A MIXED METHOD STUDY ON THE ASSOCIATING FACTORS, REASONS FOR USE, PERCEPTIONS AND QUITTING BEHAVIOUR OF E-CIGARETTE AMONG DUAL USERS IN MALAYSIA

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by

AIMI NADIRA BINTI MAT RUZLIN

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ACKNOWLEDGEMENT

"But they plan, and Allah plans. Surely Allah is the best of planners" (8:30)

Alhamdulillah, I would like to begin by expressing my heartfelt appreciation to my wonderful supervisor Associate Professor Balamuguran Tangiisuran for his invaluable guidance, unwavering support and most importantly, for having total faith in me throughout my PhD journey. May God continue to bless you and your family abundantly. My appreciation to Professor Dr. Maizurah Omar, Professor Dr. Rahmat Awang from the National Poison Centre (NPC) and Associate Professor Hua Yong from the Cancer Council Victoria Australia for their constructive guidance and feedback. I would also like to express my gratitude to the rest of the NPC's hardworking staff for their kind assistance. This journey would not have been possible without the unwavering support from my family. My heartfelt appreciation goes to my husband for serving as my personal support system and temporarily taking on the roles of mother and father while I worked on my thesis. To my eldest angel Ayesha, thank you for being such an amazing sister to your siblings and for understanding why I was away for most of the time. As for my angels Khayra and Jasmin, thank you for every second you've given me, and I am truly sorry for my absence. I would like to thank my parents for their unconditional love and support for their only child; this thesis is dedicated to both of you. My gratitude goes out to all my relatives, friends, and colleagues for their support, as well as to everyone who has been a part of my academic journey.

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LIST OF ABBREVIATIONS

ADs   Administrative districts

BAT   British American Tobacco

CDC   Centres for Diseases Control and Prevention

CI   Confidence intervals

EC   E-cigarette

ENDS   Electronic nicotine delivery/dispensing systems

ENNDS   Electronic non-nicotine delivery/dispensing systems

FCTC   Framework Convention on Tobacco Control

FDA   Food and Drug Administration

HBM   Health Belief Model

HSI   Heaviness Smoking Index

IG   Instagram

IHBM   Integrated Health Belief Model

IQR   Interquartile range

ITC   International Tobacco Control

MESTECC   Ministry of Energy, Science, Technology Environment and Climate Change

MLR   Multivariate logistic regression

MOH   Ministry of Health

MTP   Multiple tobacco product

NCDs   Non-communicable diseases

NECS   National E-Cigarette Survey

NHMS   National Health and Morbidity survey

NVPs   Nicotine vaping products

PATH   Population Assessment of Tobacco and Health

RCT	Randomized Control Trial
SD	Standard deviation
SDOH	Social determinants of health
SEA	South-east Asia
SFL	Smoke-free legislation
SHS	Second-hand smoke
SPSS	Statistical Package for the Social Sciences
THR	Tobacco Harm Reduction
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
US	United States
WHO	World Health Organization

LIST OF APPENDICES

KAJIAN KAEDAH CAMPURAN UNTUK MENGKAJI FAKTOR BERKAITAN, SEBAB PENGGUNAAN, PERSEPSI DAN TINGKAHLAKU BERHENTI MEROKOK ROKOK ELEKTRONIK DALAM KALANGAN DWI PENGGUNA DI MALAYSIA

ABSTRAK

Dwi-penggunaan rokok elektronik (RE) dan rokok konvensional (RK) boleh menyebabkan penggunaan berpanjangan, tidak terdesak untuk berhenti merokok, dan menambahkan kebergantungan terhadap nikotin. Kajian ini menggunakan kaedah kajian campuran rekabentuk penjelasan berurutan, yang melibatkan kaedah kuantitatif (Fasa I) dan kualitatif (Fasa II). Dalam Fasa I, sebanyak 40,000 perokok dirangkumi melalui data sekunder Kajian Rokok Seludup Malaysia. Soalan-soalan dalam kajian tersebut telah divalidasikan oleh Kawalan Tembakau Antarabangsa (ITC). Fasa II telah merekrut sebanyak 27 dwi-pengguna berdasarkan titik tepu dan meneroka persepsi mereka terhadap penggunaan RE dan percubaan untuk berhenti merokok dengan menggunakan komponen bersepadu daripada Model Kepercayaan Kesihatan (HBM) dan Teori Tingkah Laku Terancang (TPB). Berdasarkan keputusan Fasa I, sebanyak 5116 (12.8%) adalah pengguna dwi penggunaan RE dan RK. Tinggal di kawasan pinggir bandar (aOR 1.29, 95%CI:1.21- 1.38), beragama Islam (aOR 5.46, 95% CI: 2.88-10.32), berumur antara 18 hingga 25 tahun (aOR 10.0, 95% CI 5.59-18.0), mencuba untuk berhenti merokok RK (aOR 2.33, 95% CI: 2.16-2.52) dan mendapati agak mencabar bagi mereka untuk tidak merokok dalam masa sehari (aOR 1.95, 95% CI: 1.56-2.46) adalah merupakan faktor-faktor yang berkaitan dengan dwi pengguna. Bagi faktor-faktor frekuensi penggunaan RE (harian,

xv

mingguan,bulanan), dwi-pengguna yang menggunakan produk selain tembakau (aOR 1.449, 95% CI 1.144-1.837), merancang untuk berhenti dalam masa sebulan (aOR 2.188, 95% CI 1.471-3.254), memilih ER kerana memberikan kesan kurang bahaya terhadap kesihatan (aOR 2.717, 95% CI 2.074-3.559), menggunakan RE untuk mengurangkan penggunaan RK (1.577 1.117-2.227), menggunakan RE untuk membantu memberhentikan penggunaan RK (aOR 2.300, 95% CI, 1.642-3.221) dan menggantikan RK (aOR 1.511, 95% CI 1.110-2.056) mempunyai kemungkinan lebih tinggi untuk menjadi pengguna harian RE. Penerokaan lanjutan bagi Fasa II menghasilkan sepuluh tema dan tiga puluh dua subtema yang patut diberi perhatian seperti risiko kesihatan RE, RE yang menjejaskan aktiviti harian, kesegeraan untuk menggunakan RE, RE dan RK yang sama berbahaya, kebergantungan RE, laluan kepada berhenti merokok dan tiada percubaan berhenti merokok. Kesimpulannya, beberapa faktor berkaitan sosiodemografi dan merokok mempunyai perkaitan yang signifikan dengan dwi-penggunaan dan kekerapan penggunaannya. Selain itu, siasatan lanjut dalam Fasa II mendapati dwi-penggunaan merugikan penggunanya. Penemuan dari kajian ini menyediakan maklumat penting untuk merancang langkah pencegahan masa depan serta cadangan untuk perundangan RE di Malaysia.

