DIFFUSION OF ELECTRONIC CIGARETTES AS A SMOKING CESSATION AID AMONG YOUNG CONSUMERS

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─Abstract ─

The use of electronic cigarettes is an emerging trend in South Africa. The market entry of e-cigarettes coincides with concerted efforts by the South African government to curb tobacco smoking. Against this background, this study investigated factors influencing the diffusion and use of e-cigarettes among young consumers in South Africa. Underpinned by the diffusion of innovations theory, the study employed a quantitative research approach. Cross sectional data were collected from a student sample 150 using the snowball sampling method. The study employed regression analysis to verify the posited hypotheses. The results of the study showed that willingness to vape was influenced significantly by compatibility and observability. The study also found that willingness to vape was not related to quitting intention, implying that the use of e-cigarettes was not primarily motivated by the desire to quit smoking. Overall, the growing popularity of e-cigarettes in South Africa challenges policy makers to expedite the formulation of laws to govern the use of e-cigarettes. The findings of this study suggest the need for further studies on the risk profile of e-cigarettes and their efficacy as a smoking cessation aid.

Key Words: *Electronic cigarettes, cessation aid, diffusion of innovations theory*

JEL Classification: M10, M16, M31

1. INTRODUCTION

In spite of overwhelming evidence pointing to the harmful effects of tobacco cigarettes, most smokers are still struggling to quit (Allwood, 2013; Van Staden et al., 2013). In the last decade the emergence of e-cigarettes as a smoking cessation aids has generated sustained debate among health practitioners, marketers, national governments and the smoking public (Cho et al., 2011).This debate is spurred by the lack of conclusive scientific data on the safety and effectiveness of e-cigarettes as smoking cessation aids (Allwood, 2013). One of the greatest concerns is that information provided by marketers to consumers does not include detailed information about the risk profile of e-cigarettes (Cho et al., 2011). Another concern is that e-cigarettes may act as a gateway to smoking, especially among the youth (Pepper et al., 2013). Moreover, White et al. (2015) observed that the use of e-cigarettes by young consumers is associated with risk behaviours such as alcoholism.

Notwithstanding the lack of consensus on the safety and efficacy of e-cigarettes as a smoking cessation aid, the use of e-cigarettes is growing rapidly and has become a global phenomenon (Besaratinia & Tommasi, 2014). It is estimated that by the end of 2017, the global market value of e-cigarettes will grow to 10 billion US dollars (Lopes, 2013), with young consumers identified as the prime target market (Lee et al., 2014; White et al., 2015; Hanewinkel & Isensee, 2015).

Although the need to reduce tobacco smoking is urgent and paramount, White et al. (2015) note that very little is known about the efficacy of e-cigarettes as smoking cessation aids. To date, no published studies have sought to examine the factors influencing the rapid growth in the use of e-cigarettes usage in South Africa. In an attempt to fill this gap and avoid generalisation of results drawn from other samples to the South African context, this study investigated factors that drive the diffusion and adoption of electronic cigarettes among young consumers. In particular, this study was aimed at: (1) investigating factors triggering the rapid diffusion and adoption of e-cigarettes in South Africa; and (2) examining the relationship between willingness to use e-cigarettes and quitting intention. Specifically, the research questions that guided this study were: (1) what are the factors influencing the diffusion and adoption of e-cigarettes among young consumers in South Africa? (2) Is willingness to use e-cigarettes related to quitting intention?

2. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

2.1 Conceptualisation of e-cigarettes

During the past two decades, a number of alternatives to tobacco cigarettes were introduced in the marketplace (Cho et al., 2011). Notable products that were publicised as potential substitutes to tobacco cigarettes include Nicorette, Nicabate, Nicoderm, Nicotrol, Habitrol, Quitx, water-pipe cigarettes and electronic cigarettes (Bell & Keane, 2012; Maziak, 2011; Cho et al., 2011). Among the aforesaid products, e-cigarettes have enjoyed rapid adoption rates and are growing in popularity as smoking cessation aids (Bell & Keane, 2012).

Electronic cigarettes, also known as e-cigarettes (Pepper et al., 2014), are defined as battery-enabled devices that resemble conventional tobacco cigarettes, the consumption of which involves the inhalation of nicotine in a vapourised state (Christensen et al., 2014). A typical e-cigarette comprises a mouthpiece, a cartridge filled with a flavoured liquid and a battery-powered atomiser that converts the flavoured liquid into a vapour (Besaratinia & Tommasi, 2014). The used up cartridges may either be discarded or re-filled with an electronic fluid, which can be purchased from e-cigarette vendors (Stimson et al., 2014). The act of inhaling the vapour from the heated nicotine is called vaping (Christensen et al., 2014). For this reason, users of e-cigarettes often are identified as “vapers” (Pepper et al., 2013).

