



Daffodil *International* **University**

"Understanding Public Knowledge and Perceptions of Acrolein Risks in Vaping: A Survey on Awareness and Education"

[A dissertation submitted to the Department of Pharmacy, Faculty of Allied Health and Sciences, Daffodil International University, Dhaka. This report partially fulfills the requirements for the Bachelor of Pharmacy degree.]



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APPROVAL

This project paper, a survey on "**A Survey on the Impact of Food, Stress, and Environmental Factors on Triggering Migraine in Dhaka City,**" submitted to the Department of Pharmacy, Faculty of Allied Health Sciences, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of Bachelor of Pharmacy and approved as to its style and contents.

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DECLARATION

I hereby announce that I am carrying out this thesis study under the supervision of “Mr. Galib Muhammad Abrar Ishtiaque Lecturer”, Department of Pharmacy, Faculty of Allied Health Sciences, Daffodil International University, and Impartial Compliance with the Bachelor of Pharmacy Degree Requirement (B. Pharm). This project, I declare, is my original work. I also state that neither this project nor any part thereof has been submitted for the Bachelor's award or any degree elsewhere.

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ABSTRACT

Bangladesh has a rising smoking rate, especially among the younger population, with 35% of children and young adults between the ages of 15 and 24 reporting they smoke. Vaping and e-cigarettes are two examples of new tobacco products that are becoming more and more popular. E-cigarettes increase the risk of stroke, heart attack, and sudden cardiac death tenfold over traditional cigarettes. They also include nicotine, which can lead to abnormalities in cholesterol and blood pressure, effectively stopping the heart. E-cigarette nicotine poses a severe risk to minors and expectant moms. This study evaluates the public's and the youth community's understanding of the potential health risks of vaping to close the knowledge gap. Both quantitative and qualitative data regarding migraines, including knowledge, attitudes, and perceptions, will be gathered through the survey. The findings will be compiled into a comprehensive report distributed through academic publications, conferences, online forums, and media outlets. Based on the survey results, recommendations for policy implications and educational interventions will be made.



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INTRODUCTION

Currently, the smoking rate is increasing in Bangladesh. The smoking rate is particularly alarming among the younger generation. According to a study, 35 percent of youth in Bangladesh between the ages of 15 and 24 are smokers. Globally, the prevalence of smoking is substantial, with over 19% of the adult population using tobacco products. Among men, the rate is 33%, while among women it is 6% [1]. On the other hand, in the modern world, the use of emerging tobacco products (e-cigarettes, vaping, heated tobacco products) in Bangladesh is increasing day by day at an alarming rate among youth and youth. Electronic cigarettes have become a fad for many young people. Cigarette smoke contains a diverse array of cancer-causing substances and substances that cause genetic mutations. These include radioactive polonium, benzopyrene, dimethylbenzanthracene, naphthalene, methylnaphthalene, polycyclic aromatic hydrocarbons, and heavy metals like cadmium. It is important to highlight the specific hazardous substances known as polycyclic aromatic hydrocarbons (PAH), tobacco-specific N-nitrosamines (TSNAs), and aldehydes [2,3].

Tobacco companies are producing and marketing these emerging tobacco products in different countries of the world, including Bangladesh, mainly targeting young people and children. In the last few years, young people have been turning to e-cigarettes in the country because of the campaign 'Use of e-cigarettes to eliminate smoking addiction.' Due to innovative techniques, the use of fragrances, and attractive designs, these tobacco products are growing in popularity among teenagers and young adults, especially school-going children. Thirty-two countries have already banned e-cigarettes and vaping products to protect public health. According to the World Health Organization, there are currently 16,000 flavored emerging tobacco products on the market [4]. No scientist is saying that e-cigarettes are entirely pollution-free or risk-free. The chemicals released from e-cigarette smoke are also present in other regular tobacco products, so they are no less harmful than actual cigarettes. Its toxins are very damaging to the human body.

E-cigarettes are addictive stimulants. The use of these harmful substances leads to nicotine addiction, which is very detrimental to health. The World Health Organization, the global guardian of the health sector, has already announced that e-cigarettes are not safe. There are many studies on its harmful aspects. Almost all studies show negative elements. Researchers from the University of Rochester, New York, USA, said that the harmful free radicals released from e-cigarettes cause poisoning in the lung cells; as soon as its heating



element is activated, the way of this poisoning is facilitated. Despite its original reputation as a safer alternative to cigarette smoking [5,6], The presence of harmful chemicals in vape aerosols has prompted inquiries on the potential long-term risks associated with vaping [7,8]. The resulting vapor that enters the body through inhalation contains various carcinogenic substances in the form of different heavy metals and nano-particles. These carcinogenic substances also directly attack the lungs, bloodstream, and other body cells. As a result, the risk of getting sick is high. Moreover, e-cigarettes contain some cancer-causing and toxic chemicals, such as formaldehyde, acetyl-aldehyde, etc. Researchers have already warned that e-cigarettes will never be a healthy alternative to regular cigarettes.

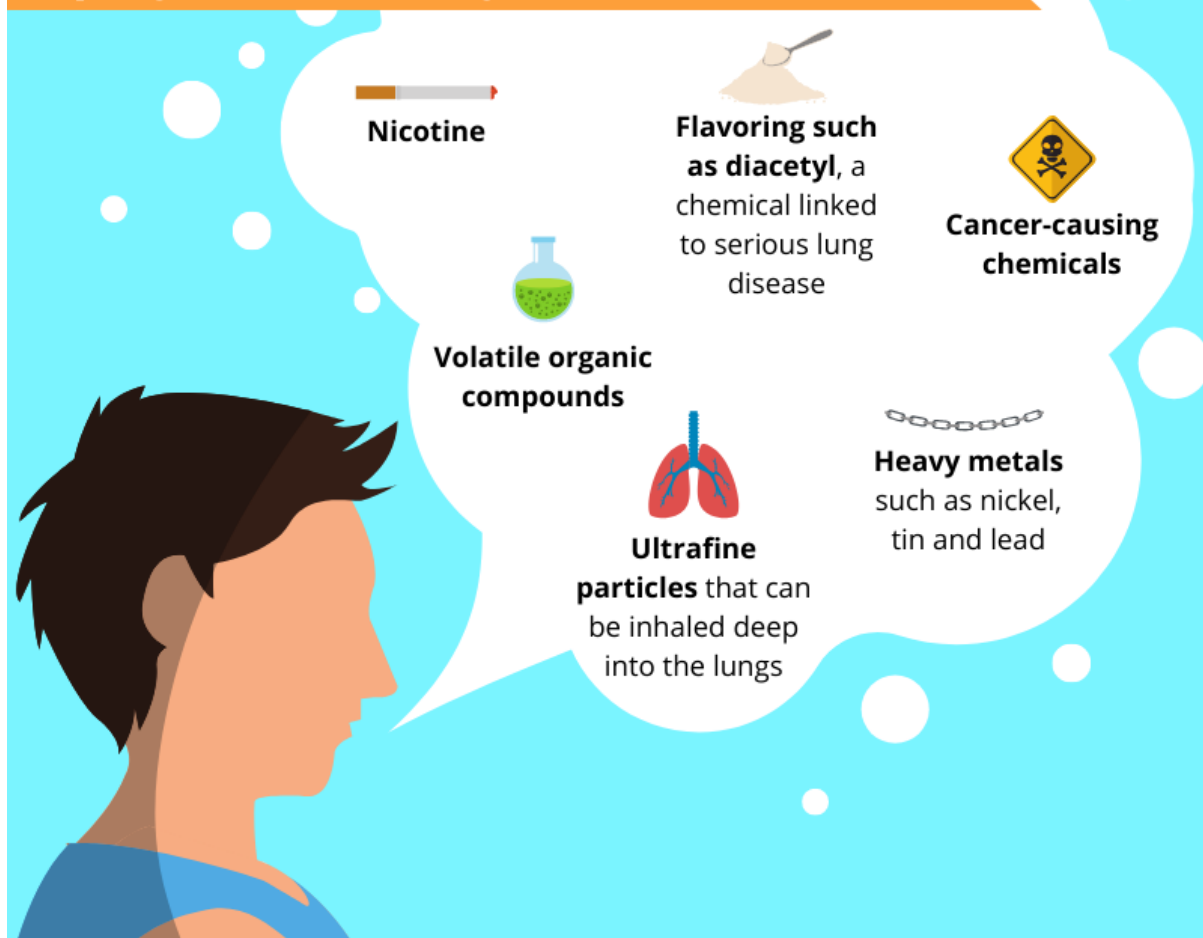
A study conducted in Japan has demonstrated that electronic cigarettes are tenfold more detrimental than conventional cigarettes. The primary source of aldehyde production is the burning and pyrolysis of tobacco, as these compounds are rarely observed in unburnt tobacco [9,10]. Vape e-cigarette users can suffer from stroke, heart attack, and sudden cardiac death. Since these device-based cigarettes also contain nicotine, their users can develop high blood pressure and cholesterol imbalances, which make the heart ineffective. The liquid used in e-cigarettes disables blood vessel cells, which causes heart disease. There is no text provided. Multiple investigations have discovered that the utilization of vaping and e-cigarettes elevates the likelihood of experiencing a stroke by 71 percent and the likelihood of suffering from a heart attack by 59 percent. The presence of nicotine in e-cigarettes poses significant risks to both youngsters and pregnant women. Liu et al conducted a highly valuable meta-analysis on the correlation between acrolein exposure and respiratory system impairment in rats/mice [11]. According to the scientists, the lungs of rats/mice can have a notable inflammatory reaction when exposed to acrolein [11]. In my survey, I will try to find out if people are aware of the dangerous sides of vaping and how Caroline kills vapers day by day. Nicotine in e-cigarettes not only damages airway mucus but also increases the risk of chronic bronchitis (American Journal of Respiratory and Critical Care Medicine). Our young generation moves to vape because cigarettes will harm their body, but they don't know that e-cigarettes are also more harmful to our bodies.

1.1 SMOKING

Smoking is the process of burning tobacco products, especially inhaling the smoke. Inhaling the burnt smoke of any standard product is called smoking, but taking the burnt smoke of tobacco products is identified as smoking. Standing on somewhere or sitting at home in one



Why are e-cigarettes so dangerous? The vapor you breathe may contain...



