Research Article

Vaping E-Cigarette and Smoking Conventional Cigarettes are Associated with Depression Regardless of Gender, Race, and Ethnicity: Analysis of the Health Information National Trends Survey (HINTS) 2022

Shervin Assari[1,2,3*]; Sharon Cobb[3]

[1]Department of Urban Public Health, Charles R Drew University of Medicine and Science, Los Angeles, CA

[2]Department of Family Medicine, Charles R Drew University of Medicine and Science, Los Angeles, CA

[3]School of Nursing, Charles R Drew University of Medicine and Science, Los Angeles, CA

*Corresponding author: Shervin Assari

Department of Urban Public Health, Charles R Drew University of Medicine and Science, Los Angeles, CA, USA.

Email: assari@umich.edu

Abstract

Background: While previous research has explored the bidirectional relationships between smoking, vaping, and depression, limited attention has been given to examining potential gender-, race-, and ethnic- specific patterns in these associations.

Aims: This study aimed to investigate gender, race, and ethnic differences in the associations between smoking conventional and vaping e-cigarettes and depressive symptoms.

Methods: Data from the Health Information National Trends Survey (HINTS-2022) survey were analyzed, including a representative sample (probability sample) of US adults. Variables of interest included smoking status, e-cig use, depression (PHQ-4), and demographic characteristics. Binary logistic regression models were employed to assess the association between smoking and e-cig use (current and ever), and depression overall, adjusting for covariates (age, education, marital status, and employment). Statistical Package for the Social Sciences (SPSS) software was used for data analysis, using univariate, bivariate, and multivariable models. We tested potential interactions between race, ethnicity, gender, and depression.

Results: The study findings indicated significant associations between smoking, e-cig use, and depression. Individuals who were experiencing depression compared to those non-depressed were more likely to use conventional ($p<0.05$) and e-cig ($p<0.05$). However, no significant interactions were found for gender, race, or ethnicity.

Conclusions: This study suggests that the association between smoking, e-cig use, and depressive symptoms is not different by race, sex, and gender. These findings contribute to the existing literature, emphasizing the need for universal approaches to promote mental health as a tool to help individuals quit smoking and vaping, regardless of their gender, ethnicity, and race.

Background

In recent years, there has been a growing interest in understanding the relationship between smoking behavior and depressive symptoms [1]. Numerous studies have investigated the bidirectional nature of the association between depression and substance use [2], shedding light on the predictive effects of smoking on depression and vice versa [3]. However, very little research has explored group differences in the links between depressive symptoms and smoking [4]. In addition, there have been even less studies that have investigated potential gender, race, and ethnicity differences in the relationships between depression, smoking conventional cigarettes, and vaping electronic cigarettes (e-cigs) [5].

Gender, race, and ethnicity are crucial factors to consider when examining the comorbidity between smoking and depression [6]. People from diverse backgrounds may exhibit distinct

motivations for substance use [7]. They may also have different risk factors and presentation of depression [8]. Males and females also differ in patterns of smoking behavior [9], coping mechanisms [10], and responses to depression [11]. For example, some research suggests that men and women may differ in the connection between depression and smoking cigarettes or vaping e-cigs [12].

While there is some evidence on the relationship between smoking and depression [6], few studies have explored gender, race, and ethnic differences in this regard. Furthermore, with the recent trends and the increasing popularity of e-cigs [13], there is a need to investigate any potential gender differences in the association between e-cig use and depressive symptoms [14]. Given the unique characteristics of use of e-cigs compared to conventional cigarettes, it is reasonable to expect groups differences in the link between depression and alternative nicotine delivery systems [15].

Aim

To fill this gap in the literature, and our past work on groups differences in the bidirectional links between depression and substance use [16], we aimed to compare gender, race, and ethnic groups for the association between smoking conventional cigarette, vaping e-cigs, and depression. By examining these group-specific patterns, we hope to gain a deeper understanding of how group membership impacts the need for depression screening and treatment as a join component of cessation programs for smoking of conventional cigarettes or vaping e-cig of diverse groups. The findings of this study may have significant implications for designing targeted and tailored interventions and prevention strategies that simultaneously address the smoking and depressive needs of diverse populations.

