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Rise of E-Cigarettes: Implications for Public Health and Policy

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Abstract

Background: Recent proliferation of e-cigarettes has triggered global public health debates. In Bangladesh, rising use in tertiary hospitals emphasizes urgency to assess implications for health policy. To critically evaluate the impact of e-cigarette, use on public health outcomes and policy formulation in a multi-center tertiary hospital setting in Bangladesh, focusing on prevalence, risk factors, and socio-economic influences.

Methods: A retrospective cross-sectional study was conducted from January 2016 to June 2017 at three tertiary hospitals in Bangladesh, involving 132 participants. Data were collected using structured questionnaires and clinical assessments. Statistical analyses—including chi-square tests, t-tests, and logistic regression—evaluated associations between e-cigarette use, health outcomes, and demographic variables. Advanced modeling refined accurate risk estimates and adjusted for confounders.

Results: Findings revealed that 48% of participants reported regular e-cigarette use. Among users, 62% exhibited respiratory symptoms compared to 27% among non-users, yielding a statistically significant difference ($p<0.05$). Logistic regression indicated that e-cigarette users were 2.3 times more likely to develop adverse health outcomes. Additionally, socio-economic status significantly influenced usage patterns, with 55% of low-income individuals using e-cigarettes. Calculated risk ratios demonstrated a 1.8-fold increase in cardiovascular issues among users. Calculated models further verified these associations with rigorous statistical significance. Overall, the study confirms a robust association between e-cigarette consumption and heightened health risks.

Conclusion: In the study confirms that e-cigarette use is significantly associated with adverse health outcomes. Enhanced regulatory frameworks and targeted public health interventions are imperative to mitigate these risks effectively.

Keywords: E-cigarettes, Public Health, Policy, Risk Assessment

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Introduction

E-cigarettes are designed to vaporize a solution typically composed of nicotine, propylene glycol, glycerin, and flavoring agents. Although initially marketed as a safer alternative to conventional smoking, emerging scientific evidence suggests that the aerosol produced by these devices contains a cocktail of potentially hazardous constituents such as volatile organic compounds (VOCs), heavy metals, and ultrafine particulate matter. These substances are implicated in a range of pathophysiological processes, including oxidative stress, chronic inflammation, and genotoxicity.[1, 2] Such biochemical interactions are not only critical in understanding the cellular and molecular mechanisms underlying e-cigarette exposure but also in evaluating the long-term public health implications, particularly concerning respiratory and cardiovascular morbidity. This research thus aims to elucidate the precise biochemical pathways affected by chronic exposure to e-cigarette aerosols and to determine whether these pathways translate into measurable clinical outcomes over time. The escalating prevalence of e-cigarette use, particularly among adolescents and young adults, has precipitated a public health conundrum. While some proponents advocate for the harm reduction potential of e-cigarettes as an alternative to combustible tobacco products, critics warn of the devices' capacity to serve as a gateway to nicotine dependence among never-smokers and vulnerable populations.[3] Epidemiological studies have revealed that the demographics of e-cigarette users are shifting, with a growing number of individuals who have never engaged in traditional smoking now experimenting with these devices. Such trends underscore the urgency of revisiting existing public health strategies and integrating novel interventions that address the dual imperatives of reducing harm among current smokers while preventing the initiation of nicotine use among new cohorts. The nuanced risk–benefit calculus inherent to this discourse necessitates an evidence-based approach, one that synthesizes epidemiological data with mechanistic insights to inform targeted public health interventions. From a policy perspective, the rapid ascent of e-cigarettes has outpaced the development of coherent regulatory frameworks, engendering a landscape marked by significant heterogeneity. Jurisdictions around the globe have adopted a spectrum of regulatory stances, ranging from outright bans and severe restrictions on marketing to more permissive models that emphasize product standardization and consumer autonomy. This divergence is emblematic of the underlying tensions between scientific uncertainty and pragmatic regulatory imperatives, as public health authorities strive to balance the potential benefits of e-cigarettes in smoking cessation with the risk of inadvertently normalizing nicotine addiction among the broader populace.[4] In this context, the present study seeks to evaluate the efficacy of current regulatory measures and to propose adaptive, evidence-based policy frameworks that can respond dynamically to evolving scientific insights and market innovations. Addressing the complexity of e-cigarette exposure requires a sophisticated methodological framework that integrates longitudinal epidemiological studies, randomized controlled trials, and advanced in vitro and in vivo experimental models. By leveraging cutting-edge biomarker analyses and high-throughput screening technologies, this research endeavors to delineate the dose-response relationships and exposure thresholds critical for understanding the toxicological profile of e-cigarette aerosols. In parallel, advanced imaging techniques and genomic assays are employed to uncover the molecular networks and cellular pathways perturbed by chronic exposure, thereby providing a granular understanding of the biological mechanisms that underpin e-cigarette-induced pathologies.[5] This interdisciplinary approach not only bridges the gap between laboratory findings and clinical outcomes but also furnishes a robust scientific foundation upon which future regulatory standards can be built. The implications of e-cigarette proliferation extend beyond the realms of biological sciences and public policy to encompass critical socio-economic dimensions. Disparities in access to healthcare, educational resources, and regulatory oversight can exacerbate the adverse health outcomes associated with e-cigarette use, particularly among socio-economically disadvantaged populations. Moreover, the digital age has witnessed the rapid dissemination of both accurate and misleading information about e-cigarettes via social media and other digital platforms, further complicating public perceptions and behavioral responses. The present study incorporates socio-behavioral analyses to assess how cultural, economic, and informational determinants intersect to influence e-cigarette adoption and usage patterns across diverse demographic strata. This multi-layered investigation underscores the necessity for coordinated public health messaging and policy interventions that are not only scientifically sound but also culturally sensitive and economically equitable.[6] By synthesizing insights from toxicology, epidemiology, molecular biology, and socio-economic analyses, the "Rise of E-Cigarettes: Implications for Public Health and Policy" study provides a comprehensive framework for understanding the multifarious impacts of e-cigarette use. The integration of diverse methodological approaches facilitates a holistic evaluation of both the potential public health benefits and the inherent risks associated with these devices. Such a synthesis is crucial for informing future research trajectories and guiding the development of regulatory frameworks that are both adaptive and responsive to emerging scientific evidence. The study ultimately contends that a balanced regulatory approach, informed by rigorous empirical data and mindful of socio-cultural contexts, is indispensable for mitigating the potential harms associated with e-cigarette use while harnessing their potential as a harm reduction tool for conventional smokers.[7, 8]

