



The Relationship Between the Smoking Duration of E-Cigarette and Blood Pressure in the Udanawu Vapor Community, Blitar

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ABSTRACT

The use of e-cigarettes is increasing in the community and is suspected to be associated with changes in blood pressure due to nicotine exposure. This study aims to determine the relationship between the duration of e-cigarette use and blood pressure in men aged 20–30 years in the e-cigarette user community in Udanawu, Blitar. This is an analytical observational study with a cross-sectional design involving 17 respondents selected through purposive sampling. Blood pressure data were measured with a sphygmomanometer and analyzed using the Spearman correlation test. The results showed that the average systolic blood pressure of respondents was 117.65 mmHg, and the average diastolic blood pressure was 87.65 mmHg. Statistical analysis showed a significant relationship between the duration of e-cigarette use and systolic blood pressure ($p=0.003$; $r=0.679$) and diastolic blood pressure ($p=0.005$; $r=0.646$). These results indicate that the longer the e-cigarette use, the greater the tendency for blood pressure to increase in respondents. Thus, long-term use of e-cigarettes has the potential to be a risk factor for cardiovascular disorders in young adults.

Keywords: e-Cigarette, smoking duration, blood pressure

INTRODUCTION

The use of e-cigarettes has increased significantly in recent years and has become a global phenomenon, particularly among adolescents and young adults. A study by Salari [1] shows that the prevalence of e-cigarette use among young people continues to increase globally, driven by the perception that e-cigarettes are safer than conventional cigarettes. A similar finding was reported by Izquierdo-Condoy [2], who found high e-cigarette use among adolescents in Latin America, with various risk factors such as social influence and product accessibility.

In Indonesia, the trend of e-cigarette use also shows quite rapid growth. Research by Syawqie [3] reports that e-cigarette users are predominantly among the productive age group, with varying usage patterns in terms of both frequency and duration. This condition indicates that exposure to e-cigarettes is not only temporary but also has the potential to be long-term.

Although often considered a safer alternative, various studies indicate that e-cigarettes still have the potential for negative health impacts. A study by Esteban-Lopez [4] revealed that e-cigarette use is associated with various health problems, including respiratory and cardiovascular disorders, as well as increased oxidative stress. Furthermore, research by Giralt [5] showed that e-cigarette aerosol can have a biological effect on bronchial and alveolar epithelial

cells, although the level of toxicity differs from that of conventional cigarettes.

From a mechanism of exposure perspective, a study by Pichelstorfer [6] showed that e-cigarette aerosol particles can be deposited in various parts of the lung depending on particle size and the individual's anatomical condition. This suggests that e-cigarette exposure has the potential to directly affect the respiratory system, which can subsequently impact the cardiovascular system.

Furthermore, the chemical composition of e-cigarettes is also a concern. Research by Pennington [7] showed that e-cigarette devices, both new and used, contain various potentially toxic chemical compounds. Repeated exposure to these compounds can lead to cumulative health effects, especially with long-term use.

The impact of e-cigarette use is not limited to the respiratory system but is also associated with various other health conditions. A study by Alshahrani [8] showed that e-cigarette use in individuals with cardiometabolic conditions can worsen health status. Furthermore, a study by Purushothaman [9] reported adverse effects in users with comorbidities, including psychological disorders and dual use with conventional cigarettes.

Furthermore, e-cigarette use in individuals who have not previously smoked has also been shown to impact the respiratory system. A study by Caci [10]

showed that e-cigarette use in non-smokers can cause respiratory dysfunction, indicating that e-cigarettes are not completely safe.

Although various studies have examined the health impacts of e-cigarettes, studies specifically linking duration of e-cigarette use to physiological parameters such as blood pressure are still limited, especially in local populations. Therefore, this study was conducted to analyze the relationship between duration of e-cigarette use and blood pressure, an important indicator of cardiovascular health.

RESEARCH METHODS

Research Design

This is an observational analytical study using a cross-sectional approach, meaning that the independent and dependent variables were measured simultaneously. This study aimed to analyze the relationship between duration of e-cigarette (vapor) use and blood pressure in men aged 20–30 years in the Udanawu vapor user community, Blitar.

Population and Sample

This study's population was all members of the e-cigarette user community in Udanawu, Blitar. The sample included members who met the inclusion and exclusion criteria. Sampling used a purposive technique. Inclusion criteria: men aged 20–30 years, active e-cigarette users, users for ≥5 years, and willing participants. Exclusion criteria included respondents who did not meet the inclusion criteria or were unwilling to participate in the entire study. The sample size for this study was 17 respondents.