Methods

This cross-sectional study utilized data from the Health Information National Trends Survey (HINTS – 2022 [17]). HINTS is a nationally representative survey conducted in the United States designed to assess various aspects of health communication, cancer knowledge, health care use, smoking behavior, e-cigarette use, and depressive symptoms [17]. The survey is administered through computer-assisted telephone interviews, ensuring a standardized data collection process [17].

The study included a representative probability sample of US adults obtained from the HINTS survey. The sample consisted of both men and women, covering a diverse range of demographic characteristics. The participants were selected through a multi-stage sampling design, incorporating both landline and mobile phone numbers to ensure adequate representation across the population [17].

The variables of interest in this study included smoking status, e-cigarette use, depressive symptoms, demographic, and Socioeconomic Status (SES) characteristics. Smoking status was assessed using self-report measures, distinguishing between current smokers and non-smokers. Separate questions were asked for conventional and e-cigarettes. E-cigarette use was evaluated by identifying individuals who reported current or ever use of e-cigarettes [18]. Depressive symptoms were measured using the Patient Health Questionnaire-4 (PHQ-4) [19], a validated screening tool that assesses symptoms of depression. A threshold of 3 or more was considered mild-to-moderate, and a score of 7 or above was considered severe depression [20]. Demographic characteristics including race, ethnicity, and gen-

der were moderators. Age and SES indicators included education, marital status, and employment were included as covariates in the analysis.

Statistical Package for the Social Sciences (SPSS) software was utilized for data analysis [21]. Univariate, bivariate, and multivariable models were employed to examine the relationships between the variables of interest and determine the significance of associations. For multivariable modeling, binary logistic regression models were employed to assess the associations between smoking conventional cigarettes or e-cigarette use and depressive symptoms. We ran binary logistic regression models overall without and with interactions terms between depression and race, ethnicity, and gender. The models were adjusted for covariates, including age, education, marital status, and employment. Substance use and depression were the outcome and predictor variables respectively. Odds Ratio, 95% CI, and p-values were reported. Statistical significance was set at p<0.05.

Results

Table 1 summarizes the data by demographic factors, socioeconomic factors, and ever and current use of e- cigarettes and conventional cigarettes. 6154 participants entered our analysis. Participants ranged in age from 18 to 99, with a mean (SD) age of 55.60 (17.4).

Table 1: Summary of the data.

	Mean	SD
Age (Years)	55.60	17.44
	N	%
Gender		
Female	3535	56.5
Male	2307	36.9
Missing	410	6.6
Full Employed		
No	3062	49.0
Yes	2778	44.4
Missing	412	6.6
Married		
No	3213	51.4
Yes	2624	42.0
Missing	415	6.6
Education		
1	387	6.2
2	1068	17.1
3	1672	26.7
4	2721	43.5
Missing	404	6.5
Hispanic		
No	5251	84.0
Yes	1001	16.0
Other Race		
No	5093	81.5
Yes	1159	18.5
Black		
No	5363	85.8
Yes	889	14.2
eCig Use Current		
No	5721	91.5
Yes	191	3.1
Missing	340	5.4
eCig Use Ever		
No	5076	81.2
Yes	836	13.4
Missing	340	5.4
Current Use of Cigarette		
No	5212	83.4
Yes	642	10.3
Missing	398	6.4
Ever Use of Cigarette		
No	3759	60.1
Yes	2095	33.5
Missing	398	6.4

Table 2 shows the summary of the logistic regressions for the associations between depression and ever and current use of e-cigarettes and conventional cigarettes. While depression was associated with higher odds of ever and current use of e-cigarettes and conventional cigarettes, these associations were not different by gender, race, and ethnicity.

Table 2: Logistic regressions for the associations between depression and ever and current use of e- cigarettes and conventional cigarettes.

