

A Strategic Research Initiative on African American Susceptibility to Periodontal Disease due to Electronic Nicotine Delivery Systems (ENDS) Usage

Introduction

Electronic nicotine delivery systems (ENDS), also called electronic cigarettes, e-cigarettes, or vapes are battery-powered devices used to smoke or “vape” (short for vaporize) a flavored solution called an e-liquid.

E-liquids typically contain various formulations of nicotine, glycerol, propylene glycol, tobacco alkaloids, pH modifiers, and flavoring agents. Since their introduction to the U.S. in 2007, ENDS designs and features have rapidly evolved creating a challenge for regulatory scientists assessing their safety.¹

Recent evidence indicates e-liquids and ENDS aerosol constituents are oral health hazards that may increase the risks of periodontal disease² especially in vulnerable populations such as African Americans. ENDS aerosols contain tobacco-specific nitrosamines, aldehydes, metals, volatile organic compounds, phenolic compounds, tobacco alkaloids and polycyclic aromatic hydrocarbons (PAHs).³ A recent pilot study investigating the retention of these hazards in the oral cavity of ENDS users found 125 times higher carbonyl levels in exhaled aerosols than in pre-exposed breath and nearly 95% retention of these carcinogenic chemicals, which may contribute to adverse oral health outcomes.⁴ In addition, highly viscous carrier solvents within e-liquids are heated to form an inhalable aerosol that is extremely adherent to tissues of the oral cavity. This, in turn, may enable bacterial adhesion leading to gingival inflammation and periodontal disease.⁵ Thus, ENDS users are exposed to hazardous chemical mixtures, which may enhance gingival inflammation and periodontal

disease risks but there is a lack of data correlating ENDS preference, usage behavior, and oral health outcomes.

The overarching goal of this study is to establish risk factors and biomarkers of gingival inflammation, the precursor to periodontal disease, associated with ENDS use.

Understanding oral disease onset will allow for early screening and development of treatment options.

These findings will be beneficial to dental professionals in the identification of individuals at risk for ENDS-related oral health effects and can inform prevention strategies. Specifically, this study seeks to answer the following research questions:

- Is periodontal health negatively impacted by ENDS use? Specifically, does ENDS usage result in enhanced gingival inflammation and bleeding, calculus presentation, periodontal pockets and alterations in subgingival microbial communities consistent with oral disease progression?
- Are ENDS usage behaviors and preferences primary contributors to individual oral and periodontal health risks?

Study Objectives

Examine ENDS user characteristics, usage patterns, and oral health as compared to those of never-established smokers.

Identify oral health risks of ENDS use while also establishing translatable biomarkers for gingival inflammation and periodontal disease in ENDS users.

Study Plan Overview

The study objectives will be met using the following sampling and analysis plan.

1. Two participant groups will be recruited. One will be never-established smokers (n=25) and the other will be current and exclusive ENDS users (n=50). Our intentions are to oversample for African Americans due to increased susceptibility to oral diseases, historical targeting by the tobacco industry, the presence of additional stressors and biological susceptibility mechanisms that may enhance risk, and past underrepresentation in research studies.
2. Participant characteristics and ENDS usage preferences and patterns will be assessed via questionnaires and mobile, real-time puff topography devices.
3. Participants will undergo a clinical assessment of periodontal and oral health and potential ENDS-induced oral health alterations. Samples collected for analysis during the clinical assessment will include exhaled carbon monoxide, saliva, gingival cell swabs, and subgingival plaque.
4. Participant characteristics, ENDS usage, and results of the clinical assessment will be integrated and analyzed via statistical analysis.
5. Collected gingival epithelial cells will be evaluated for alterations within the epithelial mesenchymal transition (EMT) pathway. These types of changes are thought to be an initiating event of periodontal disease.
6. Saliva samples will be examined via comprehensive metabolomic analysis to determine pathways and biomarkers of gingival inflammation and periodontal disease in ENDS users.

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Scientific Outcomes

01

Characterization of oral and periodontal health risks of ENDS usage.

02

Correlation of ENDS user characteristics, preferences, usage behaviors, and oral health outcomes.

03

Identification of pathways and biomarkers of gingival inflammation and periodontal disease in ENDS users.

Research Partners

Georgia State University

Purdue University

Soft Smiles, LLC