For more information visit
healthoregon.org/vapingillness

Oregon
Health
 Authority

Figure 01

place, someone is smoking nearby, and that smoke enters your breath; many people must have been in such a situation and it's called passive smoking or indirect smoking [12,13]. This Passive or indirect smoking, also known as secondhand smoking, involves inhaling the smoke of a smoker and infecting the breath of those around them. This type of smoking increases the risk of lung cancer, heart disease, and other diseases. There is no text provided. According to the World Health Organisation, tobacco usage causes the death of 8 million individuals each year, while passive smoking affects 12 million people. Cigarette smoke comprises more than 7,000 compounds, including a minimum of 70 components that are carcinogenic. Individuals who do not smoke but are exposed to secondhand smoke face a heightened chance of acquiring

lung cancer and experiencing a heart attack, with an increased likelihood ranging from 20 to 30 percent [14]. All types of tobacco are harmful, and there is no safe level of exposure. The primary factor is that the chemicals emitted undergo a sequence of transformations throughout the smoking process of tobacco products [15]. Tobacco and tobacco smoke include around 9500 intricate combinations of chemicals that have an effect on the body [16]. The intake of tobacco products by smokers is directly correlated with a rise in the occurrence of many types of cancer, including lung [17], ovarian [18], bladder [19], prostate [20], and pancreatic cancer [21]. At a time when public awareness against tobacco is building around the world, tobacco companies are scrambling to keep people hooked on alternatives by confusing them. They have a keen eye on developing and underdeveloped countries like Bangladesh.

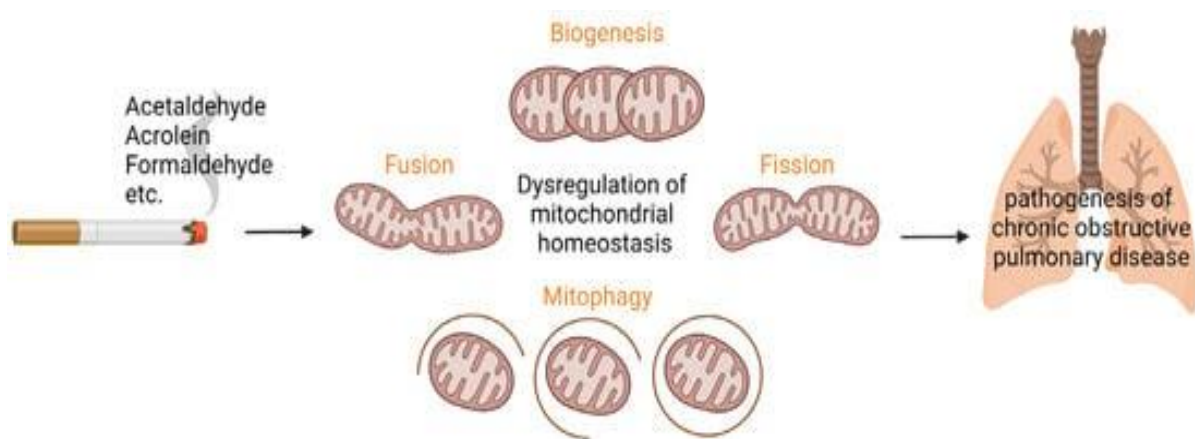


Figure 02

1.2 VAPING

Electrical cigarettes, also known as e-cigarettes or 'vapes,' are electrical devices specifically designed to send a vaporized liquid directly into the lungs. There are numerous on vaporized liquid directly into the lungs. There are numerous varieties of vapes, which might provide a considerable challenge when it comes to their identification. Vapes primarily consist of propylene glycol, vegetable glycerin (or glycerol), and commonly include nicotine, flavors, and several additional substances. Vaping products may contain undisclosed hazardous substances that are not listed on the packaging. A common fallacy regarding vapes is that they possess a lower toxicity level compared to cigarettes, however, this notion is unfounded. Vaping is inherently unsafe. The increase in teenage vaping can be attributed partly to the belief that vaping is a less harmful substitute for smoking cigarettes [22], as well as advertising tactics

The Dangers of Vaping

The amount of nicotine in e-cigarettes can be as high or higher than that of cigarettes.



Nicotine is highly addictive and can affect the developing brain.



Counterfeit e-cigarettes are being sold. Since these devices are not regulated by the FDA, they can be more likely to contain harmful or illegal substances.



Teens who vape are more likely to begin smoking cigarettes.



Explosions and burns have been reported due to vaporizer malfunctions and faulty batteries.

Some substances found in e-cigarette vapor have been linked to an increased risk of cancer.



Vaping during pregnancy could harm a developing fetus.



Liquid from e-cigarettes can cause acute nicotine poisoning, especially in children.

Figure 03

that specifically appeal to adolescents [23]. There is a significant rise in the prevalence of new tobacco products, including e-cigarettes, vaping, and heated tobacco products, among the youth population in Bangladesh. These items mostly focus on children and teenagers because of their inventive methods, scents, and appealing designs. Research indicates that over 20% of high school kids in the United States are frequent users of vape pens, but just 5% of adults use vape devices [24]. The Tobacco Control and Research Cell (TCRC) at Dhaka International University has documented the establishment of e-cigarette stores in close proximity to universities, with the intention of luring young individuals. These shops are engaging in illegal practices by promoting diverse forms of advertising and actively encouraging individuals who wish to quit smoking to switch to e-cigarettes as an alternative to traditional cigarettes. There is no text provided. Although the majority of current data focuses on the usage of vape products containing nicotine, a recent meta-analysis revealed an increasing incidence of adolescents using vape products containing cannabis. [25]. A 2020 study conducted among Dhaka University students found that most were unaware of the harmful health effects of e-cigarettes, which contain at least 80 toxic ingredients.

1.2.1 DIFFERENCE BETWEEN SMOKING AND VAPING

Although smoking and vaping are used mainly for the same purpose, they can be categorized at different rates.

Smoking:

1. Smoking produces smoke, which changes the amount of nicotine and absorbs the smoke of soil, coal, oil and other natural substances. Carbon monoxide, nitrogen oxides, ammonia, barium, etc., can be attached to the coal in smoke formation, which can be dangerous for cancer, heart disease, restlessness, and other health-related problems.
2. Smoking is the process of producing smoke produced by using tobacco.
3. The main ingredient used in smoking is nicotine, which is part of tobacco.
4. The usual smoking method used to control smoke is the gradual transfer of tobacco (cigarettes, stoves, etc.).
5. Copper is burned in the dark to create smoke, which has been considered a risk for cancer by reviews of light or carcinogenic environments.

Vaping:

1. Vaping uses technology to produce vapor by generating heat without constant heat or at high temperatures.
2. Vaping products are mainly based on technology, which can contain multiple nicotine or no nicotine, and often, these products are associated with health benefits. Vaping is a technology for producing smoke from liquids and other materials containing tobacco or nicotine using electronic devices.
3. Vaping devices may use nicotine or nicotine elixir, but sometimes, certain flavors and other ingredients are used in addition to nicotine.
4. Vaping devices use electronic currents to produce smoke, creating smoke that is generally lighter and safer but does not reduce cancer risk.
5. In vaping technology, the primary means of generating smoke and delivering nicotine to the head is temperature, which can be lower than that of smoking, although higher.
6. It has different type of flavor. Although there are regulations in place to restrict the sale of flavored vape products, a survey conducted in 2020 revealed that the majority of high school students were still primarily using fruit, mint, menthol, and dessert flavored vape solutions [26].

1.2.2 VAPING ALSO LEADS TO DRUG ADDICTION!

The majority of the 68 million users of vape pens are primarily located in China, the United States, and Europe [27]. Beniyara has been very tactfully promoting e-cigarettes or vaping. For the last seven or eight years, in the Western media and imitating in the newspapers of our country, e-cigarettes can be an alternative to smoking addiction. It has 95 percent less health risks than cigarettes! There have even been ridiculous reports that 'vaping reduces the risk of heart disease.' They are again citing the researchers. They argued that although e-cigarettes contain harmful substances, they are less than cigarettes. Vaping will gradually reduce the number of smokers.

The adoption rate among young individuals has been notably significant, and in the United States, the use of vaping has surpassed that of cigarettes as the prevailing method of nicotine intake among teenagers and young adults [28]. Research indicates that over 20% of high school pupils in the United States are habitual users of vape pens, while just 5% of adults



utilise vape items [29]. However, it didn't take long for the undeniable truth about vaping to come to light. Engaging in the use of e-cigarettes or vaping might potentially result in substance dependence. The act of vaping has a detrimental impact on the development of the adolescent brain and has adverse effects on the reproductive health of young individuals. The detrimental effects of vaping on public health are gradually becoming more apparent, indicating that it is yet another perilous threat to public well-being. However, the apocalypse had already concluded.

1.2.3 E-CIGARETTES ARE GETTING TEENS & YOUNG GENERATION ADDICTED TO TOBACCO

There is a growing prevalence of vaping among teens in Bangladesh, particularly among pupils in grades six to ten, who are the primary consumers of e-cigarettes. A study conducted by Dhaka International University revealed that e-cigarette establishments have emerged in close proximity to campuses with the intention of enticing young individuals. The public health consequences of teenage vaping are worsened by the high occurrence of vaping among individuals who have never smoked (defined as having smoked fewer than 100 cigarettes in their lifetime),⁵⁴ and the subsequent adoption of cigarette smoking among teenagers who vape [30]. Similarly, 50% of adults who now engage in vaping have never smoked cigarettes. There is ongoing worry that vaping may act as a pathway to using traditional cigarettes [31,32]. According to a 2020 survey conducted by the Ahsania Mission, 35% of the participants reported being hooked to tobacco as a result of using e-cigarettes, while 60% had no knowledge of the advantages and disadvantages of using e-cigarettes. In order to tackle this issue, it is imperative to comprehend the vaping procedure. Over the past decade, multinational tobacco corporations have made significant investments in e-cigarettes and have conducted marketing campaigns specifically targeting young people. Although there are regulations in place to restrict the sale of flavored vape products, a survey conducted in 2020 revealed that the majority of high school students were still primarily using fruit, mint, menthol, and dessert flavoured vape solutions [33]. Our young society is the focus of our efforts. Tobacco firms are currently allocating resources to the development and promotion of electronic cigarettes. Our young society is the focus of our efforts. In the last ten years, international tobacco firms have made significant financial investments in e-cigarettes. They are conducting multiple campaigns to attract the younger generation.