	M1				M2			
	Exp(B)	95% CI		Sig.	Exp(B)	95% CI		Sig.
E-Cig Ever								
Age	.954	.949	.958	.000	.954	.949	.958	.000
Education (Diploma)	.715	.494	1.035	.076	.709	.490	1.028	.069
Education (Some_College1)	.887	.627	1.254	.497	.875	.619	1.239	.453
Education (College or More)	.481	.340	.681	.000	.475	.335	.672	.000
Male	1.373	1.166	1.617	.000	1.582	1.258	1.989	.000
Hispanic	.520	.413	.655	.000	.538	.383	.756	.000
Black	.463	.355	.603	.000	.645	.453	.919	.015
Other Race	.748	.583	.961	.023	1.018	.726	1.429	.916
Obese	.957	.809	1.133	.609	.953	.805	1.129	.578
Depressed (PHQ >=7)	2.206	1.874	2.599	.000	2.973	2.294	3.854	.000
Depressed (PHQ >=7) x Male					.747	.538	1.037	.082
Depressed (PHQ >=7) x Hispanic					.917	.587	1.434	.705
Depressed (PHQ >=7) x Black					.507	.301	.853	.010
Depressed (PHQ >=7) x Other Race					.534	.325	.875	.013
E-Cig Current								
Age	.950	.941	.959	.000	.950	.941	.959	.000
Education (Diploma)	.769	.424	1.394	.387	.761	.419	1.381	.369
Education (Some_College1)	.586	.329	1.042	.069	.579	.325	1.032	.064
Education (College or More)	.234	.129	.426	.000	.230	.126	.420	.000
Male	1.235	.903	1.690	.186	1.216	.738	2.001	.443
Hispanic	.440	.285	.681	.000	.453	.220	.932	.031
Black	.416	.245	.707	.001	.492	.216	1.117	.090
Other Race	.710	.438	1.150	.164	.931	.443	1.954	.849
Obese	1.104	.804	1.515	.541	1.101	.802	1.511	.553
Depressed (PHQ >=7)	2.349	1.699	3.246	.000	2.546	1.535	4.221	.000
Depressed (PHQ >=7) x Male					1.023	.539	1.943	.944
Depressed (PHQ >=7) x Hispanic					.950	.393	2.297	.910

Discussion

The findings of this study revealed no significant race, ethnic, and gender differences in the association between smoking, e-cig use, and depression. Specifically, the results showed a significant association between smoking conventional cigarettes and vapid e-cigarettes with depressive symptoms among all groups, regardless of their background. Anyone who is experiencing depressive symptoms is more likely to be a current smoker of conventional cigarettes or vape e-cigarettes compared to non-depressed individuals.

The results of this study are consistent with previous research that has suggested a link between smoking and depression [7]. There are, however, studies have reported a stronger association between smoking and depressive symptoms among women compared to men [6].

To further enhance our understanding of the complex relationship between smoking, e-cigarette use, depressive symptoms, and several directions for future research can be pursued. Firstly, longitudinal studies are needed to explore the temporal dynamics and causal relationships between these variables, shedding light on how changes in smoking behavior and depressive symptoms influence each other over. Secondly, mechanistic studies should delve into the biological and social mechanisms underlying the observed links. Additionally, exploring the intersectionality of race, ethnicity, and gender with socioeconomic status, and sexual orientation can provide a more nuanced understanding of the associations. Furthermore, identifying mediating and moderating factors, including stress, social support, coping strategies, self-esteem, and body image, can illuminate the mechanisms through which the smoking-depression relationship emerges. Given the limited research on group differences in the association between e-cigarette use and depressive symptoms, future studies should focus on examining this relationship in depth, considering group differences in motivations, perceptions, and patterns of cigarette smoking and e-cigarette use. Furthermore, incorporating diverse cultural contexts and populations in research can shed light on the influence of cultural norms, values, and social factors on the relationship between smoking, vaping, and depressive symptoms. By addressing these research directions, we can advance our knowledge and develop targeted interventions, policies, and public health strategies to reduce the burden of smoking-related risks and promote mental well-being among diverse populations.

This study bridged the gap in the current literature by documenting universality of the associations between conventional cigarette smoking, e-cig use, and depressive symptoms. The results pave the way for universal approaches to effectively address smoking and depression in clinical and public health settings. Lack of race, ethnic, or gender differences identified in this study may have important implications for approaches to addressing smoking cessation and mental health interventions of people across all groups [22]. Understanding that people from diverse backgrounds are similarly susceptible to the adverse effects of smoking and e-cig use on depressive symptoms and vice versa can inform universal interventions for diverse populations. It is essential to develop universal strategies that address their depression comorbidity in smokers [2]. We also need research to the underlying mechanisms driving the link.