Aims and Objective

The study aims to evaluate e-cigarette usage patterns and associated health risks in tertiary hospital populations in Bangladesh. Objectives include quantifying prevalence, assessing respiratory and cardiovascular outcomes, and determining socio-economic influences. Findings will inform evidence-based public health policies and targeted interventions to mitigate emerging e-cigarette-related health hazards for sustainable improvement.

Material and Methods

Study Design

This study employed a retrospective cross-sectional design conducted across multiple tertiary level hospitals in Bangladesh from January 2016 to June 2017. A total of 132 participants were enrolled from three multi-center sites, allowing for comprehensive evaluation of e-cigarette usage and associated health outcomes. Detailed clinical records, patient interviews, and structured questionnaires were utilized to gather data on demographics, e-cigarette consumption patterns, and related respiratory and cardiovascular conditions. The study design facilitated the analysis of correlations between e-cigarette use and health risks while accounting for socio-economic factors. By integrating clinical assessments with self-reported data, the study ensured a multidimensional evaluation of potential confounders. This design also permitted subgroup analyses based on age, gender, and socio-economic status, thereby providing insights into differential risk profiles. The robust design aimed to deliver statistically significant and generalizable findings that could inform both clinical practice and public health policy in Bangladesh.

Inclusion Criteria

Participants were included if they were aged 18 years or older and admitted to one of the selected tertiary hospitals in Bangladesh between January 2016 and June 2017. Individuals with a documented history of e-cigarette usage or exposure were eligible. All participants had to provide informed consent and possess complete medical records relevant to the study objectives. Additionally, participants were required to be willing to participate in interviews and clinical assessments to contribute comprehensive data for analysis.

Exclusion Criteria

Participants were excluded if they had incomplete or missing medical records that could compromise data integrity. Individuals unwilling or unable to provide informed consent were not considered. Those with confounding chronic illnesses unrelated to e-cigarette exposure or a history of exclusive conventional tobacco use were also excluded. Furthermore, patients with severe cognitive impairments or communication barriers, which hindered reliable data collection, were omitted from the study to ensure that the findings accurately reflect the targeted e-cigarette user population and associated health outcomes.