2.2 Factors influencing diffusion and adoption of e-cigarettes

E-cigarettes are perceived as a form of disruptive innovation, which is rapidly revolutionising smoking behaviour (Stimson et al., 2014). The term disruptive innovation refers to inventions that rapidly transform the way products are produced, distributed and consumed (Christensen et al., 2014). According to Stimson et al. (2014), e-cigarettes are regarded as a form of disruptive innovation because they are challenging established norms of tobacco control, compelling manufacturers of conventional tobacco cigarettes to innovate and changing the traditional perceptions of smoking. Based on this view, this study employs the diffusion of innovations theory (DIT) to help explain the spread and use of e-cigarettes. The DIT identifies relative advantage, compatibility, complexity, observability and trialability as attributes that influence the rate of diffusion and adoption of innovations (Rodgers, 2003). Following is a discussion of how the aforementioned factors affect the rate of diffusion and adoption.

2.2.1 Relative advantage

This study conceptualises relative advantage as the extent to which users of e-cigarettes perceive them as better than tobacco cigarettes. The relative advantage of e-cigarettes over tobacco cigarettes emanates from their value propositions of low nicotine, reduced smoking costs and immunity from smoke free zones restrictions (Goniewicz et al., 2013; Tan & Bigman, 2014). In addition, e-cigarettes are considered more aesthetically attractive than conventional cigarettes (Peters et al., 2013; Van Staden et al., 2013).

The aesthetic benefit of e-cigarettes emanates from the reduced exposure of users to tar and residue associated with tobacco cigarettes (Peters et al., 2011). According to the DIT, the higher the relative advantage of a product over its substitutes, the higher the rate of its adoption (Rogers, 2003). This supposition was confirmed empirically in a comparative study of e-cigarettes and conventional cigarettes conducted by Pepper et al. (2014), which found that the aesthetic design of e-cigarettes facilitates more use of e-cigarette as compared to tobacco cigarettes. Based on the foregoing discussion, it is hypothesised that:

H_1: Relative advantage positively influences willingness to use e-cigarettes as opposed to smoking tobacco cigarettes.

2.1.2 Compatibility

In this study, compatibility is operationalised as the degree to which the use of e-cigarettes resonates with the values and lifestyle of users. E-cigarettes are positioned as fashionable, high-tech products and these attributes are considered consistent with the novelty-seeking behaviour of young consumers (Trumbo & Harper, 2013). This view was supported in a study conducted by Peters et al. (2013) that found that a 'cool' personality attached to e-cigarettes by young consumers induces trial. The DIT posits that the higher the degree of compatibility of an innovation with the target market's value system, the higher its rate of adoption (Rogers, 2003). In view of the preceding discussion, it is posited that:

H_2: Compatibility positively influences willingness to use e-cigarettes as opposed to smoking tobacco cigarettes.

2.1.3 Complexity

In the context of this study, complexity denotes the easiness or difficulties associated with the use of e-cigarettes. According to the DIT, the rate of adoption

of complex innovations tend to be slower as compared to those of less complex ones (Rogers, 2003). Although e-cigarettes are considered as technical products, Barbeau et al. (2013) noted that the online platforms predominantly used to market e-cigarettes such as chat forums and online videos provide usage information, which makes it easy for product trial. In line with the preceding discussion, the following hypothesis was formulated:

H_3: Complexity in the use of e-cigarettes positively influences willingness to vape as opposed to smoking tobacco cigarettes.

2.1.4 Observability

In this study, observability refers to the extent to which the benefits of using e-cigarette are visible to users and non-users. As e-cigarettes are promoted mainly using online platforms, Lee and Cappella (2011) note that the exposure of non-users to videos and images of e-cigarettes has the potential to act as subliminal cues that encourage willingness to vape. In addition, McQueen et al. (2011) note that the consumption of e-cigarettes in groups has the potential to entice observing non-users to initiate vaping.