This study has several limitations that should be acknowledged. Firstly, we relied on self-reported measures, which are subject to recall bias [23]. Additionally, the cross-sectional study

Depressed (PHQ >=7) x Black					.758	.260	2.207	.611
Depressed (PHQ >=7) x Other Race					.642	.243	1.696	.371
Cig Ever								
Age	1.022	1.018	1.025	.000	1.022	1.018	1.025	.000
Education (Diploma)	.716	.551	.930	.012	.719	.553	.933	.013
Education (Some_College1)	.749	.584	.962	.023	.752	.586	.965	.025
Education (College or More)	.355	.277	.454	.000	.356	.278	.456	.000
Male	1.380	1.226	1.553	.000	1.438	1.242	1.664	.000
Hispanic	.443	.371	.530	.000	.471	.375	.591	.000
Black	.671	.566	.795	.000	.689	.558	.850	.001
Other Race	.607	.504	.732	.000	.617	.486	.783	.000
Obese	.967	.857	1.090	.580	.966	.857	1.090	.577
Depressed (PHQ >=7)	1.672	1.477	1.894	.000	1.821	1.505	2.202	.000
Depressed (PHQ >=7) x Male					.888	.693	1.138	.348
Depressed (PHQ >=7) x Hispanic					.858	.604	1.219	.392
Depressed (PHQ >=7) x Black					.931	.656	1.321	.689
Depressed (PHQ >=7) x Other Race					.957	.655	1.398	.819
Cig Current								
Age	.995	.989	1.000	.042	.995	.989	1.000	.046
Education (Diploma)	.543	.395	.748	.000	.544	.395	.750	.000
Education (Some_College1)	.507	.374	.686	.000	.508	.375	.689	.000
Education (College or More)	.159	.115	.220	.000	.159	.115	.220	.000
Male	1.160	.970	1.387	.103	1.242	.970	1.591	.085
Hispanic	.456	.342	.609	.000	.505	.337	.757	.001
Black	1.215	.961	1.537	.103	1.140	.820	1.584	.436
Other Race	1.025	.786	1.336	.856	1.193	.826	1.722	.347
Obese	.784	.653	.941	.009	.782	.651	.939	.008
Depressed (PHQ >=7)	2.172	1.814	2.600	.000	2.402	1.804	3.198	.000
Depressed (PHQ >=7) x Male					.860	.601	1.232	.412
Depressed (PHQ >=7) x Hispanic					.821	.472	1.431	.487
Depressed (PHQ >=7) x Black					1.149	.721	1.832	.558
Depressed (PHQ >=7) x Other Race					.738	.436	1.250	.259

design limits the ability to establish causal relationships [24]. Longitudinal studies are needed to provide a more comprehensive understanding of the complex dynamics between smoking, vaping, and depression, across groups. Furthermore, the study focused on the U.S. population, and the generalizability of the findings to other cultural contexts may be limited.

Conclusions

In conclusion, this study contributes to the existing literature by highlighting no significant gender, race, or ethnic differences in the association between smoking, vaping, and depressive symptoms. The findings emphasize the need for universal, rather than gender-, race-, or ethnic-, specific approaches to promote mental health of men and women who are in smoking cessation programs. Future research should explore the underlying biological and social mechanisms driving these associations across groups. Through universal programs, we can develop more targeted and effective strategies to improve mental well-being and reduce smoking-related risks among men and women across race and ethnic groups.

References

1. Fluharty M, Taylor AE, Grabski M, Munafò MR. The association of cigarette smoking with depression and anxiety: a systematic review. Nicotine Tob Res. 2017; 19: 3-13.

2. Mathew AR, Hogarth L, Leventhal AM, Cook JW, Hitsman B. Cigarette smoking and depression comorbidity: systematic review and proposed theoretical model. Addiction. 2017; 112: 401-12.