Research Variables

The variables in this study consisted of independent and dependent variables. The independent variable was the duration of e-cigarette use (in years). The dependent variable was blood pressure, including systolic and diastolic blood pressure.

Data Collection Instruments and Techniques

Data collection was conducted through interviews and direct measurements. Data on duration

of e-cigarette use was obtained through interviews using a questionnaire. Blood pressure was measured using a calibrated sphygmomanometer.

Blood pressure measurements were taken in a sitting position after the respondent had rested for at least 5 minutes. A cuff was placed on the upper arm according to the appropriate size, and systolic and diastolic blood pressure were measured according to standard procedures.

Data Analysis

The data were statistically analyzed using data processing software. Normality was tested using the Shapiro-Wilk test. Because the data were not normally distributed, the analysis of the relationship between duration of e-cigarette use and blood pressure was performed using the Spearman correlation test. A p-value <0.05 was considered to indicate a statistically significant relationship.

RESULT AND DISCUSSION

Respondent Characteristics by Age

Based on **Table 1.**, the majority of respondents were in the young adult age range, with a predominance of 24 (29.4%) and 26 (23.5%) respondents. This distribution indicates that e-cigarette users in this study were predominantly in the productive age group.

This finding aligns with research by Salari [1], which reported that the global prevalence of e-cigarette use was higher among adolescents and young adults. Furthermore, a study by Izquierdo-Condoy [2] also showed that e-cigarette use was increasing significantly among the younger population, primarily influenced by social and lifestyle factors.

In Indonesia, research by Syawqie [3] found that the majority of e-cigarette users were young males, which aligns with the characteristics of the respondents in this study. The dominance of this age group warrants attention, as exposure to e-cigarettes from a young age has the potential to have long-term health impacts, particularly on the cardiovascular and respiratory systems.

Table 1. Respondent characteristics based on age

Age	Frequency (n)	Percentage (%)
20	1	5.9
22	3	17.6
23	2	11.8
24	5	29.4
25	1	5.9
26	4	23.5
27	1	5.9
Total	17	100

Respondent Characteristics Based on Systolic Blood Pressure

According to **Table 2.**, the mean systolic blood pressure of respondents was 117.65 mmHg, with a minimum value of 110 mmHg and a maximum of 125 mmHg, and a standard deviation of 5.623. These results indicate that respondents' systolic blood pressure was

generally within the normal range, but tended to approach the upper limit of normal. The relatively small standard deviation indicates that systolic blood pressure values among respondents were quite homogeneous.

This trend toward the upper limit of normal values could be an early indication of increased blood

pressure in respondents. This condition is relevant to nicotine exposure from e-cigarettes, which is known to affect the cardiovascular system. Research by Lee [11] indicates that e-cigarette use is associated with an increased risk of hypertension. Furthermore, a study by Espinoza-Derout [12] reported that e-cigarette use may increase the risk of cardiovascular disease through mechanisms such as increased blood pressure and vascular dysfunction.

Furthermore, experimental research by Sailis

Table 2. Mean systolic pressure of respondents

	Mean	Min	Max	Standard deviation
Systolic	117.65	110	125	5.623

Respondent Characteristics Based on Diastolic Blood Pressure

According to **Table 3.**, the mean diastolic blood pressure was 87.65 mmHg, with a minimum value of 70 mmHg and a maximum of 100 mmHg, and a standard deviation of 8.314. These results indicate that respondents' diastolic blood pressure ranged from normal to near-hypertension, with some even reaching hypertension (≥ 90 mmHg). The larger standard deviation compared to systolic pressure indicates that variation in diastolic blood pressure among respondents tends to be more heterogeneous.

This indicates differences in individual responses to exposure to risk factors, including e-cigarette use. Research by Lee [11] showed that e-cigarette use is

Table 3. Mean diastolic pressure of respondents

	Mean	Min	Max	Standard deviation
Diastolic	87.65	70	100	8.314

Respondent Characteristics Based on Duration of Smoking

According to **Table 4.**, the average duration of e-cigarette use among respondents was 6.35 years, with a minimum value of 5 years and a maximum of 8 years, and a standard deviation of 0.820. These results indicate that most respondents have used e-cigarettes for a relatively long period of time and with low (homogeneous) variation.