The social learning theory (Bandura, 1977) also supports the role of observation in modelling behaviour. The social learning theory suggests that observation has the socialising effect that promotes imitative behaviour among observers (Bandura, 1977). In the context of e-cigarettes, a study conducted by Trumbo and Harper (2013) confirmed the existence of a positive association between observability and use of e-cigarettes. Based on the preceding discussion, it is hypothesised that:

H4: Observability in the use of e-cigarettes positively influences willingness to vape as opposed to smoking tobacco cigarettes.

2.1.5 Trialability

In the context of this study, trialability refers to the relative ease of accessing and using e-cigarettes. According to the DIT (Rogers, 2003), an innovation is more likely to be adopted if it is capable of being tried on a limited basis. With regards to e-cigarettes, Trumbo and Harper (2013) note that the use of e-cigarettes among the youth is enhanced significantly by easy access to online marketing platforms. Apart from marketing e-cigarettes, Paek et al. (2014) note that online platforms also provide online support programs that have the potential of guiding non-users

to start vaping. For this reason, Trumbo and Harper (2013) argue that one of the factors responsible for the rapid proliferation in the use of e-cigarettes is unregulated accessibility. Based on this discussion, it is posited that:

H_5: Trialability of e-cigarettes positively influences willingness to vape as opposed to smoking of tobacco cigarettes.

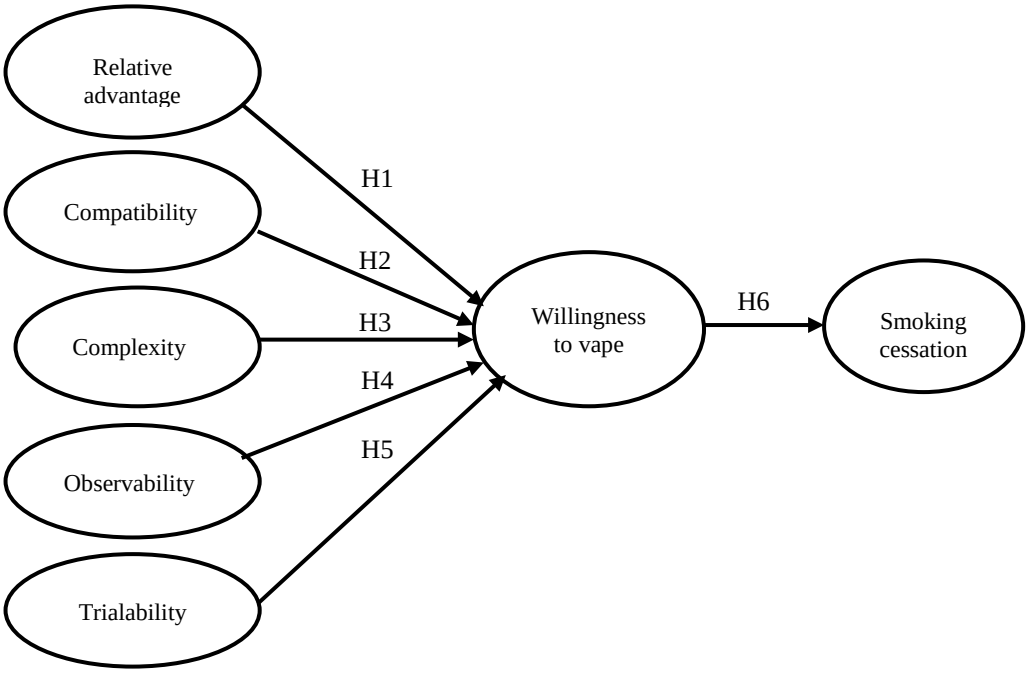
2.1.6 Willingness to vape

This study conceptualised willingness to vape as the inclination of an individual to use e-cigarettes. Extant literature on e-cigarettes associates the willingness to use e-cigarettes to quitting behaviour (Siegel et al., 2011; Tan & Bigman, 2014). However, to date, there is mixed empirical evidence on the efficacy of e-cigarettes as a smoking cessation aid (Farsalinos & Stimson, 2014; Sutfin et al., 2013; Bell & Keane, 2012). Based on this discussion, it is hypothesised that:

H_6: Willingness to vape is positively associated with smoking cessation as opposed to smoking tobacco cigarettes.

Consistent with the posited hypotheses, Figure 1 shows the conceptual framework that guided this study.