Smoking and vaping are often seen in drama movies, especially on the OTT platform. This is not a coincidence but part of a concerted advertising campaign. These tobacco companies pay millions of dollars to actors, actresses, models, and musicians to vape in public. Seeing which the teenagers are motivated. They are also trying to attract the youth by secretly organizing vaping fairs. In fact, this is the latest strategy to get the young generation addicted to drugs.



Figure 04

Smoking and vaping are often seen in drama movies, especially on the OTT platform. This is not a coincidence but part of a concerted advertising campaign. These tobacco companies pay millions of dollars to actors, actresses, models, and musicians to vape in public. Seeing which the teenagers are motivated. They are also trying to attract the youth by secretly organizing vaping fairs. In fact, this is the latest strategy to get the young generation addicted to drugs.

1.2.4 HIDDEN DANGERS: THE HARMFUL SIDE OF VAPING

Despite persistent inquiries regarding safety, vaping has emerged as a promising method for reducing harm among cigarette smokers [34]. From 2017 to 2018, there was a significant 78% surge in the prevalence of e-cigarette usage among school-age kids in the United States within a single year. E-cigarette stores have been established in Bangladesh with the intention

of luring university students, while simultaneously promoting marketing for detrimental items on social media platforms. The initial documented instance was recorded in 2012, when a patient exhibited symptoms of coughing, widespread hazy areas in the lungs, and an accumulation of fat-filled immune cells (lipid laden macrophages) during a procedure called bronchoalveolar lavage (BAL), which was linked to the use of a vape pen [35]. Tobacco corporations are urgently seeking to legalize the emerging e-cigarette industry, despite significant financial setbacks caused by traditional smoking. Tobacco is a major contributor to avoidable mortality in Bangladesh, accounting for 67 percent of fatalities attributed to non-communicable diseases. In order to guarantee the well-being of our nation in the long term, it is imperative to prioritize the health of young individuals and prevent them from being unfairly blamed for the tobacco industry's insatiable desire for financial gain. An analysis of 200 documented occurrences of EVALI revealed that the majority of individuals affected were primarily males in their teenage years to early 30s. Furthermore, a significant proportion (80%) of these individuals had been utilizing products that included THC [36]. The Ministry of Health and Family Welfare has implemented measures to prohibit the importation, manufacturing, sale, promotion, and utilization of e-cigarettes or vaping devices within the nation. Signatory states are obligated to adhere to the guidelines outlined in article 5.2 of the FCTC. There is a widespread belief among many individuals that e-cigarettes carry lower health risks compared to traditional cigarettes, primarily because of deceptive advertising campaigns. It is imperative to prevent young people from using e-cigarettes and to prohibit the importation, production, sale, promotion, and usage of vape, e-cigarettes, heat tobacco, or new tobacco products. Studies have discovered that vape aerosols contain several harmful compounds, such as the byproducts of the breakdown of the different components of the vape solution [37]. The use of mass spectrometry in analyzing vape aerosols has detected several oxidative and pro-inflammatory chemicals, including as benzene, acrolein, volatile organic compounds, and propylene oxide [38,39].

E-cigarettes, also known as e-liquids or e-juices, contain nicotine, cannabis extracts, and other drugs. The main ingredient in tobacco is nicotine, which can lead to respiratory system infections and chronic coughing. E-cigarettes also contain:

- Diacetyl.
- A chemical that damages the lungs' air sacs.
- Causing asthma and chronic coughing.



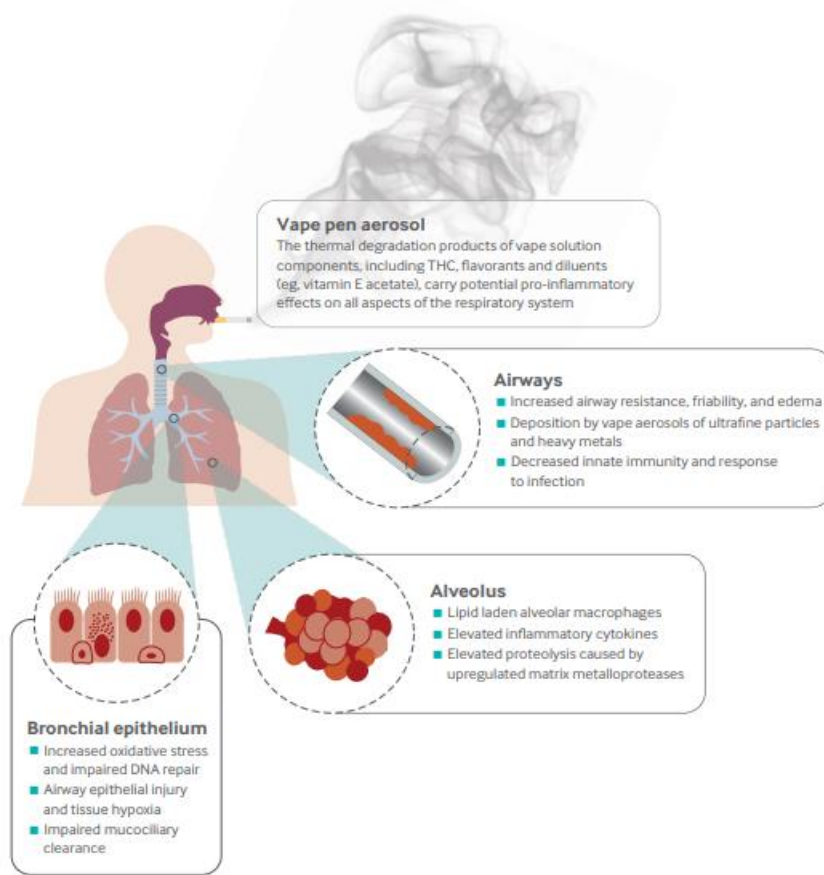


Figure 05

They also produce formaldehyde, which can cause cancer and other health issues. E-juice flavors, like strawberry watermelon, mango, cardamom, bubble gum, and blueberry honey, are synthetic chemicals that increase the risk of cancer and long-term liver and kidney disease. Nicotine in e-cigarettes is extremely dangerous for babies and pregnant mothers, as it impairs fetal development during pregnancy and destroys nerve stem cells, leading to premature aging and heart disease. E-cigarettes elevates the likelihood of experiencing a stroke, heart attack, and heart disease by 71%, 59%, and 40% respectively. According to research conducted in Japan, e-cigarettes are found to be ten times more detrimental to health compared to conventional cigarettes [40].

Research on vape aerosols has indicated several pro-inflammatory impacts on the respiratory system. These effects encompass heightened airway resistance [41], compromised immune response to infection [42], and decreased ability to remove mucus by cilia movement [43]. Studies have discovered that vape aerosols might cause oxidative stress in lung epithelial

cells, leading to DNA damage and impaired DNA repair. This suggests a possible carcinogenic effect. Long-term exposure to vape aerosols in mice resulted in heightened airway hyperreactivity and structural alterations in the lung tissue that are characteristic of chronic obstructive pulmonary disease [46].

Research on vape aerosols has indicated several pro-inflammatory effects on the respiratory system [41]. These factors encompass heightened airway resistance, compromised immune response to infection, and decreased ability to remove mucus by cilia movement [42, 43]. Studies have shown that vape aerosols can cause oxidative stress in lung epithelial cells. They can also cause DNA damage and hinder DNA repair, which suggests a possible carcinogenic effect [44, 45]. Long-term exposure to vape aerosols in mice resulted in elevated airway hyperreactivity and structural alterations in the lung tissue that are characteristic of chronic obstructive pulmonary disease [46].

1.3 ACROLEIN

Acrolein is an obnoxious chemical that arises from tobacco burns, burns, or other sources in tobacco percussion. It gets volatile and can leach into the skin. The global adult e-cigarette user population was expected to be 68 million in 2020. [47]. When vaping, acrolein can be produced as a significant component. Vaping is influenced by temperature, which increases the formation of acrolein in the presence of tobacco liquid content. When vaping, it mixes with other volatile substances and can cause respiratory and neurological problems.

A significant effect of acrolein is that it produces respiratory distress and pain. This may increase the risk of cancer and may require early detection and treatment for neurologic problems. This may include:

A significant effect of acrolein is that it produces respiratory distress and pain. This may increase the risk of cancer and may require early detection and treatment for neurologic problems. This may include:

1. Shortness of breath and self-control or general shortness of breath and self-control may become more difficult
2. Pinching
3. Chest pain



Figure 06

4. Breathing problems

5. Reversal of shortness of breath or other respiratory problems.

In the same way that smoking and vaping differ, there are two ways in which acrolein can become immeasurable in your body, thereby affecting your health. These losses are generally indistinguishable from each other.

