizations recommend careful regulation of e-cigarettes and consider them as harmful products, until sufficient evidence to the contrary is available (Ferkol et al., 2018; International Union Against Tuberculosis and Lung Disease, 2013; WHO FCTC, 2016; World Health Organization, 2019).

## 5. Conclusion

In conclusion, we found that one in nine smokers in six states and regions of Myanmar use e-cigarettes and the prevalence was higher among students, males, young adults and heavy smokers. These subgroups may be targeted by information and education campaigns. We recommend a national survey to obtain representative information and consider regulation of e-cigarettes in line with the WHO FCTC guidelines. Data on ENDS should be collected as part of every tobacco survey in future. The current national tobacco control law in the country should be revised to incorporate the regulation of e-cigarettes.

## CRediT authorship contribution statement

**Ye Phyo:** Conceptualization, Methodology, Software, Validation, Formal analysis, Data curation, Writing - original draft, Writing - review & editing, Visualization. **Ajay M.V. Kumar:** Conceptualization, Methodology, Writing - original draft, Writing - review & editing, Funding acquisition. **Khine Wut Yee Kyaw:** Conceptualization, Methodology, Formal analysis, Writing - original draft, Writing - review & editing, Project administration. **Kyaw Kan Kaung:** Conceptualization, Methodology, Writing - original draft, Supervision. **Mya Lay Nwe:** Conceptualization, Methodology, Writing - original draft, Supervision. **Thida:** Conceptualization, Methodology, Writing - original draft, Supervision. **Tharaphi:** Conceptualization, Methodology, Writing - original draft.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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## Appendix A. Supplementary data

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