Figure 1: Conceptual framework



3. MATERIALS AND METHODS

3.1 Sample and sampling method

Cross sectional data were collected between August 2015 and April 2016 from a student sample aged between 20 and 33 years. The sample was drawn from a South African university in the Gauteng province. The student sample was selected due to the following reasons: (1) represents young consumers, (2) the innovative and high-tech image of e-cigarettes resonate with the novelty seeking behaviour of the university students, (3) online platforms used to market e-cigarettes make the youthful university cohort to be more susceptible to e-cigarettes than other generations (Cho et al., 2011) and (4) university students are perceived to be at the forefront of embracing new trends (Trumbo and Harper, 2013). Due to the unavailability of a sample frame of e-cigarette users, non-probability snowball sampling was used to select respondents. Using this method, field workers recruited respondents with the assistance of other e-cigarette users. Participation in the study was voluntary and no incentives were offered.

3.2 Instrumentation and data collection

Data were collected with an aid of a self-administered structured questionnaire. The questionnaire consisted of four sections. Section A requested respondents' age, education level, gender, race and e-cigarette club membership. Section B, measuring the factors that influence the diffusion of e-cigarettes, included items pertaining to compatibility, complexity, trialability, observability and relative advantage. Section C requested information on the respondents' willingness to use e-cigarettes. Lastly, Section D covered questions on quitting intention. All variables were measured on a five-point Likert scale with anchors ranging from strongly disagree (1) to strongly agree (5).

All variables under investigation were operationalised using validated scales drawn from previous studies. Relative advantage was measured using a six-item scale adapted from previous studies (Pepper et al., 2014; Trumbo and Harper, 2013). Compatibility, complexity, observability and trialability were all measured using items adapted from a study conducted by Trumbo and Harper (2013).Willingness to vape was assessed using items adapted from a study conducted by Pepper et al. (2013). Lastly, quitting intention was measured using items adapted from a study conducted by Tan and Bigman (2014).

4. DATA ANALYSIS

Data analyses involved reliability and validity analyses, sample composition, correlation analysis and multiple regression analysis. The Statistical Package for the Social Sciences (SPSS), Version 23.0 was used to analyse data. The results of the study are presented in the following section.

5. RESULTS

5.1 Reliability and validity

The internal consistency of the measurement items utilised in the study is reported in Table 1. All items returned acceptable Cronbach's alpha values ranging from 0.711 to 0.896, which are above the recommended threshold of 0.70 (Malhotra, 2010). As indicated in Table 2, the correlational matrix showed significant positive correlations between variables suggesting evidence of convergent validity.

Table 1: Scale Reliability

Variable	Number of items	Mean	Standard deviation	Cronbach's alpha
Relative advantage	6	3.89	0.65	0.896
Compatibility	4	3.70	0.61	0.816
Complexity	4	3.71	0.53	0.711
Trialability	4	3.70	0.56	0.799
Observability	4	3.83	0.56	0.737
Willingness to vape	3	3.84	0.65	0.819
Quitting intention	5	3.70	0.73	0.887

5.2 Sample composition

The majority of the respondents (86%) were male (n = 129) and 14 percent were female (n = 21). In terms of age, respondents between 20 and 25 years were the majority age group (64.7%), followed by between 26 and 30 years (30%) and 31 and 33 years (5.3%). In terms of race, 64.3 percent were black Africans (n = 98), 34.7 percent were Coloured (n = 52). A total of 15.3 percent (n = 23) claimed to have e-cigarette club membership and 84.7% had no membership (n = 127). Most of the respondents (70%) were enrolled for a diploma, 24.7 percent for a degree and 5.3 percent for a postgraduate programme.

5.3 Correlations

In order to assess the degree of association between variables that constituted the conceptual model, the Spearman's rho was computed. Table 2 provides the correlation matrix.

Table 2: Correlation matrix

	RA	COMP	COMPL	TRI	OB	WTV	QI
RA	1.00						
COMP	0.460**	1.00					
COMPL	0.525**	0.603**	1.00				
TRI	0.554**	0.510**	0.784**	1.00			
OB	0.660**	0.629**	0.803**	0.762**	1.00		
WTV	0.570**	0.571**	0.585**	0.565**	0.779**	1.00	
QI	0.025	-0.197*	-0.032	-0.043	-0.013	0.092	1.00

** Correlation is significant at the 0.01 level. * Correlation is significant at the 0.05 level. *RA = Relative advantage, COMP = Compatibility, COMP = Complexity, TRI = Trialability, OB = Observability, WTV = Willingness to vape, QI = Quitting Intention.*

In order to assess the strength of relationships between variables under investigation and to examine the influence of the dependent variable(s) on the independent variable, regression analysis was conducted.