A MIXED METHOD STUDY ON THE ASSOCIATING FACTORS, REASONS FOR USE, PERCEPTIONS AND QUITTING BEHAVIOUR OF E-CIGARETTE AMONG DUAL USERS IN MALAYSIA

ABSTRACT

Dual usage of e-cigarettes (ECs) and conventional cigarettes (CCs) may prolong the usage of both products, reducing the urge to quit smoking and increasing nicotine dependence. This study used a mixed method explanatory sequential design, consisting of both quantitative (Phase I) and qualitative (Phase II) methods. In phase 1, secondary data was obtained from the Malaysian Contraband Trade Study comprising 40,000 smokers, which used validated questions originating from the International Tobacco Control (ITC). Phase II recruited 27 dual users based on saturation point and explored their perceptions about EC use and attempts to quit smoking using the integrated components of the Health Belief Model (HBM) and Theory of Planned Behaviour (TPB). According to Phase I findings, there was a total of 5116 (12.8%) dual users of ECs and CCs. Living in an urban area (aOR 1.29, 95%CI:1.21- 1.38), being Muslim (aOR 5.46, 95% CI: 2.88-10.32), being between the ages of 18 and 25 (aOR 10.0, 95% CI 5.59-18.0), had previous attempt to quit smoking CCs (aOR 2.33, 95% CI: 2.16-2.52) and find it somewhat challenging to go without smoking for an entire day (aOR 1.95, 95% CI: 1.56-2.46) were all factors associated with dual use. Regarding the factors associated with the frequency of EC use (daily, weekly and monthly), dual users who used other tobacco products (aOR 1.449, 95% CI 1.144-1.837), planning to quit within a month (aOR 2.188, 95% CI 1.471-3.254), opting for ECs because of their less harmful effects towards health

(aOR 2.717, 95% CI 2.074-3.559), using ECs to cut down on CCs (1.577 1.117-2.227), using ECs to help quit CCs (aOR 2.300, 95% CI, 1.642-3.221) and as a replacement for CCs (aOR 1.511, 95% CI 1.110-2.056) had higher odds of becoming daily users of ECs. Further exploration in Phase II generated ten themes and thirty-two noteworthy sub-themes such as EC health risks, ECs affecting daily activities, urgency to use ECs, ECs and CCs being equally harmful, EC dependence, pathways to smoking cessation and no quit attempts. In conclusion, several sociodemographic and smoking related factors have a significant association with dual use and its frequency of use. In addition, further investigation in phase II found that dual use was detrimental to its users. The findings from this study provide essential information to plan future preventive measures as well as recommendations for EC legislation in Malaysia.

CHAPTER 1

INTRODUCTION

This chapter gives a general introduction to several topics related to the thesis. The thesis begins in providing an overview of the tobacco scenario and its impact at a global scale and current smoking issues in Malaysia. This is followed by an exploration of the e-cigarette (EC) device as an evolving and a debatable product for tobacco harm reduction and an introduction regarding the use of e-cigarettes (ECs) among adult smokers in Malaysia. This chapter will also embark on contextualizing the theoretical framework, conceptual framework which leads to the final part of this chapter that consists of the study objectives for both quantitative and qualitative components and finally the significance of the study.

1.1   Tobacco's Global Impact

More than two hundred million fatalities are believed to have occurred due to tobacco use in the last thirty years, and with more than 1 billion smokers in the world today, these figures are certain to rise in the future decades (Cox & Dawkins, 2018). According to previous reports, eight million people would die by 2030 if present smoking patterns and prevalence rates do not change, with 80 percent of fatalities occurring in lower- and upper middle-income countries (World Health Organization [WHO], 2020). Tobacco use is the second biggest cause of mortality and disability from non-communicable diseases (NCDs) causing respiratory diseases, cardiovascular diseases, and cancer disorders, all of which have been linked to tobacco use in the past (Hamzah et al., 2020). Efforts for tobacco harm strategies have been persisted for the past two decades to encourage smokers to increase in

their quit smoking attempts to achieve higher smoking cessation rates in the population (Obisesan et al., 2019).

1.1.1 Malaysia's Tobacco Control

In Malaysia, an estimated ten thousand smoking-related fatalities are recorded each year, with the number anticipated to treble to an alarming thirty thousand by 2030 if the current trend continues (Institute for Public Health, National Institutes of Health, Ministry of Health Malaysia, 2020). This does not include the number of early deaths linked to second-hand smoke (SHS) (Ho et al., 2019). According to the National Health and Morbidity Surveys (NHMS conducted in 2011, 2015, and 2019, the prevalence of adult smokers in Malaysia has steadily declined in recent years, from 23.1 percent, 22.8 percent, and 21.3 percent, respectively (Institute for Public Health, National Institutes of Health, Ministry of Health Malaysia, 2020). However, the diminishing patterns of smoking CCs seem to have been supplanted by an increase in adult smokers using ECs (Lim et al., 2013). The assumption that ECs will complement tobacco harm reduction since it reduces exposure to various toxic substances and combustible compounds present in CCs has resulted in an expanding trend and a commercially marketable product (Abdulrahman, Ganasegeran, Loon, & Rashid, 2020).

Recognizing tobacco use as a critical public health issue in Malaysia, the government has implemented several tobacco control measures that includes the Control of Tobacco Product Regulation under the Food Act 1983 and joining forces with 180 other countries under the Framework Convention on Tobacco Control (FCTC), a legally binding treaty negotiated at the World Health Organization (WHO) (Wan Puteh et al., 2018; WHO, 2016). Malaysia had implemented smoke-free laws (SFL), increased tobacco taxes, developed smoking cessation programs,

and enacted visual health warnings on cigarette packaging as efforts to withhold the treaty of the WHO FCTC (Abidin, Zulkifli, & Abidin, 2016). In previous research, SFL have been demonstrated to lower the number of cigarettes smoked, enhance smokers' intentions to stop smoking, and raise the percentage of smokers who successfully quit (Driezen et al., 2020). SFL has also been demonstrated to lower the frequency of hospital admissions for heart attacks, asthma, and pre-term deliveries (Lim et al., 2018). However, SFL implementation and tobacco regulatory frameworks in Malaysia has yet to show the same success as in the UK in terms of lowering exposures and negative health impacts of second-hand smoke. The greatest problem in Malaysia is likely to be due to insufficient enforcement by relevant authorities in ensuring compliance with the SFL in premises as specified in the Control of Tobacco Product (Amendment) Regulations (2010). To increase the positive effects of SFL, enforcement must be constant, and monitoring is carried out on a consistent basis. This is to show government's strong commitment to making ensure that the SFL is a success for the society. However, scarcity of manpower to enforce the legislation could be an issue (Abidin et al., 2016).

