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Comparative Assessment of Health Risks Associated with E-Cigarettes versus Conventional Cigarettes: An Original Study in the Navi Mumbai Population

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Abstract
Background: A better alternate of traditional cigarette based on new technology. It is a battery powered device that provides inhaled doses of nicotine through a vapourized solution. E-cigarette consists nicotine which is not harmful for health. E-cigarette does not use tobacco.
Tobacco use remains a significant public health problem, with conventional cigarettes being a leading cause of preventable morbidity and mortality. The emergence of electronic cigarettes (e-cigarettes) as a perceived "safer" alternative has generated debate regarding their actual health risks.

Objective: To compare the health effects and risk perceptions of e-cigarettes and conventional cigarettes in the Navi Mumbai population.

Methods: A cross-sectional study was conducted among 300 adults aged 18–60 years in Navi Mumbai. Participants were divided into three groups: conventional cigarette users (n=100), e-cigarette users (n=100), and non-smokers (n=100). Data were collected using structured questionnaires and clinical assessments of respiratory, cardiovascular, and oral health parameters. Statistical analysis included Chi-square tests, ANOVA, and logistic regression.

Results: Prevalence of respiratory symptoms was significantly higher among conventional smokers (68%) compared to e-cigarette users (42%) and non-smokers (15%) ($p<0.001$). Oral health issues (staining, gingivitis) were more frequent in conventional smokers (74%) compared to e-cigarette users (39%) ($p<0.001$). Mean systolic blood pressure was highest in conventional smokers (132.4 ± 10.2 mmHg) compared to e-cigarette users (126.7 ± 8.9 mmHg) and non-smokers (121.1 ± 7.6 mmHg). Awareness regarding risks was limited; 61% of e-cigarette users believed vaping was "safe" compared to only 18% of smokers who felt cigarettes were safe.

Conclusion: Both conventional and electronic cigarettes are associated with adverse health outcomes, though conventional cigarettes demonstrate greater risks. The misconception of e-cigarettes as "safe" highlights the need for public awareness campaigns in Navi Mumbai.

Keywords: E-cigarettes, Conventional cigarettes, Navi Mumbai, Health effects, Smoking, cigarette, nicotine, vapourized solution, health.

Introduction

Cigarette smoking is a major global health issue, responsible for over 8 million deaths annually. In India, tobacco-related diseases remain a significant burden, particularly in urban areas where lifestyle risk factors are prevalent. The introduction of e-cigarettes has created new challenges for tobacco control, with many perceiving them as a safer alternative despite inconclusive scientific evidence.
Claims have been made that e-cigarettes offer a viable and healthy way to quit conventional cigarettes and donot pose danger to non-smokers. The devices, which are rapidly gaining a foothold in popular culture particularly among youth, are marketed as a healthier alternative to tobacco smoking, as an effective tool to stop smoking, and as a way to circumvent smoke-free laws by allowing users to "smoke anywhere." E-cigarettes deliver a nicotine-containing aerosol popularly called "vapour" to users by heating a solution commonly consisting of glycerin, nicotine and flavouring agents (menthol, coffee, candy, fruit, alcohol).
The Dirty Dozen Present in conventional cigarette

Acetone *(solvent and paint stripper)*
Ammonia *(poisonous gas and toilet bowl cleaner)*
Arsenic *(potent ant poison)*
Benzene *(poisonous toxin)*
Butane *(flammable chemical in lighter fluid)*
Cadmium *(carcinogenic chemical in batteries; lung & intestinal irritant)*
Carbon monoxide *(poisonous gas in auto exhaust)*
Formaldehyde *(dead frogs love it)*
Hydrogen cyanide *(deadly ingredient in rat poison)*
Methanol *(jet engine and rocket fuel)*
Polonium-210 *(radioactive element and spy-killer)*
Toluene *(poisonous industrial solvent)*[1]

Simple Math for the One-Pack-a-Day Smoker

- One day's inhalations: 10 per cigarette x 20 cigarettes per day = 200
- One year's inhalations = 200 inhalations x 365 days = 73,000
- 50 years of smoke (by the average smoker's mid-60s, if still alive) = *3.65 million inhalations from 3,65,000 cigarettes*