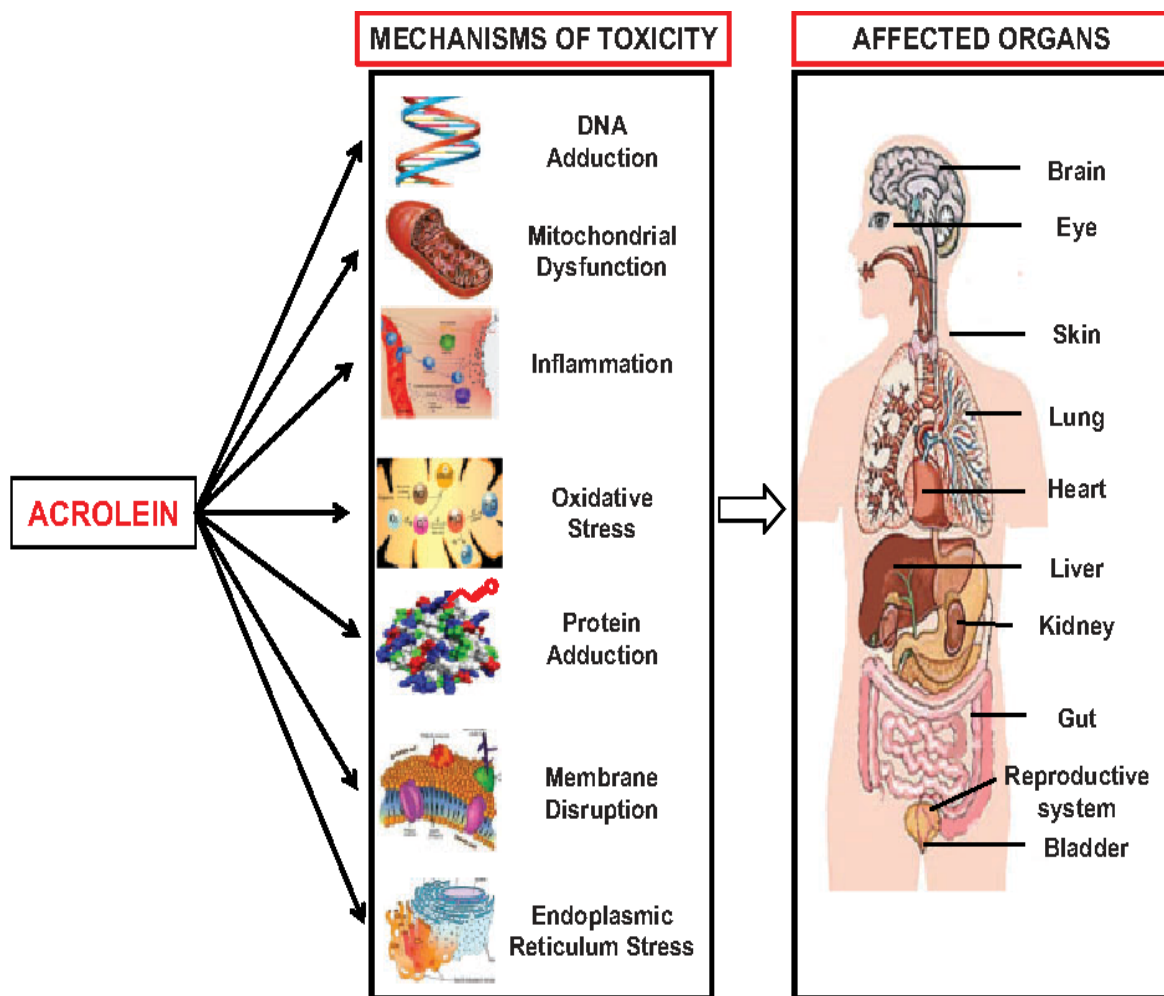


Figure 7

1.3.1 DARKSIDE OF ACROLEIN

In 2021, there were 2.06 million middle and high school kids in the United States who reported using e-cigarettes during the last 30 days. In 2019, the percentage of people who were currently using e-cigarettes ranged from 4.5% to 4.8% [48]. Acrolein is a major neurotransmitter, an essential amino acid connected to the human brain. It controls movement in the brain's circular system, states of mind, mind processes, and attention. Acrolein is added to the system to send neurotransmitters into the brain, which control attention and movement.

Electronic smoking devices present a substantial worldwide health hazard and are currently regarded as a public health crisis. Producers' assertions of reducing carcinogenic and deleterious ingredients are contradicted by new information, which indicates a significant

increase in the issue and the need for immediate care [49, 50]. The cytotoxicity of acrolein plays a crucial role in causing respiratory cancer. During this activity, acrolein interacts with cells, including animal cells, and performs diverse roles on deceased or injured cells. This function can be significantly influenced, for example, by processes such as cell division or cell death. Acrolein in tobacco smoke has a distinct influence on the regulation and creation of surgical structures in the human respiratory system. This can have an impact on the structure and function of cells, making it a favorable environment for the development of cancer. The cytotoxic activity of acrolein can be counteracted by an antagonist or inhibitory mechanism, leading to hypothesized effects on mood and cognition. Deviation from the usual range might elicit either good or negative responses, perhaps resulting in mental health issues.

Furthermore, Cheng et al. have demonstrated a notable elevation in the concentration of the carcinogenic compound acrolein in buccal cells obtained from individuals who use e-cigarettes. A DNA adduct is a chemical modification that occurs when a foreign substance binds to DNA. 8R/S-3-(2'-deoxyribos-1'-yl) The compound is named -5,6,7,8-tetrahydro-8-hydroxypyrimido [1,2-a]. The compound purine-10-(3H)-one (γ -OH-Acr-dGuo) was examined between smokers and non-smokers. The authors stress the urgent requirement for additional investigation into the possible toxicity and cancer-causing effects of e-cigarette usage, primarily due to the impact of acrolein [51]. Lobkowicz et al. have highlighted a new marker, 2,3-dihydroxypropylmercapturic acid (23HPMA), in their recent investigations on acrolein levels in e-smokers. They emphasize that this marker exhibits a far better level of specificity in its effect. The concentration of 23HPMA is elevated in individuals who use e-cigarettes, whereas it remains stable in those who smoke tobacco [52]. Malignant microorganisms can contribute to the formation of respiratory malignancies in humans through their cytotoxic action of acrolein. This could be attributed to the heightened resistance of the human respiratory system, which may contribute to the facilitation of cancer growth. Hence, the correlation between the cytotoxic activity of acrolein and the concentration of tobacco smoke is evidently demonstrated by the association of these two factors. The over use of acrolein and other substances included in tobacco smoke can heighten the probability of acquiring lung cancer. Furthermore, there is a want for additional investigation on the current state of lung diseases.

1.3.2 ACROLEIN IS ONE OF THE MAIN RISK FACTORS FOR CHRONIC OBSTRUCTIVE PULMONARY DISEASE

Chronic Obstructive Pulmonary illness (COPD) is an autoimmune respiratory illness characterized by a steady and slow progression that ultimately leads to respiratory failure. An important determinant of this disease is the absence of a defined aetiology, however, studies indicate that acrolein may play a crucial role. According to the World Health Organization (WHO), COPD is projected to become the third most common cause of mortality globally by 2030 [53]. COPD is defined by a gradual and irreversible reduction in the flow of air through the airways, which is followed by bronchitis, the formation of sputum, emphysema, wheezing, and difficulty breathing during physical activity [54].

Acrolein is a neurochemical compound that acts as a neurotransmitter and has a crucial function in the control of various physiological processes. It controls the operation of the central nervous system and has a crucial function in the respiratory system. The primary purpose of its utilization is to manage and guide the Absadi process. Acrolein is responsible for the development of this disease due to its wide range of negative effects on biological processes. These effects include interacting with proteins, regulating the expression of pro-inflammatory factors, having pro-oxidative qualities, and influencing the immune system. This has been established at a molecular level [55]. Acrolein reacts with proteins and DNA nucleophilic side groups, specifically the cysteine sulfhydryl, histidine imidazole, lysine ϵ -amino, and arginine guanidine, by generating adducts [56]. These adducts are formed with the deoxyguanosine moiety of DNA. Acrolein undergoes protein carbonylation by forming Michael-type adducts with cysteine residues, in which the aldehyde's carbonyl group bonds to the peptide structure [57].

Acrolein plays a vital role in chronic obstructive pulmonary disease by impairing respiratory function and limiting the capacity of the respiratory system. In a recent study conducted by Chen et al, it was discovered that acrolein forms interactions with α -Lys-16, α -His-50, and β -Lys-59 in the hemoglobin of smokers. This interaction leads to an increase in the levels of acrolein-modified peptides [58]. This underscores the detrimental impact of aldehyde on cellular function, DNA integrity, and immunological response. The impacts of acrolein on cytotoxicity, immunomodulation, and gene expression are substantial.

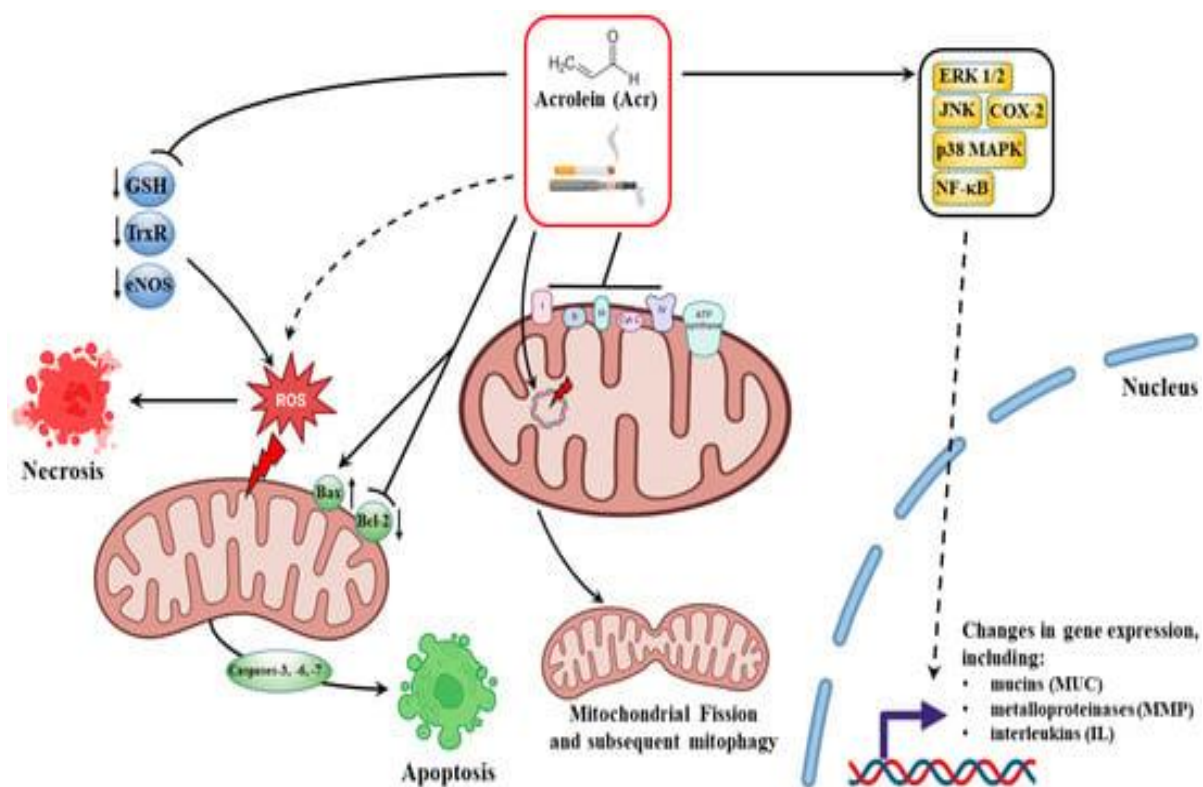


Figure 8: Smokers are exposed to acrolein (Acr), which is harmful, upsetting redox equilibrium and producing ROS. Moreover, it adversely affects mitochondrial biogenesis, which damages the cells in the lungs and respiratory system. Because of its interactions with transcription factors, such as NF-kB, acrolein has potent immunomodulatory effects. Additionally, it controls mucus hypersecretion and cell signaling pathways that produce pro-inflammatory cytokines. Through regulation of mucin and MMP gene expression, which results in tissue alteration and degradation, Acr is also implicated in lung disorders.