The emergence of the electronic nicotine delivery system (ENDS) devices since 2010, created additional problems in SFL deployment emerge. Since the introduction of e-cigarettes to the market, new obstacles have arisen in the application of the present SFL. Thus, treating e-cigarettes in the same way as traditional cigarettes will help to maintain the current SFL's strength while allowing the authority to focus on enforcement to ensure the success of the implementation. Furthermore, the emergence of a dominating group among EC users, namely ever-users and dual user groups, provides new problems to tobacco regulatory frameworks

and urgent concerns for lowering the burden of tobacco-related illnesses (Brożek, 2019; WHO, 2011).

1.2   E-cigarette Devices

1.2.1   Historical Context

Since the 1880s and 1890s, businesses have marketed innovative products that fundamentally have a heating element and a mouthpiece that reportedly reduces substantially the amount of nicotine and other traditional cigarette elements that was considered harmful to a person's health (Marques, Piqueras, & Sanz, 2021). Dr Scott attempted to develop an EC in 1887 that was publicized in Harper's Weekly (Figure 1.1). The tobacco product was claimed to light without the use of matches and to contain a cotton filter that "strains and eliminates the harmful qualities of the smoke," including nicotine (Harper's Weekly, 1887).
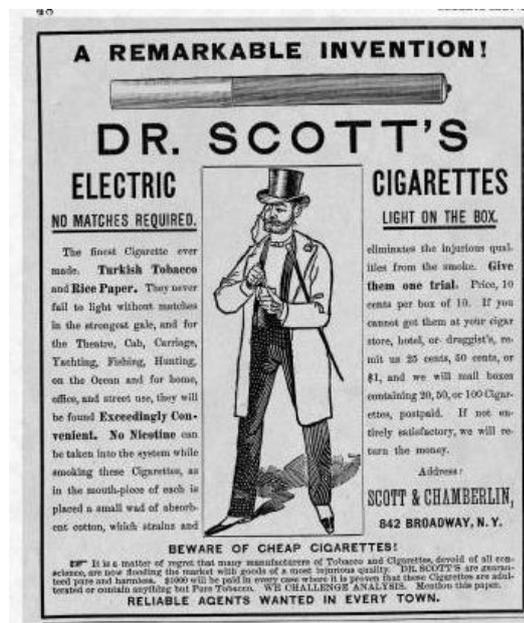
Figure 1.1   Harper's Weekly published advertising for Dr Scott's Electric Cigarettes (1887)

Source: Truth Industry Tobacco Documents

This potentially "disruptive invention" that can transform the current tobacco business and supplant traditional smoking was further explored in the 1960s by researchers at British American Tobacco (BAT), the parent company of Imperial Tobacco Canada Limited. Recognizing that smokers' brains were addicted to nicotine, BAT launched a project called "Ariel" that they dubbed 'the next generation' to design and develop a new smoking device that, through the administration of nicotine in a suitable form, would provide complete satisfaction to smokers while avoiding the well-known disadvantages of smoking CCs (Dewhirst, 2019). However, after obtaining two patents for Ariel, BAT chose to discontinue the research to prevent jeopardizing its primary product which is CCs (Risi, 2017). In 1965, Herbert A. Gilbert made history by patenting a device that had many of the same properties as ECs and is characterized as "a smokeless non-CC." However, the product was not popular at the time and had not achieved economic success (Gupta, Sharma, Srikant, & Manaktala, 2020).

The present form of the first patented EC was created in 2003 in China by Hon Lik, a Chinese pharmacist working in collaboration with Dragon Holding. Hon Lik was driven to produce a less dangerous product than the standard CC after the death of his father, who was a heavy smoker and died of lung cancer (Sapru et al., 2020). Hon Lik's firm, The Ruyan Group, whose name literally translates as "just like smoke," was the first maker of ECs in Hong Kong (Sapru et al., 2020, Wang et al., 2015). Despite having the lowest smoking incidence among industrialized nations because of its rigorous smoke-free legislation, high tobacco tax, and free quit smoking programs, Hong Kong continues to have a sizeable daily smoking population (652,000; 10.5 percent of all adults aged over 15 years) (Sun et al., 2021). EC hit the market in China in 2004, Europe in 2006, and the United States (US) in

2007 and quickly grew to become the most popular nicotine product especially among young adults (Karey, 2021).

1.2.2 The Evolution of the E-cigarette

ECs is one of the many terms used to describe Electronic nicotine delivery/dispensing systems (ENDS) or electronic non-nicotine delivery/dispensing systems (ENNDS), which are battery-operated devices that vaporize a liquid solution, more commonly referred to as e-liquid. Since they first became available on the market more than a decade ago, they have been widely regarded as a less harmful alternative to CCS (Marques et al., 2021). This notion stems from the e-liquid which include propylene glycol, vegetable glycerine, nicotine (though labelling of concentration is not always correct), and food-grade flavourings, which have been evaluated and approved for oral consumption (Barhdadi, Rogiers, Deconinck, & Vanhaecke, 2021). Regardless of whether food safety authorities have approved their use in food products in the United States and Europe, the quality and safety of ECs have not been evaluated (Barhdadi et al., 2021). Furthermore, the inhalation safety of these flavours, such as diacetyl and ultra-fine particles, has been linked to severe lung diseases (Barhdadi et al., 2021).