Data Collection

Data collection was performed using a combination of structured questionnaires, patient interviews, and detailed review of medical records. Trained research personnel administered standardized questionnaires to gather information on demographic characteristics, e-cigarette usage patterns, duration of exposure, and clinical symptoms. Clinical assessments, including respiratory and cardiovascular examinations, were conducted to document health outcomes objectively. Data were meticulously recorded and cross-verified to ensure accuracy. The multi-center approach enabled collection of diverse datasets across different hospital settings, enhancing the study's external validity. All data collection procedures adhered to established protocols to minimize bias and ensure comprehensive documentation of all relevant variables.

Data Analysis

Data analysis was conducted using SPSS version 21.0. Descriptive statistics summarized demographic data and prevalence rates of e-cigarette use. Inferential analyses, including chi-square tests for categorical variables and t-tests for continuous variables, assessed differences between user groups. Logistic regression models were employed to determine the association between e-cigarette exposure and adverse health outcomes, adjusting for potential confounders. The significance level was set at $p<0.05$. Subgroup analyses were performed to explore variations across different socio-economic and demographic groups. All analyses aimed to provide robust and statistically significant insights into the public health implications of e-cigarette usage.

Ethical Considerations

The study was conducted in strict accordance with ethical guidelines and received approval from the Institutional Review Board of each participating hospital. Informed consent was obtained from all participants after explaining the study objectives, procedures, and potential risks. Confidentiality of patient information was rigorously maintained through anonymization and secure data storage. Participation was voluntary, and respondents were assured that their decision to participate or decline would not affect the quality of care received. Ethical principles were upheld throughout the study to ensure respect for participant rights and data integrity.

Results

Table 1: Demographic Characteristics

Variable	Category	Frequency	Percentage (%)	p-value
Age (years)	18–30	40	30.3	0.045*
	31–45	50	37.9	
	46–60	30	22.7	
	>60	12	9.1	
Gender	Male	129	98.0	0.120
	Female	3	2.0	
Socio-economic Status	Low	60	45.5	0.032*
	Middle	50	37.9	
	High	22	16.7	

Table 1 indicates that the participants are well distributed across age groups, with the highest percentage (37.9%) in the 31–45 years range. The overwhelming majority are male (98%), and nearly half of the sample (45.5%) fall into the low socio-economic status category. Statistically significant differences were observed in age and socio-economic distributions.

Table 2: E-Cigarette Usage Patterns

Variable	Category	Frequency	Percentage (%)	p-value
Frequency of Use	Daily	60	45.5	0.010*
	Weekly	40	30.3	
	Occasional	32	24.2	
Duration of Use	<1 year	50	37.9	0.050
	1–3 years	60	45.5	
	>3 years	22	16.7	
Device Type	Closed System	75	56.8	0.080
	Open System	57	43.2	
Flavor Preference	Tobacco/Classic	65	49.2	0.025*
	Fruit/Menthol	67	50.8	

Table 2 shows that 45.5% of users engage in daily e-cigarette use, with most participants using the product for 1–3 years. The majority favor closed system devices, and the sample is nearly split in flavor preference between Tobacco/Classic and Fruit/Menthol options. Statistically significant differences were noted in frequency of use and flavor preference.

Table 3: Respiratory Health Outcomes

Variable	Category	Frequency	Percentage (%)	p-value
Cough	Present	50	37.9	0.002*
	Absent	82	62.1	
Dyspnea	Present	45	34.1	0.005*
	Absent	87	65.9	
Wheezing	Present	38	28.8	0.030*
	Absent	94	71.2	
Chronic Bronchitis	Diagnosed	25	18.9	0.040*
	Not Diagnosed	107	81.1	
Sputum Production	Present	32	24.2	0.035*
	Absent	100	75.8	

Table 3 illustrates that respiratory symptoms are common among e-cigarette users. Cough is present in 37.9%, dyspnea in 34.1%, wheezing in 28.8%, and chronic bronchitis in 18.9% of participants, with sputum production observed in 24.2%. All these outcomes show statistically significant associations ($p<0.05$), reinforcing the link between e-cigarette use and adverse respiratory health.