1.3.3 THE ROLE OF ACROLEIN IN THE DEVELOPMENT OF LUNG AND ORAL CANCER

Acrolein, which has been categorized as a group 2A drug by the International Agency for Research on Cancer, is highly likely to cause cancer in people. This conclusion is supported by a significant body of evidence from research conducted in test tubes, animals, and human populations [59, 60]. In addition, recent study indicates that acrolein plays a direct role in

causing mutations and also helps cancer cells become more resistant to standard cisplatin chemotherapy by disrupting certain signalling pathways [61]. The experiments conducted by Matsumoto et al [62] give unequivocal evidence of the carcinogenic and cytotoxic effects of acrolein. A 2-year exposure to acrolein through inhalation in both mice and rats resulted in the development of squamous cell carcinomas in the nasal cavity, among other effects.

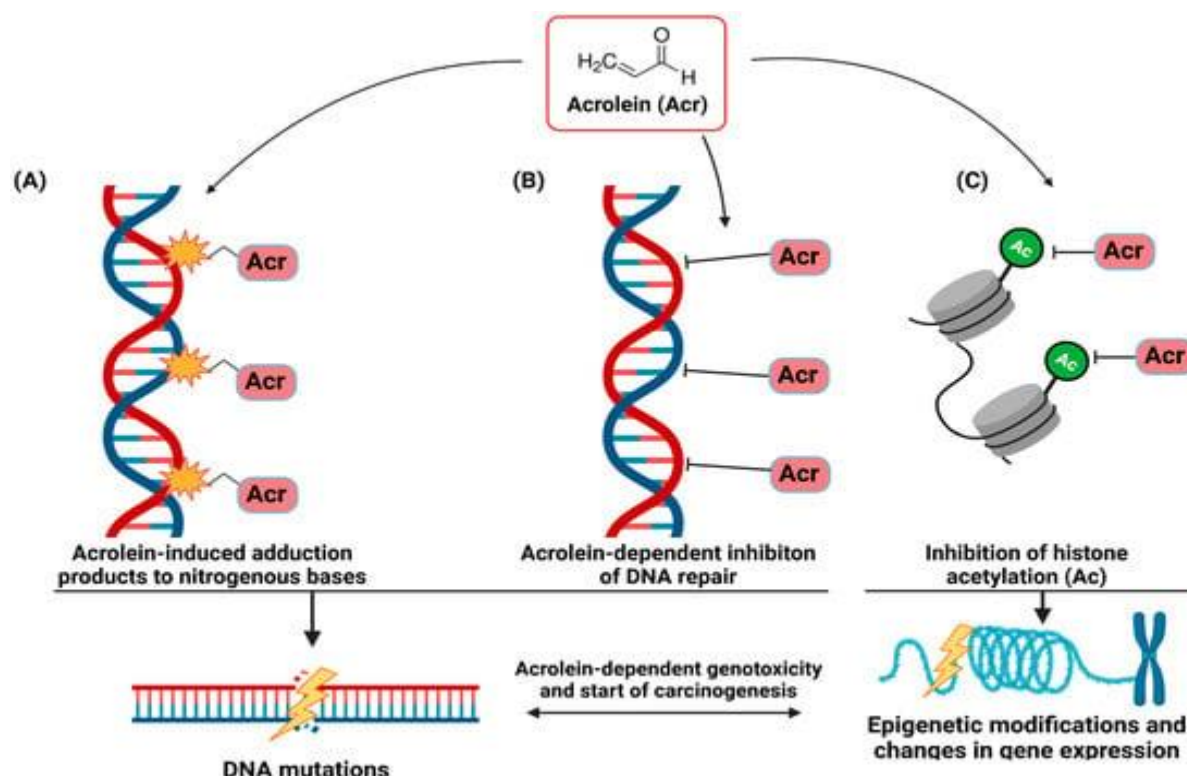


Figure 9: Acrolein's (Acr) genotoxic qualities appear to be essential in causing cancer mutations in smokers. Direct interactions between acrolein and nucleotide bases result in the formation of Acr-nucleotide base adducts, which chemically modify the bases (A). DNA damage and mutations in cells are exacerbated by efficient acrolein-dependent suppression of DNA repair enzyme activity or activity (B). Furthermore, acrolein inhibits histone H4 acetylation (C), influencing the epigenetic methods of gene expression regulation.

Acrolein, a constituent of cigarette smoke, is widely recognized as a primary causative factor for the development of lung cancer [63]. According to the most recent research by Peterson et al., it is worth noting that acrolein is a strong mutagen. Additionally, it has the

ability to enhance the effects of other substances found in cigarette smoke. Research has demonstrated that acrolein enhances the lung cancer-causing effects of the nitrosamine 4-(methylnitrosamino)-1-(3-pyridyl)-1-butanone (NNK). The exposure of mice to acrolein for a duration of three hours did not cause the development of lung adenomas. However, it did greatly increase the carcinogenicity of NNK in the lungs. The specific mechanism behind this interaction is still unknown. Research unequivocally demonstrates that the combination of tobacco smoke components enhances their activity and leads to a heightened carcinogenic effect [64].

1.4. THE ROLE OF ACROLEIN IN OXIDATIVE STRESS AND THE DEATH OF CELLS

The study investigated the detrimental impacts of e-cigarette aerosols on PMA-differentiated THP-1 cells, which are a specific type of human monomyelocytic leukaemia cell line. THP-1 cells experienced more severe damage when exposed to aerosols containing higher levels of nicotine (480 puffs). Oxidative stress plays a crucial role in the cytotoxicity induced by particles, and samples with the highest dosage of nicotine and the greatest number of puffs resulted in a decrease in cellular GSH levels. The aerosols produced by e-cigarettes can also induce pro-inflammatory effects, as demonstrated by the production of IL-1 β and TNF- α in THP-1 cells. BEAS-2B cells had similar patterns and higher resilience compared to THP-1 cells. The levels of IL-8 and TGF- β 1 expression in BEAS-2B cells treated with e-cigarette aerosol were measured using ELISA [65]. The toxicity of commercially available e-liquid with different nicotine doses was also evaluated in THP-1 cells. The intracellular concentrations of GSH demonstrated that commercial e-liquids induced cell death via oxidative stress [67]. The study investigated the detrimental impacts and oxidative stress induced by e-cigarette aerosols consisting only of pure propylene glycol (PG) and exclusively pure vegetable glycerin (VG). PG demonstrated more cytotoxicity towards THP-1 cells compared to VG, possibly due to oxidative stress. Neither PG nor VG have the ability to stimulate IL-1 β production. When propylene glycol (PG) and vegetable glycerin (VG) were directly introduced into the cell culture medium, they did not demonstrate any significant harmful effects on THP-1 cells. The application of heat played a vital role in causing cell death. PG demonstrated greater toxicity towards THP-1 cells, even in the absence of combustion, at a dosage of 100 mg/mL. The cytotoxic effects of nicotine did not vary with concentration, while higher doses were found to suppress the generation of IL-1 β [68]. To summarise, the study highlights the importance of understanding the cytotoxicity and pro-inflammatory effects of e-cigarette aerosol.

An experiment was carried out on animals using transgenic NF-KB-luc mice to investigate the impact of e-cigarette aerosols, both with and without nicotine, on the respiratory system. The results indicated that e-cigarette aerosols have the ability to activate the inflammatory system and elicit stress responses. A study conducted on wild-type C57BL/6 mice for 24 hours showed clear evidence of dose-dependent acute inflammatory responses in mice exposed to high-puff e-cigarette aerosols [69]. The increased exposure led to an elevated generation of IL-1 β and a more pronounced infiltration of neutrophils in the bronchoalveolar lavage fluid (BALF) when compared to animals exposed to lower-puff e-cigarette aerosols [70]. The expression of the HO-1 protein in lung tissue was increased in correlation with the presence of particulate matter from e-cigarette aerosols following exposure. This effect was further confirmed by different levels of localised inflammation in the lung, as demonstrated by hematoxylin and eosin staining.

PURPOSE OF THE STUDY

This study's primary goal is to bridge the knowledge gap by evaluating the nation's and the youth community's awareness of the possible health hazards of vaping. Primarily concentrating on how vaping causes acrolein to cause oxidative stress to our body and cell damage in vital areas like muscle and fat. Through the completion of this survey, we observe:

Educating people on the adverse effects of vaping, the dangers it poses to our health, the production of acrolein when vaping, and other related topics. As the globe has developed, people are becoming more conscious of the harmful effects of smoking and switching to e-cigarettes without realizing it. How can we pinpoint locations where efforts to raise awareness and educate the public may be improved to lessen the adverse health effects of vaping?