Puffing on the battery-operated device activates the atomizer's heating element, which vaporizes the e-liquid into a plume of mist inhaled by the smoker. However, various EC brands may contain varying amounts of liquid and nicotine (Cotti, Nesson, Pesko, Phillips, & Tefft, 2021). In principle, these devices, together with nicotine inhalers, may assist smokers in quitting smoking more than other nicotine-containing products do since they address at least some of the behavioural and sensory elements of smoking addiction, such as mimicking hand-mouth motions (El Dib et al., 2017).
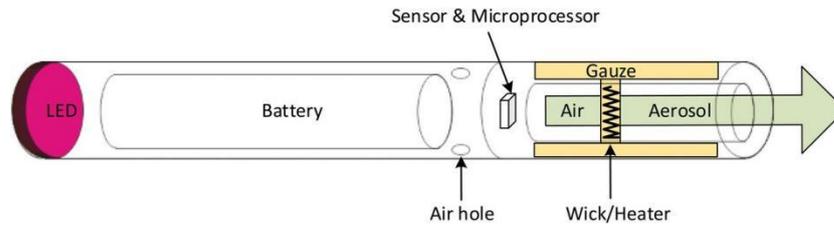
Figure 1.2   Typical e-cigarette configuration

Source: Brown and Cheng (2014)

Figure 1.2 presented a schematic illustrates a disposable EC, which is often the same size and shaped as a regular CC and has a similar-looking mouthpiece. ECs with refillable or changeable cartridges often have the cartridge located near the heating element on one end of the EC. EC variants are often classified as "generations", and based on previous research, they emphasized the rise of a new generation of ECs known as pod mods, which are still gaining popularity due to their simplicity of use and portable design (Spindle & Eissenberg, 2018). Other EC models that do not resemble cigarettes are those with refillable tanks (second generation) and products modified by users ("mods" third generation), which continue to be the most popular device type in Europe due to their similar amount of nicotine content to CCs and ability to satisfy smokers' cravings (Tattan-Birch, Brown, Shahab, & Jackson, 2021). Previous research show that dual users have higher saliva cotinine levels, as nearly two-thirds of dual-user smokers (63.3%) were classified as having high salivary cotinine level as compared with exclusive EC users of pre-filled e-cigarette models (Mohd Radzi, Saub, Mohd Yusof, Dahlui, & Sujak, 2021). In addition, those first and second-generation models may have similar effects as cigarette withdrawal symptoms (Mohd Radzi, Saub, Mohd Yusof, Dahlui, & Sujak, 2021). The variability EC designs and ease of use demonstrate that ECs are not a single product but rather a class of products as demonstrated in figure 1.3. The

rapid changes in their design affects smokers' smoking behaviours as the proclivity to experiment with novel products increases (Martinelli et al., 2021).

Figure 1.3　　　Various Electronic Cigarette Models

Source: Eltorai, Choi, and Eltorai (2019)

1.2.3　Malaysia's Regulatory Framework for E-Cigarette

Despite the harm associated with smoking an EC, there is little information available in local contexts to help the creation of policies aimed at reducing the use of this device (Wan Puteh et al., 2018). In 2016, the WHO FCTC published a short study to help nations worldwide in adopting EC regulations that are compliant with national legislation. In the local context, since the present of SFL only applies to CCs and smoking activities, the use of ECs in smoking-prohibited areas could not be restricted. This is shown by research that examined the motivations for EC use and discovered that one of the most often cited reasons is that they are allowed to smoke ECs anywhere and can be used to avoid smoke-free regulations (Grana & Ling, 2014). To date, significant efforts has been made to create public awareness and educate the public about the SFLs implementation, particularly in terms of establishing a social stigma against smoking in public areas. However, absence of limits on EC use jeopardizes the existing SFLs efficacy (Glantz & Bareham, 2018). The final impact of EC use on public health is heavily dependent on policy developments. Thus, including EC and vaping use within the present SFL and

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limiting their use in comparable locations where CCs are prohibited would ensure the SFL's success (Abidin et al., 2014).

Countries categorize ECs according to their nicotine level, claimed purpose of use, device components, and legal wording (van der Eijk et al., 2022). ECs are often categorized as medical equipment if the producer makes a health claim (Kennedy, Awopegba, De León, & Cohen, 2017). Nicotine is classed as a restricted poison or dangerous substance in Australia, Brunei Darussalam, the Czech Republic, and Malaysia. On the 30th of October 2015, the cabinet has made a decision not to ban electronic cigarettes and vape. However, the e-liquid containing nicotine and other substances listed under the Poisons List are highly regulated under the Poisons Act 1952 and the Dangerous Drugs Act 1952 (Abdullah, 2015; Clinical Pharmacy Working Committee, 2019; Fong et al., 2004). While the Ministry of Health (MOH) is responsible for regulating nicotine-containing ECs, it is up to each state to prohibit their sale and use (Yee & Spykerman, 2016). As of 1st January 2016, the Malaysian states of Johor, Kelantan, Negeri Sembilan, and Kedah have forbidden the sale of ECs, while the other states awaited more direction on whether to control the sale and use of ECs within their jurisdiction (Wong, Mohamad Shakir, Alias, Aghamohammadi, & Hoe, 2016). Appointed ministries that were held accounted for in developing the regulations for ECs were the Ministry of Health, the Ministry of Energy, Science, Technology, Environment, and Climate Change (MESTECC), and the Ministry of Domestic Trade and Consumer Affairs (KPDNHEP) (Lim et al., 2019).

The MOH controls the sales of e-liquid containing nicotine under the Poisons Act 1952 and the Sale of Drugs Act 1952, which enable the sale of preparations containing nicotine for medical treatment only to licensed pharmacies and qualified

medical practitioners. Additionally, the ministry oversees the sale, advertising, and use of health-related labelling on EC liquids without nicotine and vape, including enforcing a prohibition on their use by minors. Under the Consumer Protection Act 1999, the KPDNHEP is responsible for regulating and enforcing safety requirements for EC devices and batteries, as well as vaping equipment (Act 599). The ministry controls and enforces the marking and labelling of ECs, nicotine-free liquids, and vapes under the Trade Descriptions Act 2011 (Act 730; Act 599; the Price Control and Anti-Profiteering Act (Act 723), and the Weights and Measures Act 1972 (Act 71). KPDNHEP would regulate the licensing, manufacture, and distribution of EC devices, nicotine-free liquids, including their importation, exportation, and sale, under a new legislation. Meanwhile, under the Standards of Malaysia Act 1996, MESTECC will set standards for EC batteries, devices, and the packaging of nicotine-free, e-liquid, and vapes via the Department of Standards Malaysia ("Laws to Control E-cigarettes in the Pipeline," 2016).

The revised Tobacco Bill's final text has been delivered to the Attorney General for assessment and presentation at community halls and state councils. As of 1 January 2019, ECs and shisha containing nicotine were included in the rule prohibiting smoking in all food establishments. Malaysia has implemented an excise levy on EC devices, non-EC devices, liquids, and gels, including those containing nicotine, beginning in 2021, with exceptions for local producers. Excise tax on devices will be 10% 'ad valorem' (according to value), while liquids and gels would be levied at a rate of 40 sen per millilitre (ml) (Yunus, 2021).

