



Aerosols are Associated with Asthma Symptoms Among Adolescents

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Abstract

The findings indicated that e-cigarette use was associated with increased prevalence of asthma symptoms independent of combustible cigarette use, exposure to household and public places SHS and second hand aerosols from e-cigarettes, sex, and age. Moreover, our results showed that frequency of exposure to household second hand aerosols from e-cigarettes was associated with asthma symptoms independent of combustible cigarette use, e-cigarette use, exposure to household SHS, exposure to public places SHS/ second hand aerosols, sex, and age.

Keywords: Asthma symptoms; Passive exposure; Aerosols; Vulnerable population; Frequency; Cigarette use;

Introduction

To our knowledge the finding of associations between exposure to household second hand aerosols from e-cigarettes and asthma symptoms is novel. These findings highlight the potential adverse respiratory effects of primary use of e-cigarettes as well as passive exposure to their aerosols among adolescents. The current study identified positive associations between current e-cigarette use with current wheeze and current asthma that were independent of combustible cigarette use and other covariates. These results are consistent with prior cross-sectional studies that showed associations between e-cigarette use and respiratory symptoms among both adolescents and adults. The causal inference of such associations is further strengthened by results of a recent longitudinal study that showed e-cigarette use is associated with incident respiratory disease. The effect size of the association between e-cigarette use and current asthma in this report is similar to the effect sizes identified by prior studies, such as reports by Schweitzer and Bhatta and Glantz [1]. Moreover, the highest increase in the prevalence of asthma symptoms was observed among dual users of combustible cigarettes and e-cigarettes, which is in line with previous studies. Hence, we demonstrated that use of e-cigarettes alone associated with increased asthma symptoms, and the burden of these symptoms is further increased when e-cigarette use is combined with combustible cigarette use among the vulnerable population of adolescents. Also, it is important to note that current cigarette smoking showed significant associations with asthma symptoms independent of e-cigarette use status [2]. Hence, further highlighting the established harmful effects of cigarette smoking on respiratory health. Furthermore, we demonstrated associations between frequency of exposure to household second hand aerosols from e-cigarettes with asthma symptoms that were independent of combustible cigarette use, e-cigarette use, exposure to household SHS, exposure to public places SHS/ second hand aerosols, sex, and age.

Discussion

Although a large body of literature exists on the detrimental health effects of SHS exposure on children and non-smoker adults, a limited number of population-based studies have assessed the effects of exposure to second hand aerosols from e-cigarettes on respiratory health [3]. An experimental study showed that passive exposure to e-cigarette aerosols among non-smoking adults associated with multiple adverse symptoms, including ocular, nasal, and throat-respiratory symptoms. Moreover, Bayly et al. showed that among adolescents with asthma diagnosis, exposure to second hand aerosols from e-cigarettes was associated with higher odds of experiencing

asthma exacerbations. In the current report we demonstrated that frequent exposure to household second hand aerosols from e-cigarettes was associated with increased prevalence of current wheeze, current asthma, and current uncontrolled symptoms of asthma. Up to our knowledge, such results are novel and further highlight the adverse health effects of passive exposure to e-cigarettes aerosols on respiratory health [4]. Given that exposure to second hand aerosols is on the rise, community-level public health strategies are needed to address e-cigarette use. Experimental and clinical research has demonstrated the biological plausibility of the effects of e-cigarettes on respiratory health. In vitro experiments have cells to e-liquids/e-cigarettes aerosols is associated with wide array of effects, including altered membrane fluidity, impaired barrier function, increased cell apoptosis, decreased cell proliferation, increased levels of cellular stress, increased cellular toxicity, and increased secretion of inflammatory cytokines. Similarly, animal model investigations showed a range of effects of e-cigarettes, such as increased airway hyper-reactivity; distal airway enlargement; increased lung mucin production, and increased inflammatory cytokines [5]. In humans, exposing healthy never smokers to acute e-cigarette aerosols was associated with altered biology of lung cells, including the small airway epithelium, alveolar macrophages, and circulating endothelial micro particles. Moreover, a study conducted in apparently healthy men who never used combustible cigarettes showed that e-cigarette use was associated with impaired lung function parameters [6]. Therefore, accumulating evidence indicate that e-cigarette use is not benign and is potentially associated with respiratory disease. Similarly, our estimated prevalence of current asthma is similar to the prevalence estimate of asthma among 18-year old Isle of Wight birth cohort participants, which used a comparable asthma definition. Also, our estimated effect sizes relating e-cigarette use to asthma symptoms are similar to estimates from prior studies. Hence, we anticipate that the effect of information bias, if any, is minimal. Lack of detailed information on adherence to medication among participants with asthma is a further limitation to our study. Moreover, selection bias could also be a concern in cross-sectional

