

Article

Comparative Effects of Cigarette and E-Cigarette Smoking on Lactate Dehydrogenase Levels in Saliva

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Abstract: **Introduction:** cigarette smoking and vaping are recognized as significant health hazards. However, the accurate effect of cigarette and vaping smoking on salivary LDH levels remain unclear. **Objectives:** the objective of this study is investigating the effect of cigarette smoking and vaping on oral health. **Material and methods:** This study was conducted between December 2023 and February 2024, and samples were collected randomly from 90 male volunteer participants. Standard techniques were employed to collect and analyse saliva samples for estimation of LDH levels. **Results:** Out of the 90 participants, 65 were smokers and 25 were non-smokers (control group). Cigarette smokers exhibited significantly higher levels of salivary LDH compared to both vapers and non-smokers. On the other hand, vapers showed higher salivary LDH levels than non-smokers, although their levels were lower than those observed in cigarette smokers. **Conclusion:** In this study both cigarette smoking and vaping significantly elevates salivary LDH levels, indicating a potential effect on oral tissues. The increase more observed among cigarette smokers compared to vapers while non-smokers showed the lowest levels. This study suggest that both forms of smoking contribute to oral tissues damage and this signifies that additional research is required to investigate the long-term impacts of smoking and vaping on oral tissues.

Keywords: Smoking, vaping, E-cigarette, salivary LDH, oral health.

Introduction

Tobacco cigarette is a complex mixture has more 4000 chemical compounds classify as hazardous, including over 70 substances expressed carcinogenic to human and animals by the international agency for research on cancer [1], [2].

Smoking is related with many diseases such as chronic obstructive pulmonary disease, cancer, pancreatitis, gastrointestinal disorders, periodontal disease, metabolic syndrome, and some autoimmune diseases [3]-[9].

cigarette structure contains various of free radicals and volatile aldehydes that have damaging effect on biomolecules [10]. Smoking led to increase production of reactive oxygen species (ROS) because of it is rich source of antioxidants therefore, it exceeds the capacity of antioxidant defence system [11]. It penetrates the saliva that coats the oral mucosa [12].

The electronic cigarette (E- cigarette) commonly known as a vaping and their utilization become popular hoping that they offer less harmful substitute to traditional smoking [13]. In e-cigarettes, nicotine is provided for inhalation by heating a solution that contains water, nicotine, propylene glycol, and vegetable glycerine [14], [15].

Lactate dehydrogenase enzyme found in almost all cell types [16]. Despite the salivary LDH alone or in serum level has been less commonly studied [17]. LDH enzyme released when the oxidative stress or oxidative damage occur in the body and its level rising in saliva and serum. The extracellular leakage of LDH enzyme indicates cell damage or cell death [18].

Salivary LDH concentrations as an expression of cell death can be considered a specific indicator of the effect of mucosal damage leading to the loss of integrity of the oral mucosa [19]. Saliva is increasingly utilized as a biological fluid that is also important in the evaluation of overall health. [20].

In our study, we hypothesize that the smoke by vaping e-cigarettes has detrimental effects on oral tissues. Therefore, we examined LDH levels in the saliva of vapers and to compare the data with traditional cigarette smokers.

Materials and methods

This study was conducted between December 2023 and February 2024, and samples were collected randomly from volunteer participants. The volunteers had to be smokers (cigarette and/ or vape) or non-smokers. Participants who had Diabetes, mouth ulcer and tooth inflammation were excluded from the study.

Finally, 90 male participants, among them 41 were smoker's cigarette, 24 vape and 25 non-smokers (control). Then, saliva samples were collected from each volunteer, the samples were coded and classified into three groups (cigarette smokers / vaper/ control). When the samples were collected, the volunteers were asked to rinse their mouths with distilled water. Following that, the volunteers were asked to allow saliva pooling in their mouths for 5 minutes (unstimulated whole saliva), then saliva was collected in sterile disposable containers, and the obtained quantity was 5 ml. The samples were centrifuged and stored in the freezer.

Biochemical analysis

The kit is a sandwich enzyme immunoassay for in vitro quantitative measurement of LDH in human serum, plasma, tissue homogenates, cell lysates, cell culture supernatants and other biological fluids, by cloud-clone corp., Version 13.0, USA.

In this assay, 100µl of saliva was added to 100µl of LDH reagents and the absorbance was measured at a wavelength of 450nm at 37C°. The mean level of salivary LDH activity was determined for each group and compared.

Statistical analysis

The data was analyzed statistically using SPSS statistical software, to apply a Duncan's test, and the arithmetic averages were compared at significance level of 0.05.

Results

There was a total of 90 subjects recruited for this study in the three groups, with 25 subjects in control group, 41 in smokers' group and 24 in vapers group. The demographic characteristics of the study subjects are shown in Table 1.

Table 1. Demographic Characteristics of the Study Subjects

متغيرات	حجم العينة	المتوسط الحسابي ± الانحراف المعياري	. Sig
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	c0.06 ± 0.301	25	السيطرة (الأصحاء)	
0.001	a0.44 ± 0.924	41	سيجارة	LDH
	b0.24 ± 0.484	24	سيجارة الالكترونية	

The mean salivary LDH level in cigarette group was (0.44±.924), in vape group was (0.24±.484) compared with control group (0.06±0.301). There is a statistically significant between salivary LDH level among study's groups that detect a highly significant $P= 0.01$. Hence, that suggesting positive correlation between high level of salivary LDH and smoking (cigarette and vape).

Post hoc analysis indicated salivary LDH activity was significantly in cigarette smokers than in vape and control group. LDH levels in vape users were significantly elevated compared with control group, although it remained significantly lower than those observed in cigarette group.

Discussion

LDH activity has already been previously potential early diagnostic tool or biomarker for several oral cavity diseases including periodontal disease, oral leukoplakia, oral submucous fibrosis and oral squamous cell carcinoma [21]-[25].

The increase in LDH observed in smokers can be attributed to the cytotoxic effects of tobacco smoke which contains reactive oxygen species and carcinogenic compounds capable of inducing oxidative stress and epithelial cell injury [23], [24].

Our study present vape users also exhibited significantly higher LDH activity compared with control group. Thus, indicated that vaping is not biologically inert. Although the significance of LDH elevation was lower than that observed in traditional smokers, the study indicates that exposure to aerosolized nicotine and other chemical constituents in e-cigarette can still induce cellular stress and subclinical tissue injury [24], [25].

Overall, this study supports the use of LDH as a sensitive and non-invasive biomarker for the early detection of smoking related cellular damage in oral cavity [21], [22].

Conclusion

In conclusion, the results of this study indicate significant differences in LDH activity between healthy individuals, traditional smokers and e-cigarette (vape) users. The traditional smokers presented high levels of LDH underling the sever cellular stress and tissue damage traditional smoking cause on the oral cavity. However, the e-cigarette users had lower LDH level activity than traditional smokers, their levels were still significantly higher than of the control group. That indicate the e-cigarette still induces measurable cellular stress and early tissue changes that shouldn't be forgotten.

These results showed LDH potential as a straightforward, non- invasive marker for detecting early smoking related damage.

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