1.3 Concurrent Use of Conventional Cigarettes and E-cigarettes

1.3.1 Malaysia's Current Dual-Use Scenario

While there is no consensus on the proper definition of dual-use, it is commonly defined in most of the evidence-based literature as individuals who currently smoke both ECs and CCs, whereas those who smoke only ECs are referred to as single users or exclusive users of ECs (Robertson et al., 2019). Among the several conceivable poly-tobacco use patterns, previous research indicates that the combination of smoking CCs and ECs is the norm, particularly among adolescents and young adults (Collaco, Drummond, & McGrath-Morrow, 2015). However, using ECs as a substitute for CCs may increase the probability of smokers continuing to use both ECs and CCs, and nicotine dependency was believed to be the driving cause for this behaviour (Advani et al., 2022). According to a recent systematic review of current dual-use and poly-tobacco use among adults in 48 countries, the prevalence of current dual-use and poly-tobacco use was higher in lower and middle-income countries, particularly in South-east Asia, than in higher-income countries such as the United Kingdom and Denmark (Chen, Girvalaki, Mechili, Millett, & Filippidis, 2021).

ECs are widely used both domestically and globally, and their popularity is growing. In Malaysia, the device has developed and has been pushed as a safer and "healthier" alternative to CCs and other traditional nicotine delivery techniques such as hand-rolled tobacco, cigars, and tobacco pipes. On the other hand, dual users continue to incur substantial health consequences even when their cigarette intake is decreased (Robertson et al., 2019). The original goal of completely switching from smoking to vaping may be hampered, since dual usage decreases the incentive to stop (Robertson et al., 2019). Dual users reflect the vaping community's real-world

population, and further research is needed to determine if the combination of EC and CC use is likely to result in smoking cessation or an increase in nicotine addiction. Additionally, research on dual-use is still in its infancy, and recent demands for qualitative studies that use behaviour theory models to investigate dual-use have not inspired a complete response. Diverse demographics must be surveyed to give evidence for the efficacy of these innovative products (Nik Mohamed, Rahman, Jamshed, & Mahmood, 2018).

1.4   Mixed Method Study for Tobacco Control Research

According to a recent study, relying exclusively on quantitative surveys limits the depth of the findings because of their hardening interpretation (Birgili, Seggie, & Oğuz, 2021). Mixed method research is a research methodology that combines quantitative and qualitative data. It entails similar research methodology processes such as data collection, analysis, and interpretation from both phases to understand complex research problems better. It also presents a range of divergent viewpoints on the phenomenon, which is the escalating trend of EC usage among smokers in Malaysia (Fryer, Seaman, Clark, & Plano Clark, 2017). According to prior research, investigations that combine quantitative and qualitative approaches effectively acquire conclusions about a result that could not be achieved from either quantitative or qualitative methods alone (Fryer et al., 2017). There is total of five mixed method designs or approaches that can be adopted for tobacco control studies: concurrent, explanatory sequential, exploratory sequential, embedded, and multiphase (Guest & Fleming, 2015). For this specific study, an explanatory sequential design (i.e Quantitative to qualitative) which involves collecting data through quantitative methods first followed by an exploration of qualitative data to explain in-depth

regarding a certain phenomenon (Moodie, Mackintosh, Hastings, & Ford, 2011). Previously, many studies in the field of tobacco control used a mixed method sequential approach, with the majority justifying the qualitative component as a complementary aspect of the study, in that both quantitative and qualitative methods are used to examine distinct aspects of the same phenomenon, resulting in a more complex understanding of the subject (Berg et al., 2010; Elsey et al., 2015; Gendall et al., 2011; Goenka et al., 2010; Greene, Caracelli, & Graham, 1989; Levy et al., 2010; Molyneux et al., 2006; Moodie et al., 2011).

While quantitative data collection may reveal patterns, trends, and features of dual users, an in-depth approach is necessary to contextualize the reasons that lead to dual users' continuous use of ECs and CCs. For example, there is a shortage of research on why daily, weekly, and monthly EC users engage in such behaviour. This understanding is critical in strengthening future tobacco harm reduction programs and policies. There is an underlying worry that opportunistic EC usage encourages ongoing cigarette use; consequently, the study is essential to identify the characteristics and patterns of dual users, particularly those among everyday EC users (Pokhrel, Herzog, Muranaka, Regmi, & Fagan, 2015).

1.4.1 Application of the Health Belief Model (HBM) and Theory of Planned Behaviour (TPB)

To gather sufficient and valuable data and establish interventional techniques for prevention, it is critical to understand and analyse dual users' perspectives and health beliefs about EC usage. The Theory of Planned Behavior (TPB) and the Health Belief Model are two widely used health psychology methodologies for determining the underlying reasons for a given health behaviour (Case, Crook, Lazard, & Mackert, 2016). TPB is an extension of the Theory of Reasoned Action

(TRA). According to TRA, the desire to engage in a particular health-promoting or health-compromising behaviour is described by two significant factors: attitude towards that behaviour and subjective norms. In the case of TPB, an extra element, namely perceived behavioural control, will be adopted to determine an individual's capacity to change their health condition to a better state.
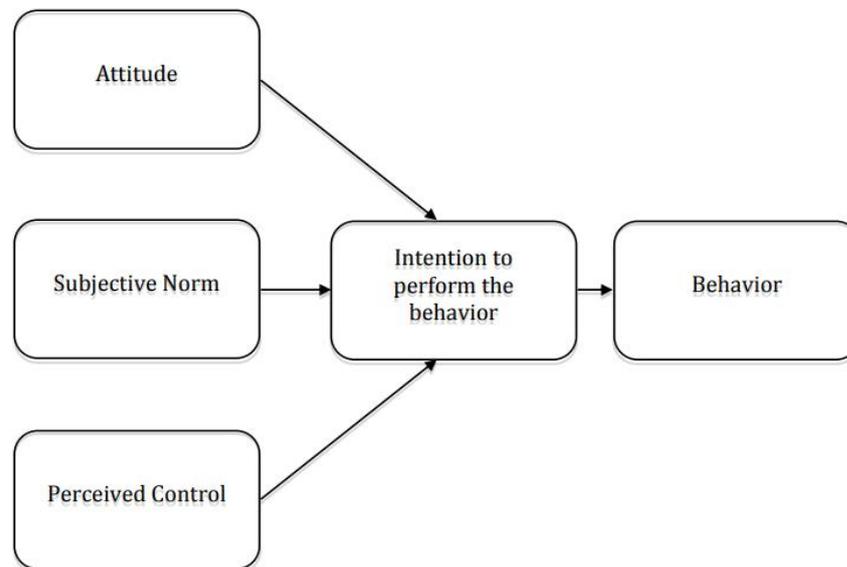
Figure 1.4   The Theory of Planned Behavior's Constructs (TPB)