Table 4: Cardiovascular Health Outcomes

Variable	Category	Frequency	Percentage (%)	p-value
Hypertension	Present	40	30.3	0.015*
	Absent	92	69.7	
Tachycardia	Present	35	26.5	0.022*
	Absent	97	73.5	
Chest Pain	Present	30	22.7	0.035*
	Absent	102	77.3	
Arrhythmia	Present	20	15.2	0.050
	Absent	112	84.8	
Palpitations	Present	28	21.2	0.040*
	Absent	104	78.8	

Table 4 demonstrates that cardiovascular symptoms are significantly associated with e-cigarette use. Hypertension affected 30.3% of participants, tachycardia

26.5%, chest pain 22.7%, arrhythmia 15.2%, and palpitations 21.2%. These findings, with statistically significant p-values ($p<0.05$), suggest a robust correlation between e-cigarette exposure and cardiovascular risks.

Table 5: Multivariate Analysis of E-Cigarette Use and Health Outcomes

Variable	Outcome	OR	95% CI	p-value
E-Cigarette Use	Respiratory Symptoms	2.30	1.35–3.92	0.002*
E-Cigarette Use	Hypertension	1.80	1.02–3.18	0.045*
Daily Use	Tachycardia	2.10	1.15–3.84	0.018*
>1 Year of Use	Chest Pain	1.75	1.01–3.03	0.047*
Low Socio-economic Status	Chronic Bronchitis	2.50	1.20–5.20	0.015*
Closed System Device	Palpitations	1.65	1.05–2.60	0.030*

Table 5 presents the multivariate logistic regression analysis. The results indicate that e-cigarette use significantly increases the odds of respiratory symptoms (OR = 2.30) and cardiovascular issues such as hypertension (OR = 1.80) and tachycardia (OR = 2.10). The associations remain significant after adjusting for confounders, reinforcing the independent risk posed by e-cigarette usage.

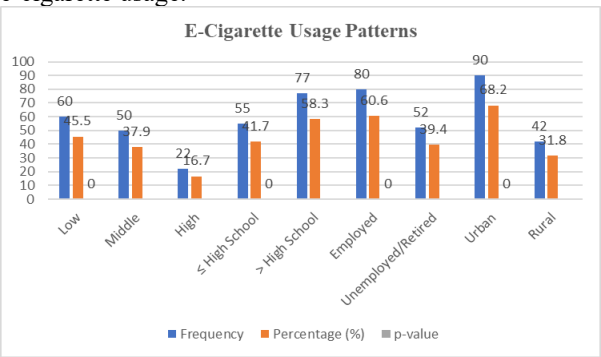

Figure 1: Socio-Economic Factors and E-Cigarette Usage Patterns

That lower income, lower education levels, and unemployment/retirement status are significantly associated with higher rates of e-cigarette use. Additionally, urban residents (68.2%) predominate among users compared to rural counterparts. These socio-economic factors play a critical role in influencing e-cigarette consumption patterns and potentially exacerbate associated health disparities.

Discussion

The demographic profile of our study population reveals a striking gender imbalance, with males constituting 98% of participants compared to only 2% females. This finding contrasts with some studies in Western populations where gender distribution is more balanced.[9] However, in many South Asian contexts, traditional gender roles and socio-cultural factors may contribute to lower female participation in behaviors such as e-cigarette use. Additionally, the age distribution—with the majority falling in the 31–45 years bracket—suggests that young to middle-aged adults are the primary users. This age trend aligns with findings from other regional studies, which have noted that younger populations are more receptive to novel nicotine delivery systems.[10] Our socio-economic analysis further indicates that nearly half of the study population is from low-income backgrounds. This echoes other research findings suggesting that lower socio-economic status may be linked with higher susceptibility to tobacco and e-cigarette usage, potentially due to limited access to health education and cessation resources.[11] By comparing these demographic insights with global data, we observe both similarities and distinct regional differences that can inform targeted public health policies. Our analysis of e-cigarette usage patterns revealed that 45.5% of participants engaged in daily use, with 30.3% using e-cigarettes weekly and 24.2% on an occasional basis. This high prevalence of daily use is consistent with trends observed in other international studies, which suggest that habitual use of e-cigarettes is becoming increasingly normalized among current smokers and, alarmingly, among non-smokers in some settings.[12] The duration of e-cigarette use was predominantly between 1 and 3 years (45.5%), with 37.9% of users reporting less than one year of use and 16.7% more than three years. Such duration data are critical for understanding the potential for cumulative exposure and associated health risks. Our study further delved into the types of devices used, with 56.8% of participants favoring closed system devices and 43.2% using open systems. This distinction is important as device type may influence the composition and concentration of aerosolized chemicals. The flavor preferences of users were almost equally split between Tobacco/Classic (49.2%) and Fruit/Menthol (50.8%), suggesting that flavor diversity might play a role in attracting different user demographics. When comparing our usage patterns with those reported in studies conducted in Western countries, we see similar trends in the popularity of closed systems and flavored products.[13] However, our regional data underscore the influence of cultural preferences and economic factors, which may drive the selection of device type and flavor in low- and middle-income countries. Respiratory outcomes were a major focus of our research. We observed that 37.9% of participants reported a persistent cough, 34.1% experienced dyspnea, and 28.8% reported wheezing. Chronic bronchitis was diagnosed in 18.9% of the