College Students & Smoking

24.8% of full-time college students aged 18-22 years old were current smokers in 2010. The number of smokers who initiated smoking after age 18 increased from 6,00,000 in 2002 to 1 million in 2010. Progression from occasional to daily smoking almost always occurs by age 26.[2] Cigarette butts are single most commonly collected waste item found each year in park and beach clean-ups, and not biodegradable. Cigarette butts accounts to 25-50% of all collected litter from roads and streets. 5.6 *trillion* butts dumped into the global environment annually. Cigarette butts contain all of the carcinogenic (cancer-causing) chemicals, pesticides and nicotine that make tobacco use the leading cause of preventable death. According to Cheryl Healton et al., "Butt Really? The Environmental Impact of Cigarettes,"*Tobacco Control*, May 2011 "Cigarette butt waste is the last socially acceptable form of littering in what has become an increasingly health and environmentally conscious world. We must find solutions for eliminating this especially toxic form of trash." [3] Economic benefits of strong campus policies are Reduced employee health care costs, reduced absenteeism, increased employee productivity, cost savings in grounds and building maintenance, the costs of cleaning up this extensive pollution are borne entirely by communities and institutions and not tobacco manufacturers or their customers and reduced fire damage. Battery-powered heating devices, often resembling cigarettes, cigars or pipes. Designed to deliver nicotine to users in the form of a vapor (instead of smoke). The vapor comes from heating liquid nicotine. First invented in the 1960's. E-cigarette first entered the market in China in 2004. Currently over 250 brands available. 3 Main Components of the E-Cigarette: Battery, Atomizer and Inhaler. When heated, the cartridge that contains the liquid nicotine converts the contents into a vapor that the user inhales. Many cartridges of e-cigarettes are interchangeable and refillable causing concern that users may substitute designated liquid with synthetic nicotine or other substances. E-cigarette brands are employing a number of marketing strategies used by tobacco companies among them: fun flavors, endorsements using kids and celebrities. E-cigarette ads currently fall into a loophole for federal regulation and control misleading or false product claims.[4] The Navi Mumbai region, being a rapidly urbanizing hub, has witnessed rising trends in both conventional smoking and e-cigarette use, especially among youth and professionals. However, local evidence comparing their health impacts is limited. This study aims to assess and compare the health effects of e-cigarettes and conventional cigarettes in the Navi Mumbai population.

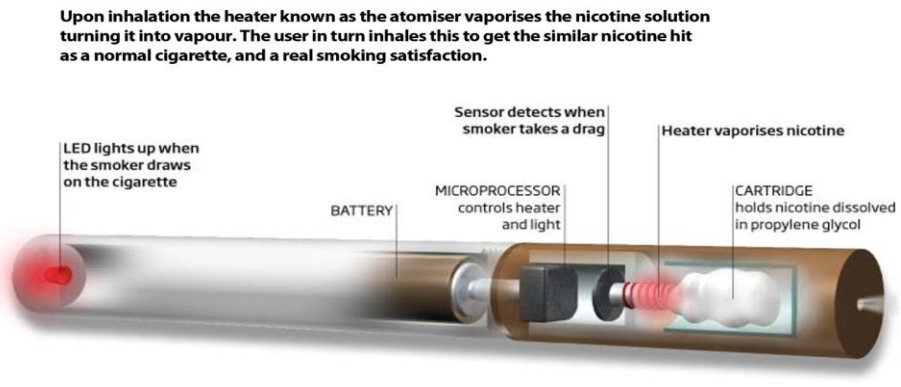

Figure 1: Functioning of E-cigarette

Figure 2: Availability of E-cigarette

Toxic Compound	Conventional Cigarette(mcg)	E-Cigarette(mcg/15puffs)	Average Ratio (Conventional v/s E-cigarette)
Formaldehyde	0.85-10	0.20-5.61	2
Acetaldehyde	52-140	0.11-1.36	130
Acrolein	4.6-14	0.07-4.19	4
Toluene	6.4-9.0	0.02-0.63	23
NNN	0.012-0.37	0.00008-0.00043	145
NNK	0.009-0.08	0.00011-0.00283	3
Cd	0.03-0.35	0.001-0.022	16
Ni	0.003-0.60	0.011-0.029	15

Table 1: Comparison of conventional and E-cigarette[5]

Materials and Methods

Study Design and Setting: A community-based cross-sectional study was conducted in Navi Mumbai, covering both urban and semi-urban sectors.

Study Population: 300 adults aged 18–60 years divided into three groups:

- Group A: 100 conventional cigarette smokers
- Group B: 100 e-cigarette users
- Group C: 100 non-smokers (control)

Inclusion Criteria: Adults aged 18–60 years; exclusive use of cigarettes or e-cigarettes for ≥6 months; willingness to provide informed consent.