Source: Montaño and Kasprzyk (2015)

The Health Belief Model
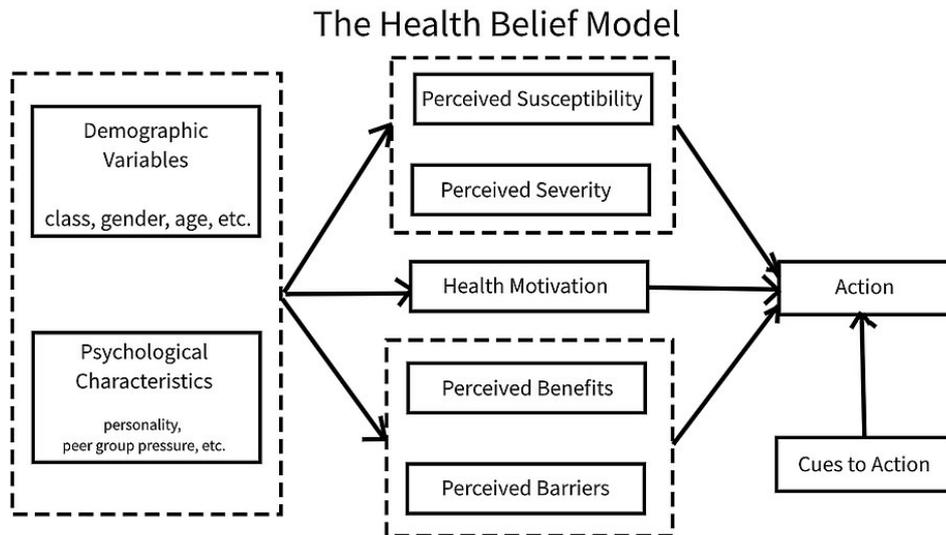
Figure 1.5   The Health Belief Model's Constructs (HBM)

Source: Becker (1974, 1988) and Janz and Becker (1984)

The health belief model (HBM) is a valuable tool for examining how dual users' perceptions and beliefs about EC use might give insight into their current perceptions on EC use and predict potential quitting behaviours (Green et al., 2020; Pribadi & Devy, 2020). HBM has been extensively used to assess a variety of lifestyle-related behaviours, including those associated with tobacco management. It conceptualizes health behaviour engagement by measuring several constructs such as perceived vulnerability and severity, perceived advantages, perceived obstacles, and perceived self-efficacy to participate in specific health behaviour (Panahi et al., 2022).

Since many of the TPB and HBM components overlap, the two frameworks were combined to uncover characteristics related to EC usage among adult smokers in Malaysia. For instance, in TPB, constructs representing attitudes and perceived norms were associated with HBM through the component of personal views. Given the similarities of the two notions of perceived behavioural control and self-efficacy

in both models, the model selected just one construct: self-efficacy (Case et al., 2016).

There is a shortage of comprehensive and complicated research studies that use widely used behaviour models to examine risk perceptions and health beliefs about EC use. The currently published opinions of the advantages or causes for EC usage are based on general population research and do not consider factors unique to the target group of existing dual users of CCs and ECs Hershberger, Connors, Um, and Cyders (2018), Case et al. (2016), Hall, Austin, Do, and Richardson (2017), Katz, Erkinnen, Lindgren, and Hatsukami (2019). Additionally, little is known about how perceptions vary by socio-demographic characteristics and frequency of EC use, which is critical for designing future preventative interventions and research investigations.

1.5   Theoretical Framework

The theoretical framework was an integrated framework which incorporates parts of the two most often utilized behavioural models, HBM and TPB. The theoretical framework outlines the elements to further understand the perceptions of EC use and intention to quit among dual users of ECs and CCs. According to the integrated framework as displayed in Figure 1.6, health beliefs and perceptions encompasses knowledge, attitudes, perceived threats (perceived risks associated with performing the behaviour); perceived barriers (perceived difficulties related to achieving the behaviour); perceived benefits (perceived benefits related to conducting the behaviour); attitudes, perceived norms, and perceived self-efficacy (belief in one's ability to perform the behaviour). The integrated theoretical framework, which has incorporated the integration of two behavioural models, has

also been developed and employed in prior studies linked to e-cigarette use and smoking cessation (Case et al., 2016; Feng, Zhu, & Zhao, 2021).

Variables

Integrated framework of HBM and TPB

Action

<u>**Socio-demographic and economic factors:**</u>

- Residence
- Gender
- Age
- Ethnicity
- Religion
- Educational status
- Working status
- Student status
- Income

<u>**Smoking profile factors:**</u>

- Age of smoking initiation
- Average number of cigarettes
- Previous quit attempt
- Plan to quit
- Smoking abstinence
- Addiction to smoking
- Type of EC
- Nicotine content