METHODOLOGY

Both quantitative and qualitative information about migraines, such as knowledge, attitudes, and perceptions, will be gathered through the survey. It will contain a Likert scale and multiple-choice questions to gauge opinions and impressions. Target respondents for the poll will include current vapers, former vapers, and non-vapers. The poll will be disseminated via several platforms, social media sites, community organizations, online courses, and educational establishments. Anonymized replies will be gathered from January through March 2024 for data gathering. The data will be statistically evaluated to ascertain correlations, attitudes, and knowledge levels. We shall follow ethical guidelines that guarantee anonymous participation, informed consent, confidentiality, and voluntary involvement. The results will be combined into an extensive report and shared via scholarly journals, conferences, online discussion boards, and media channels. Based on the survey results, recommendations for educational interventions and policy implications will be given.

RESULT AND DISCUSSION

Question 01: Age

The study consists of 122 respondents, with 22-24-year-olds making up 23.8% of the total. Other common age groups include 17-20-year-olds (13.1%) and 25-27-year-olds (10.7%). The least common age groups are 0-9 years old and 30-35 years old, each comprising 0.8% of the total.

Age

122 responses

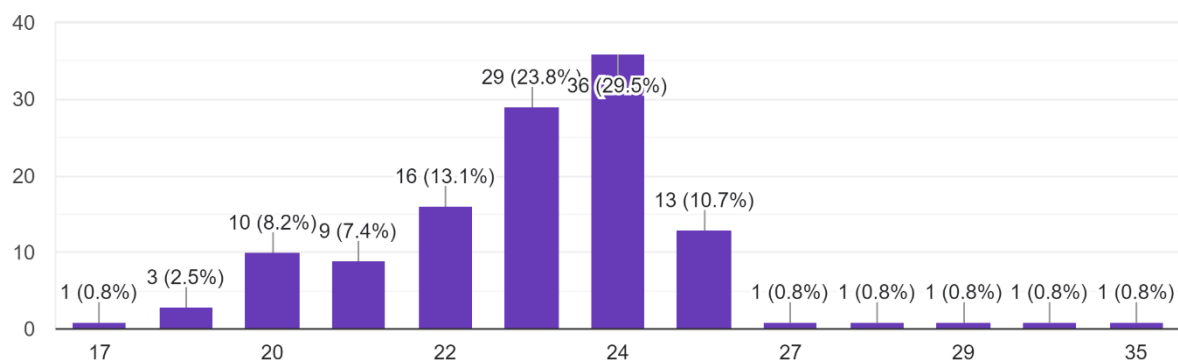


Figure 10

Question 02. Gender

The pie chart shows the gender of the survey, where out of 122 respondents, 75.4% (92 people) identified as male, and 24.6% (30 people) identified as female.

Gender

122 responses

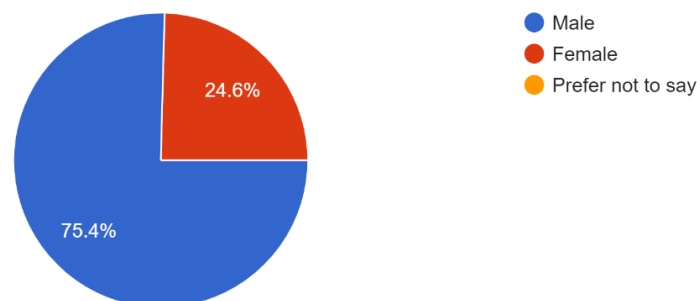


Figure 11

Question 03: Have you ever heard about e-cigarette (vapes)?

The pie chart is divided into blue (yes) and red (no) slices. This survey reveals that 87.7% of 122 people labeled as "Yes" have heard about e-cigarettes, while 12.3% labeled "No" have not, with 107 people having heard of e-cigarettes and 15 people not.

Have you ever heard about e-cigarette (vapes)?
122 responses

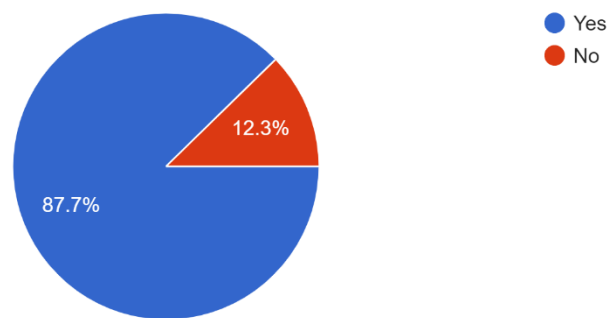


Figure 12

Question 04: How did you first learn about e-cigarettes (vapes)?

The most common way people learned about e-cigarettes was from friends or family, with 59.5% of the pie chart labeled as such. Social media was the second largest slice, with 33.1% labeled as such. The remaining slices were advertising (4.1%), Google (1.7%), and observing other people vaping (1.7%).

How did you first learn about e-cigarettes (vapes)?
121 responses

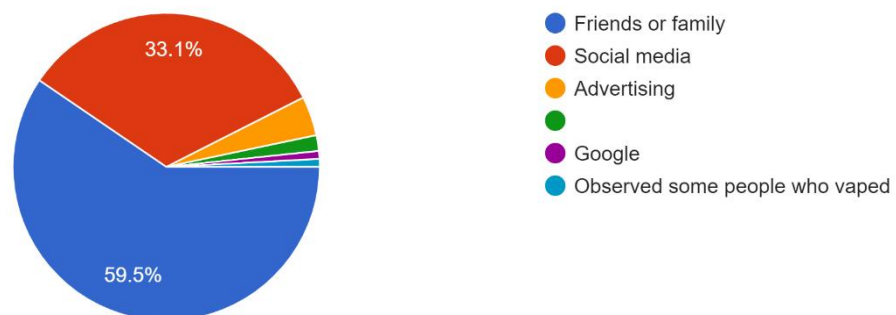


Figure 13

Question 05: Have you ever used an e-cigarette (vapes)?

This pie chart titled "Have you ever used an e-cigarette (vapes)?" shows the results of asking people if they have ever used an e-cigarette. The most significant slice, "No, and I have no interest," accounts for 52.5% of respondents. The second largest slice, "Yes, occasionally," accounts for 26.2% of respondents. The third largest slice, "No, but I've considered it," accounts for 13.1% of respondents. The blue slice, labeled "Yes, regularly" accounts for 8.2% of the respondents. The two smallest slices, blue and orange, indicate a small number of respondents regularly using e-cigarettes.

Have you ever used an e-cigarette (vapes)?

122 responses

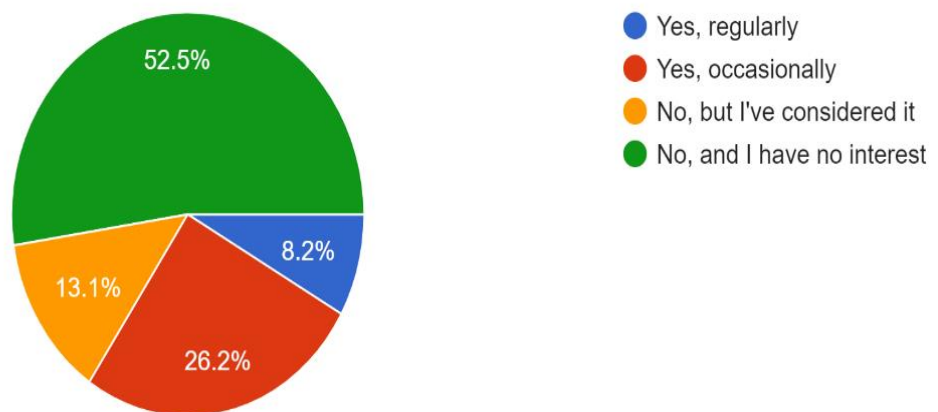


Figure 14

Question 06: What factors influenced your decision to try e-cigarettes (vapes)?

This survey revealed that curiosity was the most influential factor in their decision to try e-cigarettes. Over a quarter of respondents cited curiosity as the main reason for trying e-cigarettes. Health reason was the second most influential factor, with 26.4%, followed by the belief that e-cigarettes were less harmful than regular cigarettes. The third largest slice was peer pressure, with 8.5% of respondents believing this. Other factors included Nothing Less harmful than regular cigarettes and trying to avoid smoking etc. The pie chart suggests that curiosity was the primary reason for people trying e-cigarettes, followed by peer pressure and the belief that e-cigarettes are less harmful than regular cigarettes.

What factors influenced your decision to try e-cigarettes (vapes)?

106 responses

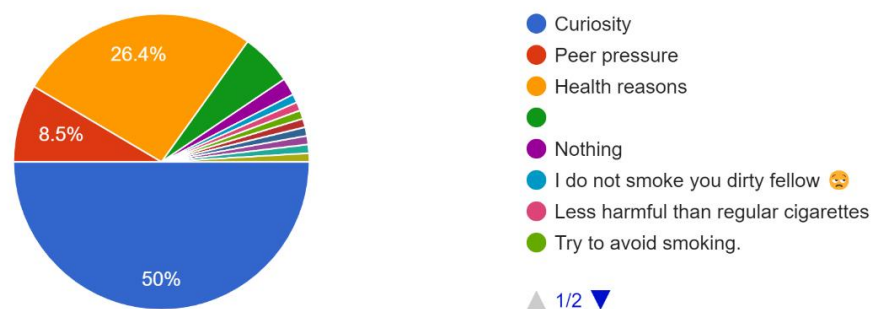


Figure 15

Question 07: How often do you use e-cigarettes (vapes)?

This pie chart titled "How often do you use e-cigarettes (vapes)?" shows that 81.4% of respondents use e-cigarettes Rarely, while 7% use them weekly. The remaining slices are "Monthly" and "Daily," accounting for 11.6% of respondents. The majority of respondents use e-cigarettes rarely, with a small percentage using them monthly or daily.

How often do you use e-cigarettes (vapes)?
86 responses

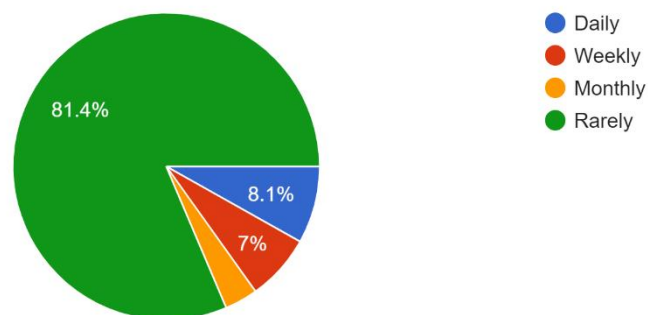


Figure 16

Question 08: Which flavor of e-cigarette (vape) do you prefer?