5.4 Regression analysis

The study conducted regression analysis on two models. Model 1 comprised factors influencing use of e-cigarettes. Relative advantage, compatibility, complexity, trialability and observability were entered in the regression model as independent variables and willingness to vape as a dependent variable. The regression analysis results of Model 1 are summarised in Table 3.

Table 3: Regression Model 1 of factors influencing diffusion of e-cigarettes

Dependent variable: Willingness to vape	Standardised beta coefficient	T	Sig.	Tol	VIF	F change
Relative advantage	0.089	1.298	.196	0.552	1.813	
Compatibility	0.153	2.282	.024	0.572	1.748	
Complexity	-0.140	-1.435	.153	0.270	3.705	49.115
Trialability	-0.032	-.366	.715	0.330	3.031	
Observability	0.761	7.377	.000	0.241	4.147	

$R = 0.764$; $R^2 = 0.630$; Adjusted $R^2 = 0.618$
Sig = Significant; Tol = Tolerance; VIF = variance inflation factor

As shown in Table 3, the tolerance values ranged from 0.241 to 0.572 and the VIF values were all below 10. This suggests that multicolinearity conditions were not

violated (Pallant, 2010). Regression analysis results of Model 1 showed an adjusted R^2 value of .618 implying that approximately 62 percent of the variance in willingness to vape was explained by relative advantage, compatibility, complexity, trialability and observability. An inspection of the standardised beta coefficients showed that observability (0.761), compatibility (0.153) and relative advantage (0.089) were positively associated with willingness to vape. However, complexity (-0.140) and trialability (-0.032) were negatively associated with willingness to vape. Model 2 assessed the influence of willingness to vape on quitting intention. To do this, willingness to vape was entered in the regression model as the independent variable and quitting intention as dependent variable. The results of the regression analysis for Model 2 are provided in Table 4.

Table 4: Regression Model 2 willingness to vape and quitting intention

Dependent variable: Quitting intention	Standardised beta coefficient	T	Sig.	Tol	VIF	F change
Willingness to vape	0.092	1.125	0.262	1.00	1.00	1.267
$R = 0\ .092$; $R^2 = 0\ .008$; Adjusted $R^2 = 0.002$						
Sig = Significant; Tol = Tolerance; VIF = variance inflation factor						

As shown in Table 4, Model 2 yielded an adjusted R^2 value of 0.002 implying that less than 1 percent of the variance in quitting intention may be explained by willingness to vape. The low standardised beta coefficient of 0.092 showed that there is no significant relationship between willingness to vape and quitting intention.

6. DISCUSSION OF RESULTS

The **first hypothesis (H_1)** posited a positive relationship between relative advantage and willingness to vape. This relationship was not supported by the data ($\beta = 0.089$, t-value = 1,298, $p < 0.196$). This result is consistent with previous studies (Tan and Bigman, 2014) that refute claims that e-cigarettes are better than tobacco cigarettes. In a related study conducted by Sutfin et al. (2013), respondents demonstrated lack of knowledge regarding the benefits of e-cigarettes over tobacco cigarettes. This result may be attributed to limited scientific data available on the benefits of e-cigarettes.

The **second hypothesis (H_2)** predicted a positive relationship between compatibility and willingness to vape. This hypothesis was supported by the data ($\beta = 0.153$, t-value = 2.282, $p < 0.024$). This finding was also supported by a strong positive correlation ($r = 0.571$, $p < 0.01$) between compatibility and willingness to vape. This result concurs with the findings of previous studies

(Trumbo and Harper, 2013). The most plausible explanation of this result could be that the positioning of e-cigarette as fashionable, recreational, high-tech as well as the use of online platforms as marketing tools are consistent with the lifestyle of the youth and induces willingness to use e-cigarettes. This finding suggests the need by policy makers to monitor online platforms of e-cigarettes continuously to safeguard the youth against unsubstantiated marketing claims.

The **third hypothesis (H_3)** postulated that there would be a positive relationship between complexity and willingness to vape. This hypothesis was not supported by the data (β = -.0.140, t-value = -1.435, $p < 0.153$). This finding implies that users of e-cigarettes perceive them as complex. An inspection of the data set showed that the measurement item "I find it easy to follow instructions on how to use e-cigarettes" pooled an average mean score of 3.2 implying that users of e-cigarettes perceive challenges related to product knowledge when using e-cigarettes. This result suggests that in the event that the benefits of e-cigarettes are proven scientifically, marketers of e-cigarettes need to engage in consumer education in order to enhance the market appeal of e-cigarettes.