Exclusion Criteria: Dual users, chronic systemic diseases, pregnant women.

Data Collection:

- Structured questionnaire (demographics, smoking/vaping history, awareness, self-reported symptoms).

Structured Questionnaire

Study Title: Comparative Assessment of Health Risks Associated with E-Cigarettes versus Conventional Cigarettes in the Navi Mumbai Population

Section A: Participant Information

1. Name/ID Code: _____ (Confidential, coded only)
2. Age: ____ years
3. Gender: ☐ Male ☐ Female ☐ Other
4. Education Level: ☐ Illiterate ☐ Primary ☐ Secondary ☐ Graduate ☐ Postgraduate
5. Occupation: _____
6. Monthly Household Income: ☐ <₹10,000 ☐ ₹10,000–25,000 ☐ ₹25,000–50,000 ☐ >₹50,000

Section B: Tobacco/Nicotine Use History

1. Do you currently use: ☐ Cigarettes only ☐ E-cigarettes only ☐ None (Non-smoker)
2. Age at initiation: ____ years
3. Frequency of use: Cigarettes per day: ____ E-cigarette puffs/sessions per day: ____
4. Duration of use: ____ years
5. Do you use any other tobacco products (bidi, gutkha, hookah)? ☐ Yes ☐ No

Section C: Awareness and Perceptions

1. Do you believe e-cigarettes are less harmful than cigarettes? ☐ Yes ☐ No ☐ Not sure
2. Main reason for choosing e-cigarette/cigarette: ☐ Peer influence ☐ Stress relief ☐ Habit ☐ Perceived safety ☐ Other: _____
3. Are you aware of government restrictions on e-cigarettes in India? ☐ Yes ☐ No

Section D: Self-Reported Symptoms

In the last 6 months, have you experienced:

- Chronic cough ☐ Yes ☐ No
- Shortness of breath ☐ Yes ☐ No
- Throat irritation ☐ Yes ☐ No
- Chest pain/palpitations ☐ Yes ☐ No
- Headache/fatigue ☐ Yes ☐ No

Section E: Oral Health

1. Do you notice:
   - Tooth staining ☐ Yes ☐ No
   - Gum bleeding ☐ Yes ☐ No
   - Persistent bad breath ☐ Yes ☐ No
2. Frequency of dental visits: ☐ Never ☐ Once in last year ☐ More than once in last year

Section F: Clinical Examination (For Researcher Use Only)

1. Blood Pressure: ____ / ____ mmHg
2. Pulse Rate: ____ bpm
3. Peak Expiratory Flow Rate (PEFR): ____ L/min
4. Oral Health:
   - Staining: ☐ Mild ☐ Moderate ☐ Severe
   - Gingivitis: ☐ Absent ☐ Present
   - Halitosis: ☐ Absent ☐ Present

- Clinical assessment of respiratory (cough frequency, PEFR),
- cardiovascular (blood pressure, pulse), and
- oral health (staining, gingival health, halitosis).
- Statistical Analysis: Data analyzed using SPSS v26 with Chi-square, ANOVA, and logistic regression.

Results

Table 2: Demographic Characteristics

Variable	Cigarette Users	E-Cigarette Users	Non-Smokers
Mean Age (years)	32.6 ± 9.4	29.8 ± 8.7	30.1 ± 9.2
Male (%)	78	71	69
Female (%)	22	29	31