<u>**Behavioural factors:**</u>

- Motivating reasons
- Perception

Knowledge

Attitudes

Perceived Benefits/Advantages

Perceived Threats/ Disadvantages

Perceived Norms

Perceived barriers

Perceived self-efficacy

Barriers to Quit

Motivating reasons to quit

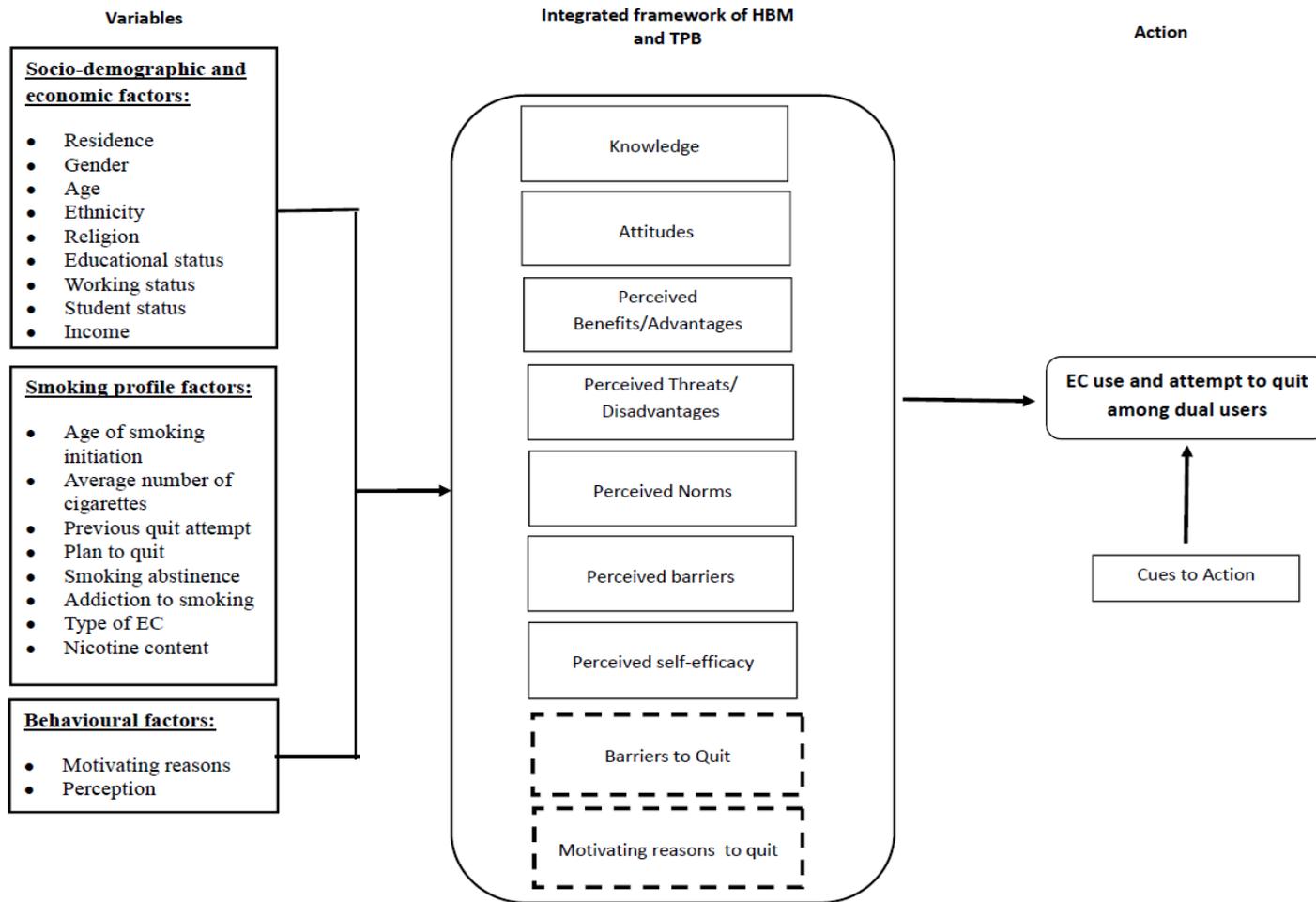**EC use and attempt to quit among dual users**

Cues to Action

Figure 1.6   Theoretical framework of the study

1.6   Conceptual Framework

The conceptual framework for this study is designed to help understand the factors that influence the use of ECs by various types of EC users, as well as the frequency of EC use by dual users. Our framework incorporates several factors such as socio-demographic and socio-economic factors, smoking profile, product characteristics and behavioural factors which consist of reasons of use and perceptions that influence the use of ECs and frequency of ECs by smokers. In previous research, critical smoking characteristics such as the age at which an individual began smoking and the average number of cigarettes smoked were found to be strongly associated with dual use of ECs and CCs, as nicotine dependence is believed to increase and become more severe if an individual begins smoking during their primary years (Cho, 2021). As for motivating reasons for use, EC users indicated that the primary reasons for use was to have the ability to smoke at places where smoking CCs was prohibited (Coleman et al., 2017). However, previous literature has highlighted that EC use may present heterogenous smoking patterns depending on whether usage was for the purpose of experimentation (e.g., curiosity) or goal-oriented reasons (e.g., quit smoking) (Abdulrahman et al., 2020). Smoking profile and EC product characteristics has also been depicted in previous literature in having a significant association with the frequency of EC use (e.g., daily, weekly, and monthly) (Kyriakos et al., 2018). Figure 1.7 provides a clearer illustration of the framework.

Independent Variables Predictors

Dependent Variables Outcome

Socio-demographic factors:

Residence
Gender
Age
Ethnicity
Religion

Socio-economic factors:

Educational status
Working status
Student status
Income

Smoking profile factors:

Age of smoking initiation
Average number of cigarettes
Previous quit attempt
Plan to quit
Smoking abstinence
Addiction to smoking

Behavioural factors:

Motivating reasons
Perception

Product characteristic

Type of EC
Nicotine content

Type of EC user

a) Non-user

b) Ever-tried

c) Dual-user

Frequency of EC use among dual user
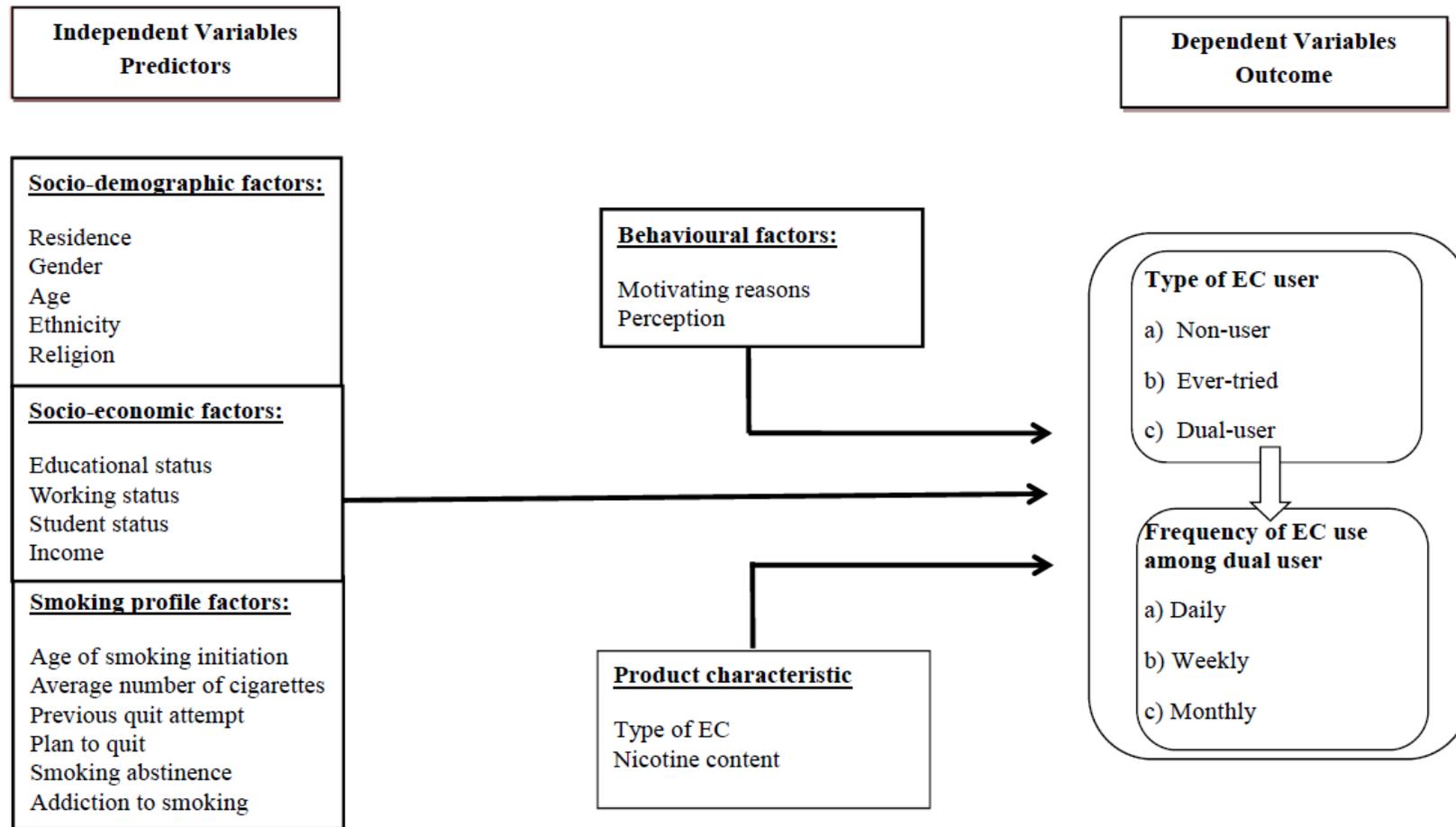
a) Daily