A pie chart titled "Which flavor of e-cigarette (vape) do you prefer?" shows the results of the most significant slice, labeled "Mint," Flavor is 26.1%; the second largest slice, labeled "Strawberry," with 26.1%, the third largest slice, labeled "I always avoid vape, No idea. You should keep option 'Never tried vaping but curious,'" is 21.7%, an option about curiosity about vaping but not having tried it and indicates some respondents were not familiar with different e-cigarette flavors or would have liked.

Which flavor of e-cigarette (vape) do you prefer?
92 responses



Figure 17

Question 09: Have you experienced any health issues related to e-cigarette (vapes) use?

The pie chart titled "Have you experienced any health issues related to e-cigarette use?" shows the results of a survey asking people if they have experienced any health issues related to e-cigarette use. The larger blue slice, labeled "No," represents 75.8% of the 95 people surveyed, while the smaller red slice, labeled "Yes," represents 24.2%.

Have you experienced any health issues related to e-cigarette (vapes) use?
95 responses

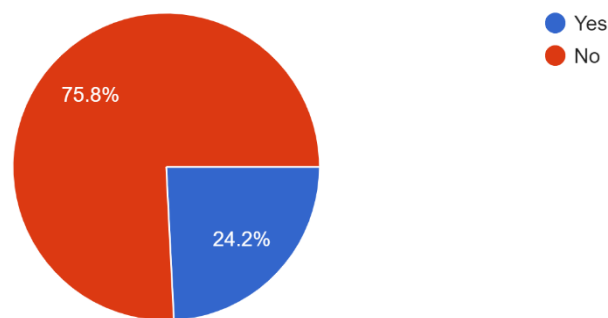


Figure 18

Question 10: Have you experienced any health issues related to e-cigarette (vapes) use? This pie chart revealed that nearly 40% prefer disposable e-cigarette devices, followed by pod systems at 24.4%, vape pens at 23.3%, and mod systems at 14%. The most significant slice of the pie chart was "disposable," with 38.4% of respondents preferring it.

What is your preferred type of e-cigarette (vapes) device?
86 responses

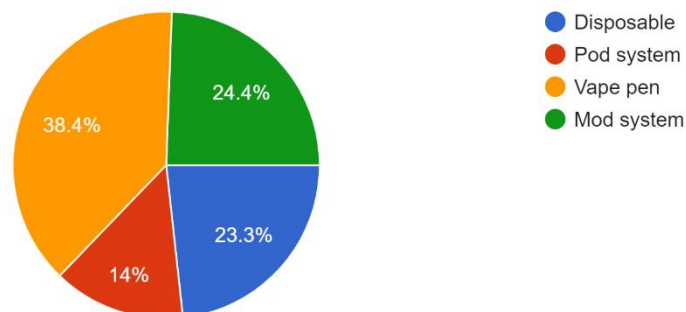


Figure 19

Question 11: Do you think e-cigarettes (vapes) can help people quit smoking?

This survey revealed that 38.6% believe e-cigarettes can help people quit smoking or not. The second largest slice, "No," is 32.5%, suggesting a significant portion of respondents believe e-cigarettes are not helpful. The third largest slice, "Yes," is 16.7%, confident about the effectiveness of e-cigarettes. The smallest slice, "Not Applicable," is 12.3%. The survey is asking for opinions and not scientific evidence, and ongoing research is ongoing on the effectiveness of e-cigarettes as a smoking cessation tool.

Do you think e-cigarettes (vapes) can help people quit smoking?

114 responses

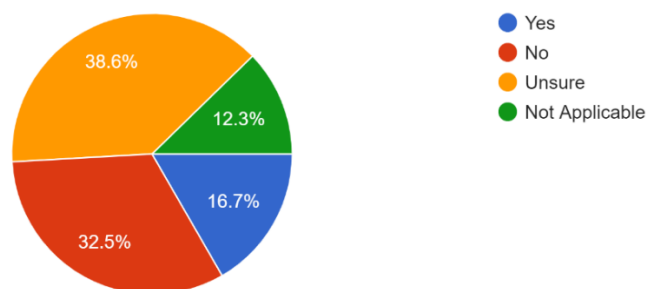


Figure 20

Question 12: Do you believe e-cigarettes (vapes) contribute to the normalization of smoking behaviors?

This pie chart revealed that nearly 40% are unsure about the link between e-cigarettes and smoking normalization. The most significant slice, labeled "Maybe," indicates that 37.6% are unsure. The second largest slice, labeled "No," with 25.6%, suggests a quarter of respondents believe e-cigarettes do not contribute to smoking normalization. The third largest slice, labeled "Yes," indicates 23.1% of people, over a fifth of respondents, believe e-cigarettes do contribute to smoking normalization.

Do you believe e-cigarettes (vapes) contribute to the normalization of smoking behaviors?

117 responses

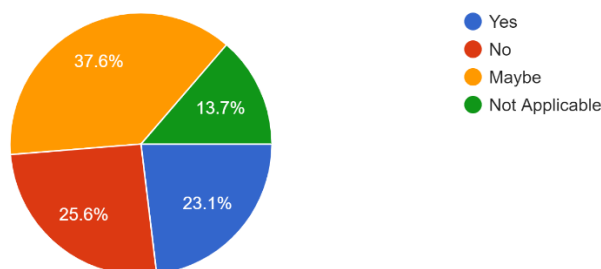


Figure 21

Question 13: Do you believe e-cigarettes (vapes) are a safer alternative to traditional cigarettes?

This pie chart shows that 36.9% are unsure or disagree that e-cigarettes are a safer alternative to traditional cigarettes, while 27.9% are neutral, suggesting a somewhat similar opinion. However, a significant portion of the population, around 27.9%, somewhat agree, with 8.2% strongly agreeing. The survey is based on opinions and not scientific evidence, and public health organizations like the CDC caution that the long-term health effects of e-cigarettes are still unknown. If considering switching to e-cigarettes, it is recommended to consult a doctor about potential risks and benefits. The survey is not based on scientific evidence and should be used for public health considerations.

Do you believe e-cigarettes (vapes) are a safer alternative to traditional cigarettes?
122 responses

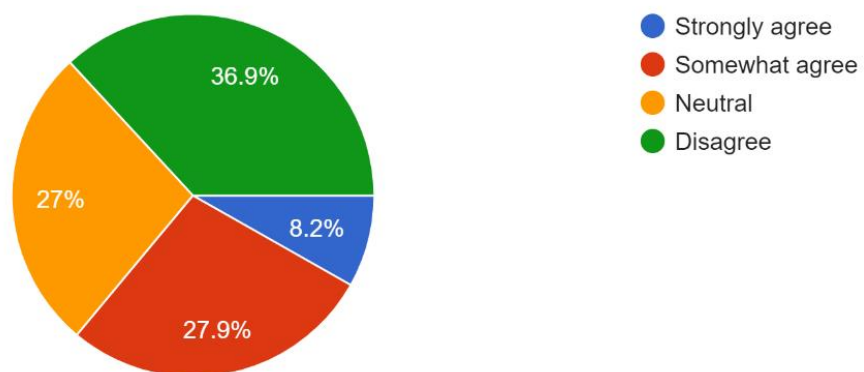


Figure 22

Question 14: Do you think e-cigarettes (vapes) should be allowed in public spaces?

A pie chart titled "Do you think e-cigarettes (vapes) should be allowed in public spaces?" shows the results of a survey of 118 people. The most significant slice, labeled "No," is 56.8%, with over half of respondents believing e-cigarettes should not be allowed in public spaces. The second-largest slice, labeled "Yes, without restrictions," is 24.6%, with over a quarter believing e-cigarettes should be allowed without restrictions. The third slice, labeled "Yes, with restrictions," has 10.2%, with some restrictions, and the smallest slice, labeled "Not sure," indicates a small number of respondents are unsure about e-cigarette regulation.

Do you think e-cigarettes (vapes) should be allowed in public spaces?
118 responses

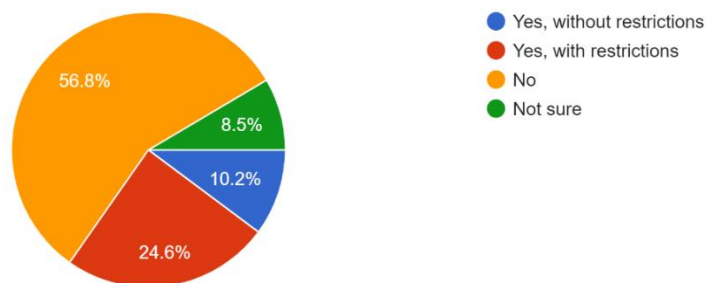


Figure 23

Question 15: Have you ever tried to quit using e-cigarettes (vapes)?

This chart titled "Have you ever tried to quit using e-cigarettes?" shows the results of the survey asking people if they have ever tried to quit vaping. The most significant slice, "No", accounts for 57.1% of respondents, indicating that over half have never tried to quit. The second largest slice, "Yes, successfully", accounts for 31.3% of respondents, suggesting that a significant portion of vapers have tried to quit.

Have you ever tried to quit using e-cigarettes (vapes)?
99 responses

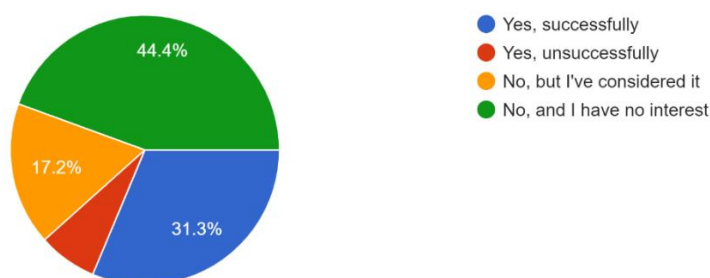


Figure 24

Question 16: How would you rate the availability of information about the risks of e-cigarettes (vapes)?