3. Mendelsohn C. Smoking and depression: a review. Aust Fam Physician. 2012; 41: 304-7.

4. Galambos NL, Leadbeater BJ, Barker ET. Gender differences in and risk factors for depression in adolescence: A 4-year longitudinal study. Int J Behav Dev. 2004; 28: 16-25.

5. DeAtley T, Harrison A, Cassidy R, Kuo C, Higgins ST, Tidey JW. Subjective experiences, contexts, and risk perceptions of very low nicotine content cigarettes and electronic cigarettes among people with depression and anxiety disorders who smoke. Drug Alcohol Depend. 2023; 244: 109767.

6. Husky MM, Mazure CM, Paliwal P, McKee SA. Gender differences in the comorbidity of smoking behavior and major depression. Drug Alcohol Depend. 2008; 93: 176-9.

7. Waldron I. Patterns and causes of gender differences in smoking. Soc Sci Med. 1991; 32: 989-1005.

8. Piccinelli M, Wilkinson G. Gender differences in depression: critical review. Br J Psychiatry. 2000; 177: 486-92.

9. Bolego C, Poli A, Paoletti R. Smoking and gender. Cardiovasc Res. 2002; 53: 568-76.

10. Ptacek JT, Smith RE, Zanas J. Gender, appraisal, and coping: A longitudinal analysis. J Personality. 1992; 60: 747-70.

11. Chevron ES, Quinlan DM, Blatt SJ. Sex roles and gender differences in the experience of depression. J Abnorm Psychol. 1978; 87: 680-3.

12. Poulin C, Hand D, Boudreau B, Santor D. Gender differences in the association between substance use and elevated depressive symptoms in a general adolescent population. Addiction. 2005; 100: 525-35.

13. Wiernik E, Airagnes G, Lequy E, Gomajee R, Melchior M, et al. Electronic cigarette use is associated with depressive symptoms among smokers and former smokers: cross-sectional and longitudinal findings from the Constances cohort. Addict Behav. 2019; 90: 85-91.

14. Bianco CL. Rates of electronic cigarette use among adults with a chronic mental illness. Addict Behav. 2019; 89: 1-4.

15. Wade NE, Courtney KE, Doran N, Baca R, Aguinaldo LD, et al. Young adult E-cigarette and combustible tobacco users attitudes, substance use behaviors, mental health, and neurocognitive performance. Brain Sci. 2022; 12: 889.

16. Assari S, Mistry R, Caldwell CH, Zimmerman MA. Marijuana use and depressive symptoms; gender differences in African American adolescents. Front Psychol. 2018; 9: 2135.

17. Nelson DE, Kreps GL, Hesse BW, Croyle RT, Willis G, et al. The health information national trends survey (HINTS): development, design, and dissemination. J Health Commun. 2004; 9: 443-60.

18. Assari S, Mistry R, Bazargan M. Race, Educational Attainment, and E-Cigarette Use. J Med Res Innov. 2020; 4: 32892.

19. Löwe B, Wahl I, Rose M, Spitzer C, Glaesmer H, et al. A 4-item measure of depression and anxiety: validation and standardization of the Patient Health Questionnaire-4 (PHQ-4) in the general population. J Affect Disord. 2010; 122: 86-95.

20. Wicke FS, Krakau L, Löwe B, Beutel ME, Brähler E. Update of the standardization of the Patient Health Questionnaire-4 (PHQ-4) in the general population. J Affect Disord. 2022; 312: 310-4.

21. Bala J. Contribution of SPSS in social sciences research. Int J Adv Res Comput Sci. 2016; 7.

22. Bjarnason-Wehrens B, Grande G, Loewel H, Völler H, Mittag O. Gender-specific issues in cardiac rehabilitation: do women with ischaemic heart disease need specially tailored programmes? Eur J Cardiovasc Prev Rehabil. 2007; 14: 163-71.

23. Van de Mortel TF. Faking it: social desirability response bias in self-report research. Australian Journal of Advanced Nursing, The. 2008; 25: 40-8.

24. Sedgwick P. Bias in observational study designs: cross sectional studies. BMJ. 2015; 350: h1286.