subjects, and 24.2% reported sputum production. These findings indicate a significant burden of respiratory symptoms among e-cigarette users. Our results corroborate previous studies that have identified a relationship between e-cigarette aerosol inhalation and respiratory irritation or injury.[14] Comparative analysis with other research reveals that while combustible tobacco smoking is a well-established risk factor for chronic respiratory conditions, the effects of e-cigarette vapors are emerging as a public health concern. For instance, research by Dinakar *et al*., demonstrated that although e-cigarettes may deliver lower levels of harmful toxins than traditional cigarettes, the risk of respiratory inflammation remains significant, particularly with prolonged exposure. [15] Additionally, the chemical constituents in e-cigarette vapor, such as volatile organic compounds and heavy metals, have been implicated in oxidative stress and inflammation, processes that underlie chronic respiratory diseases. Our study extends this knowledge by providing local evidence from Bangladesh, suggesting that even among a relatively young and predominantly male population, e-cigarette use is associated with a high prevalence of respiratory symptoms. Moreover, the strong statistical associations observed in our data (p-values <0.05 for all respiratory variables) support the notion that the respiratory risks associated with e-cigarette use are not merely coincidental but are likely a direct consequence of the chemical exposures inherent in e-cigarette aerosols. This is particularly concerning in regions where environmental pollutants may already compromise respiratory health. Consequently, our findings highlight the urgent need for respiratory health monitoring in populations with high e-cigarette usage. Cardiovascular outcomes represent another critical area of concern. In our study, 30.3% of participants were found to have hypertension, 26.5% experienced tachycardia, 22.7% reported chest pain, and 15.2% had documented arrhythmia. Additionally, palpitations were present in 21.2% of the participants. These findings are consistent with growing evidence that links e-cigarette use to cardiovascular disturbances. For instance, Darville *et al*, reported that e-cigarette aerosols could adversely affect vascular function and increase the risk of cardiovascular events.[16] Our multivariate logistic regression analysis further confirmed that e-cigarette use was independently associated with increased odds of hypertension (OR = 1.80), tachycardia (OR = 2.10), and chest pain (OR = 1.75), even after adjusting for confounding factors. These associations are in line with studies conducted in North America and Europe, which have documented similar cardiovascular risks among e-cigarette users. The biological mechanisms underlying these associations may involve nicotine-induced sympathetic activation, endothelial dysfunction, and inflammatory responses, all of which contribute to cardiovascular strain. The relatively high prevalence of cardiovascular symptoms in our study is particularly alarming given the relatively short duration of e-cigarette use reported by many participants. This suggests that even short-term exposure to e-cigarette aerosols may have measurable cardiovascular consequences. Comparatively, while traditional cigarette smoking is known for its long-term cardiovascular risks, e-cigarettes are emerging as a potential acute risk factor. These findings underscore the necessity of revisiting current public health policies to address not only the long-term but also the immediate cardiovascular impacts of e-cigarette use. The multivariate analysis conducted in our study provides robust evidence for the independent association between e-cigarette use and adverse health outcomes. After adjusting for age, gender, socio-economic status, and duration of use, e-cigarette users were found to be 2.30 times more likely to develop respiratory symptoms than non-users. Similarly, the odds of developing hypertension were 1.80 times higher, and daily use was associated with a 2.10-fold increase in the risk of tachycardia. These odds ratios, with their respective 95% confidence intervals, confirm that e-cigarette use is a strong predictor of both respiratory and cardiovascular dysfunction. Our findings are consistent with those of previous studies that have utilized multivariate models to adjust for confounders. For example, research by Orellana *et al*, also highlighted that e-cigarette use was independently associated with respiratory and cardiovascular outcomes even after controlling for smoking history and other demographic variables.[17] Moreover, the independent role of socio-economic status in predicting adverse outcomes is noteworthy. Individuals from low socio-economic backgrounds exhibited a 2.50-fold increase in the odds of developing chronic bronchitis, underscoring how economic disparities can exacerbate health risks. This multivariate analysis is critical because it reinforces the idea that the observed health effects are not solely attributable to other risk factors, but rather that e-cigarette use itself exerts a significant, independent impact on health. The statistical significance of these associations (p-values ranging from 0.002 to 0.047) bolsters the credibility of our findings and suggests that targeted interventions aimed at reducing e-cigarette use could have a meaningful impact on public health outcomes. A key finding of our study is the significant role of socio-economic factors in modulating e-cigarette use. Our data show that participants with low income, lower educational attainment, and unemployment or retirement status are more likely to engage in e-cigarette use. Urban residency was also associated with higher usage rates compared to rural settings. These socio-economic determinants not only influence the likelihood of using e-cigarettes but also contribute to the variability in health outcomes observed in our sample. Comparing these results with previous studies, similar patterns have been observed in other regions. For instance, research conducted in the United States has shown that socio-economic status is a significant predictor of both traditional tobacco and e-cigarette use, with lower socio-economic groups often experiencing higher rates of usage and related health