The **fourth hypothesis (H_4)** posited that there would be a positive relationship between observability and willingness to vape. This hypothesis was confirmed by the data (β = 0.761, t-value = 7.377, $p < 0.000$). This result was also supported by a strong positive correlation ($r = 0.779$, $p < 0.01$). This finding also mirrors that of Trumbo and Harper (2013) found a positive relationship between observability and willingness to use e-cigarettes. A possible explanation of this finding could be that the attractiveness, appearance and usage of e-cigarettes in areas where tobacco cigarettes are not allowed act as observable cues that promote the willingness to use e-cigarettes.

The **fifth hypothesis (H_5)** predicted a positive relationship between trialability and willingness to vape. This hypothesis was not supported by the data (β = -0.032, t-value = -0.366, $p < 0.755$). A possible explanation to this finding could be that in South Africa, e-cigarettes are not readily available to enhance trial. For instance, one of the measurement items of trialability "I find it easy to access e-cigarettes" returned a mean score below the agreeable threshold implying that access to e-cigarettes remains low. This could be the case given that e-cigarettes are marketed mainly in upmarket outlets with very limited availability in conventional outlets.

The sixth hypothesis (H_6) hypothesised that there would be a positive relationship between willingness to vape and quitting intention. This hypothesis

was not supported by the data (β = -0.032, t-value = -0.366, $p < 0.755$). This finding is consistent with past studies (Lee et al., 2014; Sutfin et al., 2013; Tan and Bigman, 2014) where the use of e-cigarettes was found not to be related to quitting intention. According to Tan and Bigman (2014), this finding suggests that e-cigarettes are not yet accepted as a means to quit smoking. As young users of e-cigarettes are still at the initial stages of developing their smoking behaviour, lack of empirical evidence of e-cigarettes as smoking cessation aids may assist policy makers to discourage them from continued use.

7. IMPLICATIONS OF THE STUDY

The growth in popularity of e-cigarettes is propelled by assertions that they enhance the intention of smokers of tobacco cigarettes to quit smoking. However, the findings of this study suggest that e-cigarette usage is not related to quitting intention. Thus, it is important for promoters of e-cigarettes to substantiate this claim using scientific evidence. This is necessary if concerns that marketers of e-cigarettes are misleading consumers are to be allayed.

Online platforms continue to be keen vehicles for the marketing of e-cigarettes. This underscores the need for the South African government to monitor and control the sale of e-cigarettes through online platforms. To rectify this, there is need to extend e-cigarette laws to cover online platforms. The high prevalence of smoking-related diseases in South Africa, such as tuberculosis, compels the government to commission a comprehensive scientific research on the safety and efficacy of e-cigarettes as a smoking cessation aid.

8. LIMITATIONS OF THE STUDY

This study is prone to limitations, which are worth noting. The study relied on cross sectional data to verify the posited hypotheses. As a result, it was not possible to trace the changes in smoking behaviour of users of e-cigarettes, especially quitting behaviour. A longitudinal study has the potential to provide valuable contribution in assessing the effect of e-cigarettes on quitting intention. The study was confined to one province and university only; this limits the generalisation of findings to other provinces. Further studies may consider broadening the geographic area of the study to enhance generalisability of the findings. Finally, this study used a closed ended questionnaire to collect data, which may have limited the respondents in explaining their perceptions about e-cigarettes. Further studies may adopt a qualitative approach in order to obtain a rich data set. Notwithstanding limitations, the study still make a valuable

contribution in understanding factors that influence the use of e-cigarettes and their relationship with quitting intention in South Africa.

9. CONCLUSION

The aim of this study was to investigate factors that influence the use of e-cigarettes and whether their usage was related to quitting intention. The study identified compatibility and observability as the main factors that influence the willingness to use e-cigarettes among university students. The study also showed that willingness to use e-cigarettes was not related to quitting intention. As e-cigarettes are not used primarily with the intention to quitting smoking, there is a need to delineate motivating factors behind e-cigarette usage. Overall, the findings of this study emphasise the need by the South African government to monitor the marketing of e-cigarettes continuously in order to protect consumers from unsubstantiated claims about the benefits of e-cigarettes.

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