b) Weekly

c) Monthly

Figure 1.7   Conceptual framework for the study

1.7   Problem Statement

The Malaysian government has strengthened tobacco policies to curb the prevalence of smoking. However, the invention and innovation of ECs may reverse the decades of long public health initiatives (Wee et al., 2016). The majority of EC users are current CC smokers (dual users), and dual users account for a sizeable proportion since e-cigarettes mimics the sensation of smoking while efficiently delivering nicotine to their users (Driezen et al., 2022). Estimates from the Population Assessment of Tobacco and Health (PATH) Study indicate that 37.8% of adult tobacco users—10% of the US adult population overall—are current users of two or more tobacco products which are called as multiple tobacco product (MTP) users. Among MTP users, the most common combinations of products are CCs and electronic nicotine delivery devices (ENDS; 23%).

There is a concern that dual usage could extend the use of both products, thus lessening the urgency to quit smoking (Zhuang, Cummins, Sun, & Zhu, 2016). Sufficient evidence suggests that a potential negative impact of dual use and quitting activity appears unlikely. In addition, dual users had significantly higher odds of incident respiratory symptoms compared with both exclusive electronic nicotine delivery system users (adjusted OR = 1.9; 95% CI, 1.23-2.93) and exclusive tobacco smokers (aOR = 1.24; 95% CI, 1-1.55) (Li et al., 2020NECS. The relatively high rates reported by Malaysia contradict the notion that ECs would be a less viable product in non-high-income countries (Gravely et al., 2014).

However, relative to research related with exclusive smokers, only scant data are available on the patterns of dual users or on demographic and other person-level correlates of dual use. Although multiple, large-scale databases exist for studying

tobacco use, in analyses of these data, the tobacco using population is not always broken down into sub-populations which have specific pattern-based smoking behaviours. Therefore, the availability of national representative data of Malaysian smokers that are currently using ECs is crucial in understanding the evolving patterns and factors which comprises of socio-demographic, smoking profile, reasons for use and perceptions associated with dual use. This study also extends the findings by including all states in Malaysia, which have their own regulations pertaining to ECs. In addition, to what extent are the beliefs, perceptions and motivations of dual users is warranted by using established integrated behavioural theoretical frameworks to provide more evidence on the complexities of the factors that shape smokers' decisions to initiate use and continue utilizing these products.

1.8   Objectives and Research Questions

1.8.1   General Objective

The general objective of this study is to determine the factors associated with EC use, reasons for use, perceptions and quitting behaviour among smokers in Malaysia.

1.8.1(a)   Specific Objectives

In achieving the general objectives mentioned above, this study has set the following specific objectives:

1. To determine the factors associated with smoking ECs according to groups of EC user among adult smokers as below:

    a. Current dual users (current CC and EC user)

    b. Ever tried (ever tried EC within their lifetime)

    c. Non EC user (exclusive smokers that have never tried an EC).

2. To determine the reasons for EC use among adult smokers.

3. To investigate the factors associated with the frequency of EC usage among current dual users:

   a. Daily use

   b. Weekly use

   c. Monthly use

4. To explore the perception of EC use by using the integrated constructs of HBM and TPB such as attitudes, perceived benefits, perceived threat, perceived barrier, perceived norms, and perceived self-efficacy among dual users

5. To elucidate the attempts to quit, barriers and reasons/motivations to quit among dual users

1.8.2 Research Questions

Research questions for this study are constructed as follows:

1. What are the factors associated with smoking ECs according to groups of EC user among adult smokers?

2. What are the reasons for EC use among adult smokers?

3. What are the factors associated with the frequency of EC usage among current dual users?

4. What are the perceptions of EC use among dual users?

5. What are the reasons/motivations to quit among dual users?

1.9   Significance of the Study

Further research on the use of ECs among dual users should be conducted at a larger scale to have a more nuanced understanding of the patterns and behavioural

factors of dual use among smokers in Malaysia. The current study will investigate patterns and factors associated with EC use and frequency of EC use among dual users. This will also serve as a guide to better inform public health policies and interventions in the prevention practice of EC use as well as to urge total cessation of all tobacco products in order to attain nicotine abstinence (Owusu et al., 2019). The results and findings of this survey would be able to contribute extensively in various ways. Firstly, the study will be able to provide evidence to assist regulators and policymakers in making informed decisions for tobacco control policy development and enforcement. Secondly, the findings can inform health professionals that have prominent roles in tobacco control efforts, particularly smoking prevention and cessation and may assist in improving recruitment strategies tailored to individuals that may increase the number of smokers enrolling into quit services. Thirdly, based on the results obtained from this study, smokers and dual users will gain more benefit and advantage from comprehensive tobacco control programmes.