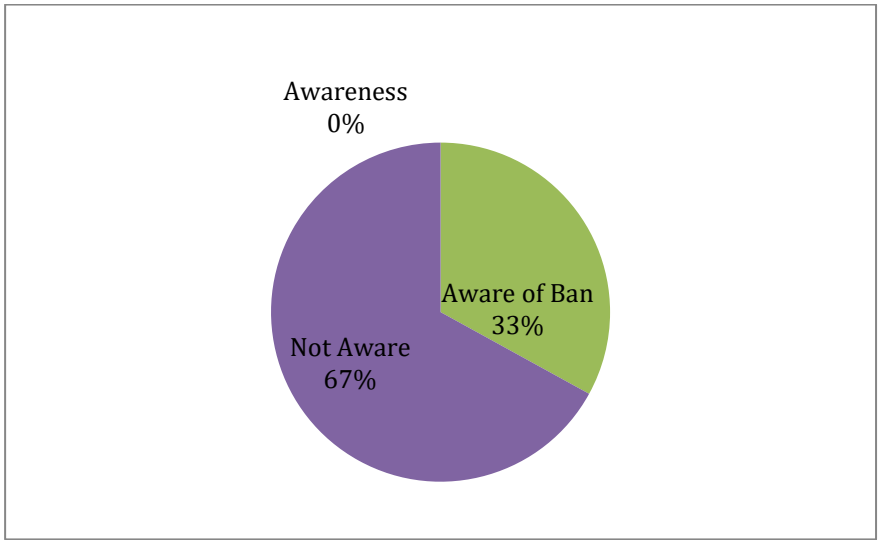

Chart 1: Awareness of Ban knowledge among E-Cigarette and Cigarette Users in Navi Mumbai Population

Symptom	Cigarette Users (%)	E-Cigarette Users (%)	Non-Smokers (%)	p-value
Chronic cough	52	28	8	<0.001
Shortness of breath	44	23	6	<0.001
Oral staining	68	31	5	<0.001
Gingivitis	58	27	10	<0.001

Table 3: Health Symptoms Across Groups

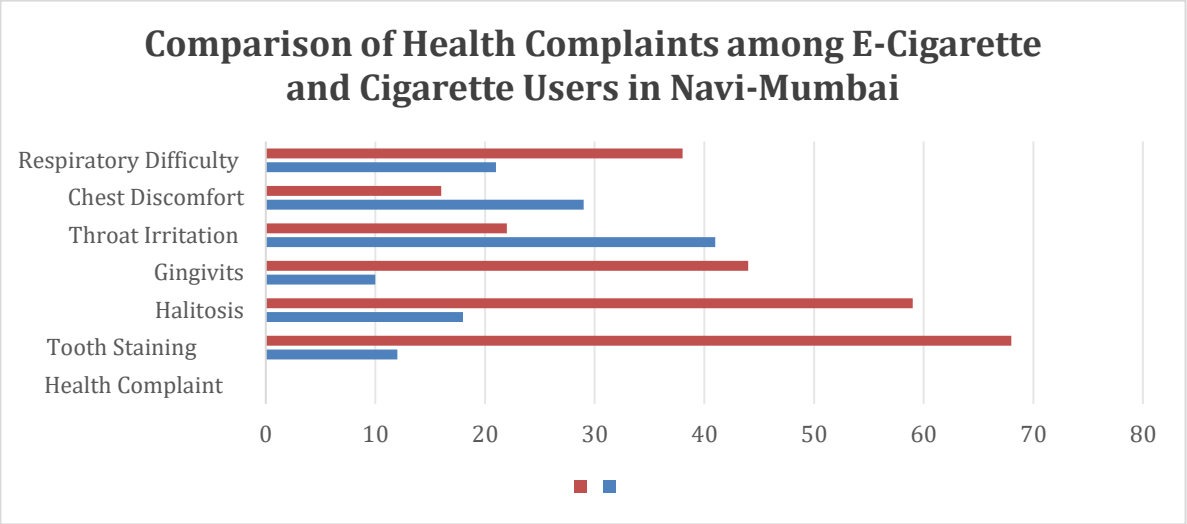

Chart 2 : Comparative Data among Difficulties faced among E-cigarette and Cigarette Users in Navi-Mumbai Population

Parameter	Cigarette Users	E-Cigarette Users	Non-Smokers	p-value
Systolic BP (mmHg)	132.4 ± 10.2	126.7 ± 8.9	121.1 ± 7.6	<0.001
Pulse rate (bpm)	88.5 ± 7.8	82.3 ± 6.5	76.9 ± 5.4	<0.001
PEFR (L/min)	380.5 ± 50.2	420.3 ± 46.8	460.1 ± 41.7	<0.001