This relatively long duration of use indicates chronic exposure to substances in e-cigarettes, such as nicotine and other chemical compounds. This long-term exposure has the potential to have cumulative effects on health. This is in line with research by Esteban-Lopez [4], which states that long-term e-cigarette use is associated with various health problems, including inflammation and organ damage.

Table 4. Average duration of respondents' use of e-cigarettes

	Mean	Min	Max	Standard deviation
Duration of e-Cigarette use	6.35	5	8	0.820

Normality Test for Smoking Duration and Blood Pressure

Based on **Table 5.**, the results of the normality test using the Shapiro-Wilk method indicate that all study variables have a significance value < 0.05 , namely smoking duration (0.046), systolic blood pressure (0.024), and diastolic blood pressure (0.029). This indicates that the data are not normally distributed.

This non-normal distribution of the data indicates that there is asymmetric variation in the

[13] shows that exposure to e-cigarettes can cause mitochondrial dysfunction, which plays a role in oxidative stress and impaired blood vessel function. This mechanism can contribute to a gradual increase in blood pressure. Therefore, although the respondents' mean systolic blood pressure was still within normal limits, the tendency for this increase in values needs to be monitored as an early indication of cardiovascular disorders, especially in long-term e-cigarette users.

associated with an increased risk of hypertension, including increased diastolic blood pressure. Furthermore, a study by Espinoza-Derout [12] suggested that exposure to e-cigarettes can trigger cardiovascular disorders through increased blood pressure and vascular dysfunction.

Furthermore, research by Findlay-Greene [14] showed that e-cigarette use is associated with impaired endothelial function and increased blood vessel stiffness, which contribute to increased diastolic blood pressure. Thus, although some respondents were still in the normal category, the presence of values approaching or exceeding the normal limit indicates a potential risk of cardiovascular disorders, especially with long-term e-cigarette use.

Furthermore, a study by Sailis [13] showed that e-cigarette exposure can cause mitochondrial dysfunction, which plays a role in increased oxidative stress and impaired cell function. This mechanism can impact the cardiovascular system and contribute to changes in blood pressure.

Besides, research by Lee [11] reported that the duration of e-cigarette use is associated with an increased risk of hypertension. Thus, the average duration of use of 6.35 years in this study indicates that respondents had been exposed long enough to potentially experience health impacts, particularly increased blood pressure. This strengthens the hypothesis that the duration of e-cigarette use is a significant factor in changes in cardiovascular parameters.

values of each variable, which could be caused by differences in individual characteristics and physiological responses to e-cigarette exposure. This variation could also reflect differences in exposure levels, duration of use, and health conditions of each respondent.

This finding aligns with research by Caci [10], which states that physiological responses to e-cigarette use, particularly on the respiratory and cardiovascular systems, can vary between individuals. Furthermore, a

study by Espinoza-Derout [12] also showed that the impact of e-cigarettes on the cardiovascular system is not uniform, but is influenced by individual factors and usage patterns.

Furthermore, research by Salari [1] in a global

meta-analysis showed high heterogeneity in the characteristics of e-cigarette users, both in terms of age, frequency of use, and duration of exposure. This may contribute to the non-normal distribution of data in this study.

Table 5. Normality test of smoking duration and blood pressure

<i>Shapiro-wilk</i>		
	Df	Sig
Smoking duration	17	0.046
Systolic		0.024
Diastolic		0.029

Table 6. Spearman Correlation Test of the relationship between smoking duration and blood pressure

	Systolic		Diastolic	
	<i>p-value</i>	Correlation coefficient	<i>p-value</i>	Correlation coefficient
Smoking duration	0.003	0.679	0.005	0.646

Relationship Between Smoking Duration and Blood Pressure

Based on **Table 6.**, the Spearman's rho test indicates a significant relationship between the duration of e-cigarette use and both systolic and diastolic blood pressure. For systolic blood pressure, the p-value was 0.003 (<0.05) with a correlation coefficient of 0.679, while for diastolic blood pressure, the p-value was 0.005 (<0.05) with a correlation coefficient of 0.646. These values indicate a positive relationship with a strong correlation, meaning that longer e-cigarette use tends to increase blood pressure.

Biologically, this relationship can be explained by inflammatory mechanisms and impaired cell function due to exposure to e-cigarette vapor. Research by Jasper [15] shows that e-cigarette exposure can cause neutrophil dysfunction due to the accumulation of filamentous actin. This condition results in decreased immune function and an increased inflammatory response, which, in the long term, can contribute to cardiovascular disorders, including elevated blood pressure.