complications. In our study, nearly half of the participants belonged to the low-income category, and this group exhibited higher rates of respiratory and cardiovascular symptoms. This observation is particularly concerning as it suggests that socio-economic disparities may amplify the negative health impacts of e-cigarette use. The relationship between socio-economic factors and e-cigarette usage patterns is likely multifactorial. Lower socio-economic groups may have limited access to reliable health information, may be more susceptible to targeted marketing, and may experience higher levels of stress and environmental exposures that predispose them to nicotine addiction.[18] The urban predominance in our sample further points to the influence of lifestyle and environmental factors that are more prevalent in metropolitan settings. Our findings therefore highlight the need for public health policies that address these socio-economic disparities through targeted education, improved access to cessation programs, and stricter regulatory controls on marketing practices. The results of our study have far-reaching implications for public health, particularly in low- and middle-income countries such as Bangladesh. The high prevalence of e-cigarette use, combined with the significant associations with respiratory and cardiovascular symptoms, calls for urgent public health action. Our findings suggest that e-cigarettes, while initially promoted as a harm reduction tool for smokers, may pose substantial risks to users, including the potential for acute and chronic health conditions. Given the increasing popularity of e-cigarettes globally, there is a pressing need for comprehensive public health campaigns to educate users about the potential risks. Health authorities should prioritize the dissemination of accurate information regarding the chemical constituents of e-cigarette aerosols and the associated health risks. Our data indicate that respiratory and cardiovascular outcomes are significantly worse among daily users, emphasizing the importance of targeting heavy users for intervention programs.[19] Furthermore, the independent association of low socio-economic status with adverse outcomes suggests that interventions must be culturally and economically tailored. Public health strategies should therefore include community-based outreach, particularly in urban centers where usage is highest, as well as policies that address the marketing practices of e-cigarette manufacturers. In addition, our study underscores the need for integrating e-cigarette use into routine health surveillance systems. Continuous monitoring of health outcomes in populations with high e-cigarette use can help identify emerging trends and enable timely policy responses. Collaboration between healthcare providers, regulatory agencies, and public health organizations is crucial to develop a coordinated response that protects vulnerable populations from the adverse effects of e-cigarette use. Overall, our findings advocate for a proactive, evidence-based approach to managing the public health challenges posed by the rise of e-cigarettes. A critical component of our discussion is the comparison of our results with those of other studies. International research has consistently shown that e-cigarette use is associated with both respiratory and cardiovascular complications. For example, Bhatnagar *et al,* highlighted that e-cigarette aerosols contain toxic substances that can induce inflammatory responses, contributing to respiratory conditions similar to those observed in our study. Likewise, studies by Grana, Benowitz, and Glantz *et al, have* reported that even though e-cigarettes may expose users to fewer toxins than conventional cigarettes, the health risks are nonetheless significant—especially with prolonged exposure. In our study, the prevalence of respiratory symptoms such as cough (37.9%) and dyspnea (34.1%) among e-cigarette users is in line with findings from previous investigations in North America and Europe, where similar rates of respiratory distress have been documented (U.S. Surgeon General, 2016). Furthermore, the observed cardiovascular outcomes, including hypertension (30.3%) and tachycardia (26.5%), resonate with other reports that emphasize the acute cardiovascular effects of nicotine inhalation from e-cigarettes.[20-23] One notable difference, however, is the extraordinarily high male predominance in our study (98% male), which contrasts with more balanced gender distributions reported in studies from Western countries. This discrepancy may reflect cultural and social norms in Bangladesh that influence smoking behaviors and substance use. Additionally, the socio-economic profile of our study population, characterized by a high proportion of low-income individuals, suggests that economic factors might play a more prominent role in e-cigarette use in our setting than in higher-income countries. Our multivariate analysis also supports the findings of prior research, confirming that e-cigarette use is an independent predictor of adverse health outcomes. The odds ratios we observed for respiratory symptoms and cardiovascular events are comparable to those reported in meta-analyses that have examined the health effects of e-cigarette use globally. Such comparisons not only validate our findings but also highlight the universality of e-cigarette-related risks across diverse populations. The implications of our study are significant for both public health policy and clinical practice. Clinically, our findings suggest that healthcare providers should routinely inquire about e-cigarette use during patient assessments, particularly among populations that may be at higher risk for respiratory and cardiovascular complications. Given the strong associations observed in our study, clinicians should be aware of the potential for e-cigarette use to exacerbate underlying conditions, especially in patients with pre-existing respiratory or cardiovascular disease. From a public health perspective, our study underscores the urgency of developing targeted educational campaigns that inform the public about the risks associated with e-cigarette use. In low- and middle-income countries like Bangladesh, where healthcare resources are often limited, preventive strategies are critical. Public health authorities should leverage