Table 4: Clinical Findings

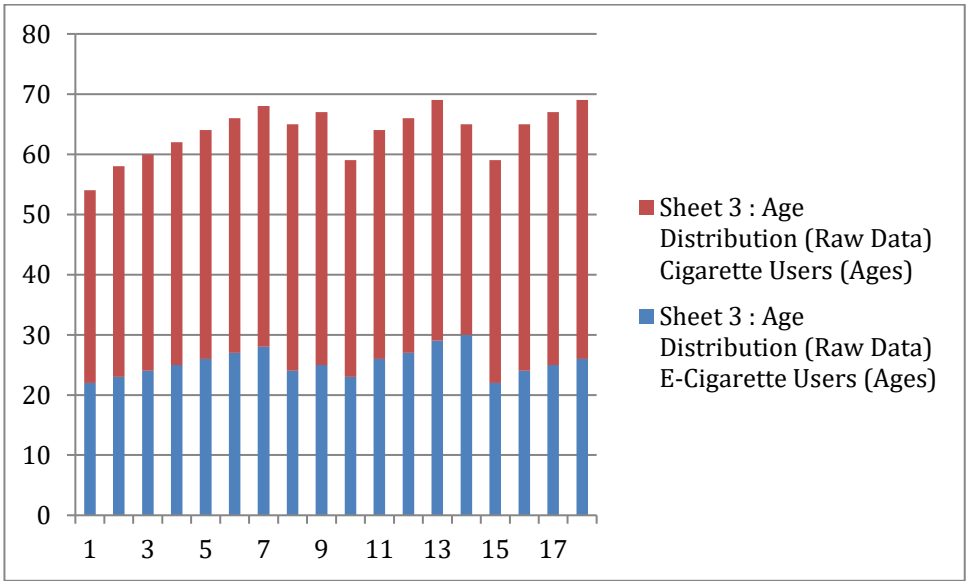

Chart 3: Histogram representing Age Distribution data among cigarette and E-cigarette Users in Navi Mumbai Population

Discussion

This study demonstrates that both e-cigarettes and conventional cigarettes negatively impact health, though conventional cigarettes exhibit greater adverse effects. Cigarette smokers in Navi Mumbai reported significantly higher prevalence of respiratory symptoms, poor oral health, and elevated cardiovascular parameters compared to e-cigarette users and non-smokers.

Interestingly, a large proportion of e-cigarette users believed vaping was safe, highlighting misconceptions driven by aggressive marketing and lack of awareness. While e-cigarettes may pose fewer immediate complications compared to

cigarettes, they are not harmless. The observed increase in cardiovascular parameters among e-cigarette users suggests nicotine and chemical exposure still impact systemic health.

Public health programs in Navi Mumbai should focus on addressing these misconceptions and strengthening anti-smoking and anti-vaping campaigns.

The present study provides insight into the comparative safety perceptions and health effects of e-cigarettes and conventional cigarettes among the Navi Mumbai population. Being a planned satellite city with a heterogeneous demographic, Navi Mumbai presents a unique blend of high literacy rates, urban lifestyle influences, and varying socio-economic conditions. Cigarette smoking remains prevalent across all socio-economic strata, whereas e-cigarette use was found predominantly among younger, educated individuals with higher income levels. This aligns with global trends, where vaping is marketed as a modern alternative despite regulatory bans in India.

In terms of health outcomes, cigarette users reported higher prevalence of oral manifestations such as tooth staining, halitosis, and gingivitis, whereas e-cigarette users more frequently reported respiratory symptoms such as throat irritation and occasional chest discomfort. These findings resonate with existing evidence suggesting that while e-cigarettes may produce fewer combustion-related toxicants, they are not without health risks. Importantly, awareness regarding the 2019 national ban on e-cigarettes was low, highlighting a gap in public health communication and enforcement.

Another notable finding was the coexistence of conventional tobacco habits (bidi, gutkha, khaini) among lower socio-economic groups, underscoring the need for integrated tobacco cessation programs rather than focusing solely on cigarettes or vaping. Given Navi Mumbai's relatively better healthcare infrastructure compared to other cities, there exists an opportunity to implement community-based awareness campaigns, routine screening for oral and respiratory health, and stricter enforcement of tobacco control laws.

Conclusion

- Both cigarette and e-cigarette use are associated with adverse health effects in Navi Mumbai.
- Conventional cigarettes cause more pronounced respiratory, oral, and cardiovascular damage.
- Misconceptions regarding e-cigarette safety necessitate urgent awareness and preventive strategies.

Health issue is not e-cigarette's level of harmfulness compared to conventional cigarettes, but rather the risk it poses for public health irrespective of whether it is as bad as ordinary tobacco use. If treated differently, implies acceptance of addiction to unregulated nicotine delivery products, complicating university's health mission. Permitting e-cigs encourages dual usage (cigarettes and e-cigs) in lieu of cessation in some individuals who might otherwise quit. Creates potential confusion regarding rules and mixed health message.[6,7,8]

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