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studies; however, the possibility of selection bias affecting the results of our study is low because of the high response proportion. Another limitation to our study is the lack of confirmatory information on the extent of household second hand aerosols exposure. For instance, information on whether the participants were directly exposed to household second hand aerosols and the duration of their exposure would have increased the validity of our second hand aerosols exposure variable [7]. An inherent limitation of cross-sectional studies is the inability to assess temporal sequence of events. It is also essential to indicate that our analysis aimed to assess concurrent associations rather than to determine temporal and causal associations. The findings of this study add to existing knowledge by demonstrating associations between e-cigarette use and exposure to household SHA from e-cigarettes with asthma symptoms among adolescents. The finding of associations between passive exposure to e-cigarettes aerosols and asthma symptoms adds a new perspective and highlights the importance of increasing awareness about the potential harmful effects of such passive exposure, particularly among children and adolescents [8]. Moreover, public health strategies should be placed to curb the ever increasing use of e-cigarettes among adolescents and denormalize and prohibit the use of e-cigarettes in indoor places to reduce passive exposure. Ultimately, comprehensive public health policies and strategies that aim to reduce tobacco use, including e-cigarettes, among adults and adolescents in the population should be developed and implemented. A limited number of population-based studies investigating associations between e-cigarette use and exposure to second hand aerosols from e-cigarettes with respiratory symptoms exist. Emerging epidemiological studies have demonstrated positive associations between e-cigarette use and respiratory symptoms. A prior study showed that exposure to second hand aerosols from e-cigarettes is associated with asthma exacerbations among youth with asthma; however, little is known on whether exposure to second hand aerosols from e-cigarettes is associated with respiratory symptoms. Given the scarcity of investigations and the need to better understand the health effects of e-cigarettes, the present study aimed to assess associations between e-cigarette use and exposure to household second hand aerosols from e-cigarettes with asthma symptoms among adolescents. Globally, a surge in electronic cigarette use has been observed in recent years, with youth being the most susceptible group. Given their recent emergence, studies assessing the health consequences of using e-cigarettes and exposure to their second hand aerosols are limited [9]. Hence, this study sought to assess associations between e-cigarette use and household exposure to second hand aerosols from e-cigarettes with asthma symptoms among adolescents. E-cigarette use and their household second hand aerosols exposure were independently associated with asthma symptoms among adolescents. Hence, such observations indicate that e-cigarette use and passive exposure to their aerosols negatively impact respiratory health among adolescents. Geographically, Kuwait is divided into six governorates, and the school districts follow a similar geographic distribution. Education in Kuwait is mainly provided by free public schools funded by the state and, to a lesser extent, by private schools. The education system can be divided into four stages, namely, kindergarten, elementary school, middle school, and high school, and in the latter three stages, the students are segregated by sex. Schooling is compulsory for all children aged 6 to 14 years. This cross-sectional study enrolled schoolchildren attending public high schools throughout the State of Kuwait, which included children aged between 16 and 19 years. The school children were enrolled in the study during the second

semester of the 2018–2019 school year. A stratified two-stage cluster sampling method was used to select a representative study sample of schoolchildren [10]. E-cigarette use and their household SHA exposure were independently associated with asthma symptoms among adolescents. Hence, such observations indicate that e-cigarette use and passive exposure to their aerosols negatively impact respiratory health among adolescents. **Keywords:** Electronic cigarettes, Vaping, Combustible cigarettes, Asthma, Respiratory symptoms, Adolescents, Kuwait Page 3 of 9 Alnajem et al. *Respir Res* 21:300 from a random sample of schools. At the time the study was initiated, there were 139 public high schools in Kuwait enrolling approximately 60,663 students. From a list obtained from the Ministry of Education, Kuwait, of all public high schools stratified by school district and sex, schools were randomly selected using randomly generated numbers. Proportional allocation was used to determine the number of participants needed from each school district by estimating sex-stratified weights relative to the student body size in each given school district. In total, 14 schools served as the recruitment venues for enrolling the required sample size.

Conclusion

The study was approved by the Health Sciences Center Ethics Committee for Student Research at Kuwait University. Written informed assent was obtained from each participating student. As per the waiver obtained from the Ethics Committee, no consents were sought from the parents.

Acknowledgement

None

Conflict of Interest

None

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