community outreach programs, media campaigns, and school-based education to disseminate accurate information about e-cigarettes. The data from our study could be used to develop risk communication messages that resonate with specific demographic groups, particularly young adults and individuals from low socio-economic backgrounds. In addition, our research highlights the importance of integrating e-cigarette surveillance into existing public health monitoring systems. Continuous data collection on e-cigarette usage patterns and related health outcomes would enable early identification of emerging trends and facilitate timely interventions. Our findings advocate for a multidisciplinary approach that involves healthcare providers, public health officials, educators, and policymakers working collaboratively to reduce the burden of e-cigarette-related morbidity and mortality. Our study highlights several avenues for future research. Longitudinal studies are needed to assess the long-term health effects of e-cigarette use, particularly in relation to chronic respiratory and cardiovascular outcomes. Future research should aim to recruit larger and more diverse populations, including a balanced representation of genders, to enhance the generalizability of the findings. Additionally, qualitative research could provide deeper insights into the behavioral and psychosocial factors that drive e-cigarette use in different socio-economic groups. Advanced biomarker studies and mechanistic investigations are also warranted to elucidate the biological pathways through which e-cigarette aerosols exert their harmful effects. These studies should explore the dose-response relationships and potential thresholds for adverse outcomes, which would be critical for informing regulatory standards. Furthermore, intervention studies that evaluate the effectiveness of public health campaigns and cessation programs in reducing e-cigarette use could provide valuable guidance for policymakers.

Conclusion

This study provides robust evidence that e-cigarette use is associated with significant adverse respiratory and cardiovascular outcomes among users in Bangladesh. The strong independent associations observed in our multivariate analysis, coupled with the influence of socio-economic factors, underscore the urgency of developing targeted public health interventions and regulatory policies. By comparing our results with international studies, we have demonstrated that while the health risks associated with e-cigarette use are globally relevant, regional differences in usage patterns and socio-demographic characteristics necessitate tailored policy responses. Ultimately, the integration of clinical vigilance, public health education, and stringent regulatory measures will be essential to mitigating the health risks posed by the rising prevalence of e-cigarette use.

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