Furthermore, Camero's [16] study found changes in the transcriptional profile of mononuclear cells in e-cigarette users, particularly in genes involved in inflammation and oxidative stress. These changes in gene expression suggest a chronic biological response to e-cigarette exposure that may impact blood vessel function and blood pressure regulation.

Furthermore, a study by Findlay-Greene [14] showed that e-cigarette liquid and vapor have cytotoxic effects on lung epithelial cells, which can trigger oxidative stress and cell damage. Persistent oxidative stress can lead to vascular endothelial dysfunction, contributing to increased blood pressure.

The relationship between smoking duration and blood pressure is complex and strongly influenced by cumulative exposure to bioactive compounds, particularly nicotine and oxidative agents present in cigarette smoke and electronic cigarette (e-cigarette) aerosols. A growing body of evidence indicates that the longer an individual is exposed to smoking, whether conventional or electronic, ultimately leading to

sustained elevations in blood pressure.

According to the systematic review by Nogueira et al. [17], e-cigarette use is consistently associated with increases in both systolic and diastolic blood pressure. Importantly, the review distinguishes between acute and chronic exposure, noting that while short-term use may cause transient increases due to immediate sympathetic stimulation, prolonged use results in more stable and persistent blood pressure elevation. This suggests that smoking duration is a key determinant in shifting from reversible physiological responses to more permanent pathological changes. Chronic nicotine exposure stimulates the release of catecholamines such as epinephrine and norepinephrine, leading to increased heart rate, vasoconstriction, and ultimately higher blood pressure. Over time, repeated activation of this pathway can reset baseline cardiovascular function toward a hypertensive state.

From a mechanistic perspective, El-Mahdy et al. [18] provide critical insight into the molecular basis underlying this duration-dependent effect. Their findings demonstrate that exposure to e-cigarette aerosols activates NADPH oxidase, a major enzymatic source of reactive oxygen species (ROS) in the vasculature. With increasing duration of exposure, ROS production becomes excessive, overwhelming the antioxidant defense system and resulting in oxidative stress. This condition has profound implications for endothelial function, particularly through the process of endothelial nitric oxide synthase (eNOS) uncoupling. Under normal conditions, eNOS produces nitric oxide (NO), a potent vasodilator essential for maintaining vascular tone and blood pressure. However, in the presence of oxidative stress, eNOS becomes "uncoupled" and produces superoxide instead of NO, further exacerbating oxidative damage. The progressive loss of NO bioavailability leads to impaired vasodilation, increased vascular resistance, and consequently elevated blood pressure. Notably, these effects are cumulative, meaning that longer smoking duration intensifies endothelial dysfunction and makes recovery less likely.

Furthermore, Martinez-Morata [19] reinforces

the concept that chronic exposure to e-cigarettes influences blood pressure through both functional and structural vascular changes. Repeated exposure leads to persistent vasoconstriction, but more importantly, it contributes to vascular remodeling and arterial stiffness. Structural changes in the vascular wall, such as increased collagen deposition and reduced elasticity, impair the ability of blood vessels to buffer pressure fluctuations. In addition, long-term smoking can disrupt baroreceptor sensitivity, which plays a crucial role in short-term blood pressure regulation. Impaired baroreflex function reduces the body's ability to adapt to hemodynamic changes, further promoting sustained hypertension. These structural and regulatory impairments are typically not observed in short-term exposure, highlighting the importance of duration as a critical factor in disease progression.

Thus, these results demonstrate that the association between prolonged e-cigarette use and increased blood pressure is not merely statistical but also has a strong biological mechanistic basis through inflammatory pathways, oxidative stress, and cellular damage. This reinforces the notion that long-term e-cigarette exposure has the potential to increase the risk of cardiovascular disease.

CONCLUSION

The study found the average systolic blood pressure was 117.65 mmHg and diastolic was 87.65 mmHg. Both are within normal range but near the upper limit. Respondents had used e-cigarettes for an average of 6.35 years, showing long-term exposure. Spearman's correlation test showed a significant link between e-cigarette use duration and blood pressure. Systolic blood pressure had a p-value of 0.003 and r of 0.679, while diastolic had a p-value of 0.005 and r of 0.646. These numbers show a strong positive correlation. Thus, the longer e-cigarette use, the more likely it is that blood pressure, both systolic and diastolic, will increase in respondents.

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