The bar graph depicts the availability of information about e-cigarette risks, with a rating scale of 1 to 4. With "Neutral" being the most common rating (30.3%), followed by "Somewhat Good" (25.7%), "Somewhat Poor" (21.1%), and "Very Good" (21.1%). The least common rating was "Very Poor" (1.8%), chosen by only 2 people.

How would you rate the availability of information about the risks of e-cigarettes (vapes)?

109 responses

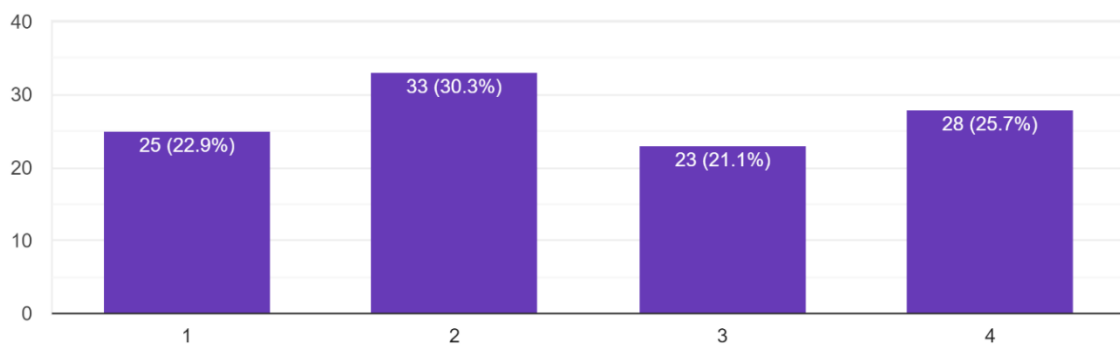


Figure 25

Question 17: Do you think e-cigarettes (vapes) are more affordable than traditional cigarettes?

A survey reveals that 59.6% of respondents believe e-cigarettes are not more affordable than traditional cigarettes. The most significant percentage of respondents (23.7%) believe e-cigarettes are more affordable than traditional cigarettes, but they are not quite sure. The smallest slice (16.7%) is "Yes".

Do you think e-cigarettes (vapes) are more affordable than traditional cigarettes?

114 responses

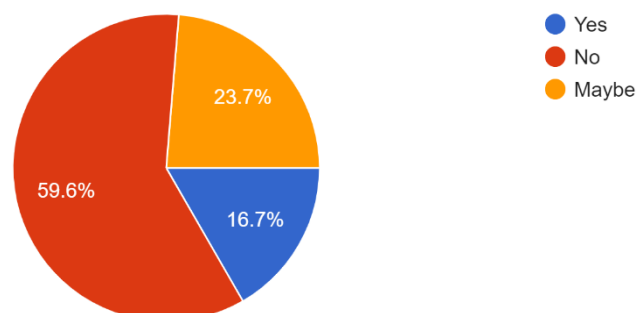


Figure 26

Question 18: Have you ever experienced addiction or dependence on e-cigarettes (vapes)?

The pie chart depicts about "Have you ever experienced addiction or dependence on e-cigarettes (vapes)?" The chart is divided into three slices: "No," "Maybe," and "Yes." The most significant slice, "No," is 76.7%, followed by "Maybe," 14.6%, and "Yes," 8.7%, respectively. The blue slice is labeled "No," the orange slice "Maybe," and the green slice "Yes."

Have you ever experienced addiction or dependence on e-cigarettes (vapes)?
103 responses

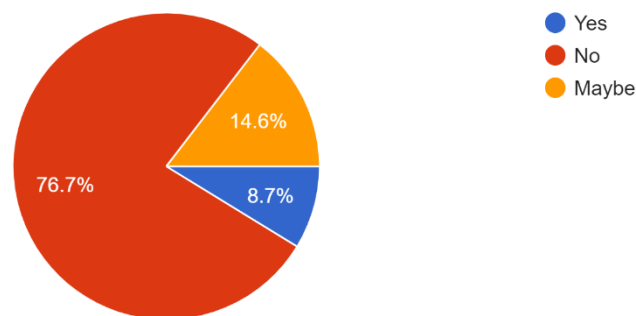


Figure 27

Question 19: Would you recommend e-cigarettes (vapes) to others?

The pie chart depicts the survey question results about recommending e-cigarettes to others. The title is "Would you recommend e-cigarettes (vapes) to others?" The most significant percentage (60.5%) said "No", followed by "It depends" (19.3%), "Not Applicable" (10.1%), and "Yes" (10.1%).

Would you recommend e-cigarettes (vapes) to others?
119 responses

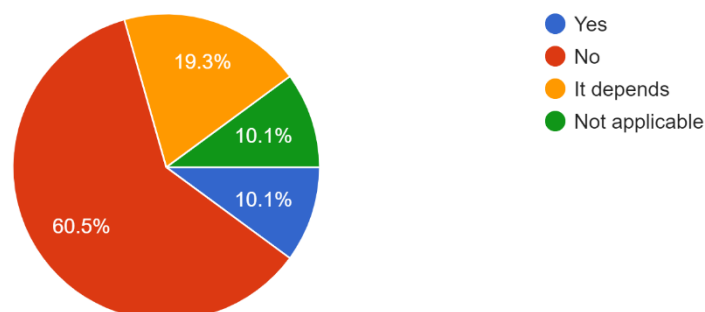


Figure 28

CONCLUSION

This review examines the biomolecular processes by which acrolein contributes to the development of lung illnesses and malignancies resulting from smoking and e-cigarette usage. E-cigarettes, which have emerged as a substitute for smoking in contemporary society, pose significant health risks. Unbeknownst to us, we begin utilizing e-cigarettes as a substitute for ceasing tobacco consumption. However, it contains acrolein, a key component of cigarette smoke, which is often considered one of the most harmful substances for tobacco users. Several studies have shown the vital importance of it in the progression of COPD and lung cancer. Acrolein impacts various cellular levels, spanning from organelles to immune system cells. The inhalation of acrolein causes protein inactivation, oxidative damage, cell death, chronic inflammation, and the restructuring of respiratory tissue. This ultimately leads to the development of chronic obstructive pulmonary disease.

Acrolein is a causative agent of DNA damage in the respiratory system and lungs of individuals who smoke. The intricate mechanisms by which acrolein acts at a molecular level are yet unknown, and comprehensive investigations into the connection between the time course of acrolein-dependent effects and its toxicity in lung illness are necessary. This survey indicates that our society is not as extensively engrossed in e-cigarettes as the developed countries. Presently, the younger generation is not as heavily dependent on the taste of e-cigarettes. Gradually consuming. Individuals are drawn to this novel electronic cigarette. Furthermore, the young population in a growing nation such as ours plays a crucial role in supporting the extensive e-cigarette sector. Now is the opportune moment for us to cultivate our awareness. We should cultivate a heightened sense of awareness regarding this matter. We must acknowledge that there is no viable substitute for smoking.



Daffodil
International
University

“A Survey on E-Cigarettes (Vapes)”

Hello! My name is Prama Paul, and I am a final year undergraduate student at the Department of Pharmacy at Daffodil International University. As part of my BPharm project, I am conducting this survey on E-cigarettes (Vapes). We will not record your name; the data you provide will only be used for research. Please answer the questionnaire with your true situation and thoughts. Thanks for your cooperation!

SURVEY QUESTION

Question 01. Age

Question 02. Gender

- ☐ Male
- ☐ Female
- ☐ Prefer not to say

Question 03: Have you ever heard about e-cigarette (vapes)?

- ☐ Yes
- ☐ No



Question 04: How did you first learn about e-cigarettes (vapes)?

- ☐ Friends or family
- ☐ Social media
- ☐ Advertising

Question 05: Have you ever used an e-cigarette (vapes)?

- ☐ Yes, regularly
- ☐ Yes, occasionally
- ☐ No, but I've considered it
- ☐ No, and I have no interest

Question 06: What factors influenced your decision to try e-cigarettes (vapes)?

- ☐ Curiosity
- ☐ Peer pressure
- ☐ Health reasons
- ☐ _____

Question 07: How often do you use e-cigarettes (vapes)?

- ☐ Daily
- ☐ Weekly
- ☐ Monthly
- ☐ Rarely

Question 08: Which flavor of e-cigarette (vape) do you prefer?

- ☐ Mint
- ☐ Chocolate
- ☐ Strawberry
- ☐ Peach
- ☐ Other

Question 09: Have you experienced any health issues related to e-cigarette (vapes) use?

- ☐ Yes
- ☐ No



Question 10: What is your preferred type of e-cigarette (vapes) device?

- ☐ Disposable
- ☐ Pod system
- ☐ Vape pen
- ☐ Mod System

Question 11: Do you think e-cigarettes (vapes) can help people quit smoking?

- ☐ Yes
- ☐ No

Question 12: Do you believe e-cigarettes (vapes) contribute to the normalization of smoking behaviors?

- ☐ Yes
- ☐ No
- ☐ Maybe
- ☐ Not Applicable

Question 13: Do you believe e-cigarettes (vapes) are a safer alternative to traditional cigarettes?

- ☐ Strongly agree
- ☐ Somewhat agree
- ☐ Neutral
- ☐ Disagree

Question 14: Do you think e-cigarettes (vapes) should be allowed in public spaces?

- ☐ Yes, without restrictions
- ☐ Yes, with restrictions
- ☐ No
- ☐ Not Sure

Question 15: Have you ever tried to quit using e-cigarettes (vapes)?

- ☐ Yes, successfully
- ☐ Yes, unsuccessfully
- ☐ No, but I've considered it
- ☐ No, and I have no interest



Question 16: How would you rate the availability of information about the risks of e-cigarettes (vapes)?

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4

Question 17: Do you think e-cigarettes (vapes) are more affordable than traditional cigarettes?

- ☐ Yes
- ☐ No
- ☐ Maybe

Question 18: Have you ever experienced addiction or dependence on e-cigarettes (vapes)?

- ☐ Yes
- ☐ No
- ☐ Maybe

Question 19: Would you recommend e-cigarettes (vapes) to others?

- ☐ Yes
- ☐ No
- ☐ It depends
- ☐ Not Applicable