Parent's Depression as a Moderator of the Association Between Offspring's Depressive Symptoms and Use of Combustible Cigarettes and Electronic Vapor Products

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Introduction

Several research teams in systematic reviews have reported a positive association between depression and cigarette smoking,[1–3] with evidence that the association may be bidirectional.[1–3] Compared with the knowledge about the association between depression and cigarette smoking, little is known about the association between depression and electronic vapor product use.[4] Two cross-sectional studies of US adults[5] and college students[6] reported a positive association between mental health problems including depression and electronic vapor product use. A recent longitudinal study among college students in Texas concluded a predictive effect of depressive symptoms on electronic vapor product use, but not vice versa.[4]

In the USA, both depressive symptoms and nicotine-containing product use, specifically electronic vapor product use, are common and emerging public health concerns among young people.[7–10] In 2016, 12.8% of US adolescents aged 12–17 and 10.9% of young adults aged 18–25 experienced a major depressive episode.[7] Electronic vapor products have been the most commonly used nicotine-containing product among US adolescents since 2014; 11.7% of US adolescents were current electronic vapor product users, while 7.6% were current cigarette smokers in 2017.[8] For young adults aged 18–24, combustible cigarette smoking is still more common than electronic vapor product use, but the prevalence of electronic vapor product use has been increasing[9]; 5.2% were current electronic vapor product users, and 13.0% were current cigarette smokers in 2015.[10] Since depressive symptoms and nicotine-containing product use are positively associated, even though the directionality is still controversial,[1–3] identification of the possible moderators of the association between these two problems is critical to identify the populations at greater risk of cigarette smoking and electronic vapor product use more accurately and to prepare better prevention strategies.

Of various influencing factors for depressive symptoms among adolescents and young adults, the presence of parents' depression is considered as a salient risk factor.[11,12] Children of parents who suffered from depression are more likely to experience depressive symptoms compared with

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their counterparts.[11,12] If this intergenerational continuity of depressive symptoms between parents and children exists, parents' depression could influence the association between children's depressive symptoms and nicotine-containing product use. However, in previous studies, the associations of depressive symptoms with cigarette smoking and electronic vapor product use were examined without considering the influence of parent's depression.[1–6] Thus, the results about the association in previous studies could be imperfect and investigations that examine the influence of parents' depression may be required.

This study examined whether the moderation effect of parent's depression on the positive association between depressive symptoms and use of combustible cigarettes and electronic vapor products among adolescents and young adults exists or not. Two major research questions were tested: (1) Are adolescents and young adults' depressive symptoms and their cigarette smoking and electronic vapor product use associated positively? (2) Are the associations of depressive symptoms with cigarette smoking and electronic vapor product use among adolescents and young adults moderated by parent's depression?

Methods

Data source

The data from the 2016 Rochester Intergenerational Study (RIGS) was used. The RIGS is an intergenerational extension of the Rochester Youth Developmental Study (RYDS) that was conducted from 1988 to 2006.[13,14] The Rochester studies aimed to examine the intergenerational continuity of problem behaviors, specifically substance use and delinquency. In 1988, 1000 adolescents (referred as generation 2 [G2]) from 7th- to 8th-grade classes in public schools in Rochester, New York, and their primary caregiver (G1) were recruited as the original sample of the RYDS.[13] Male adolescents (73%) and those who lived in high-crime neighborhoods were oversampled. In 1999, the RIGS began. The first-born child of G2 participants (G3) was included and has participated in annual interviews beginning when the child turned 8.[13] Two questions for electronic vapor product use were added to the 2016 RIGS survey, and only G3 participants who were aged 12 years or older answered the questions. Data collection and use were reviewed by the Institutional Review Board at the University at Albany.

Of the original G3 sample in the 2016 RIGS ($N = 419$), those who were under 12 years were excluded because they did not participate in the questions for electronic vapor product use ($n = 17$). A G3 participant who had missing values for electronic vapor product use variables ($n = 1$) was excluded. In addition, G2 parents who did not participate in the diagnostic interview for depression ($n = 47$) were excluded. As a result, the data of 354 G3 participants aged 12–30 years old and their parents were analyzed.

Dependent variables

G3 participants' current cigarette smoking and electronic vapor product use were measured as dichotomous variables. Those who smoked cigarettes at least one time during the past month before the interview were considered as current cigarette smokers (yes = 1, no = 0). Those who used electronic cigarettes or vapor products at least once a month in the past 12 months before the interview were considered as current electronic vapor product users (yes = 1, no = 0).

Independent variables

G3 participants' depressive symptoms were measured using a 13-item questionnaire adopted from the Center for Epidemiology Studies-Depression (CES-D) scale.[15,16] The CES-D is a

commonly used measure of depressive symptoms among community-dwelling populations. Respondents indicated how frequently they felt 11 depressive symptoms and 2 reverse-coded joyful experiences in the past 12 months. Responses included (1) never, (2) almost never, (3) sometimes, and (4) often. The standardized Cronbach's alpha for the 13 items was 0.91. An average value was calculated and higher scores indicated more frequent depressive symptoms.

G2 parent's depression was assessed using the Computerized Diagnostic Interview Schedule (CDIS)-version IV[17,18] in the RIGS diagnostic interview. The CDIS-IV is a structured questionnaire based on the Diagnostic and Statistical Manual of Mental Disorders (DSM)-version IV. The diagnostic interview was administered between April 2004 and July 2007 when the parent's age was between late 20s and early 30s. The parent who met the DSM-IV criteria for major depressive episode in his or her entire life was considered to have a history of depression (yes = 1, no = 0).

Statistical analysis

Group differences in categorical variables were tested with chi-square tests and continues variables were tested with *t* tests. Multiple logistic regression analyses were conducted to examine the association of G3 participants' depressive symptoms with their cigarette smoking and electronic vapor product use, adjusting for control variables. To test the effect modification of the G2 parent's depression on the associations of interest, an interaction term between the G2 parent's depression and the G3 participant's depressive symptoms was included in regression models.

A set of variables that were considered in previous studies were used as control variables.[1,4–6] G3 participants' demographic variables included sex (male or female), age (year), and race (African American or not). G2 parent's variables included sex (male or female), age at start of the study (year), age at birth of the G3 participant (year), and the neighborhood arrest rate (per 100 people) which was used as a sampling parameter. In general, female individuals show higher prevalence of depression than males throughout the life courses,[1,19] so the sex of both parent and child was adjusted in regression analysis. All statistical analyses were conducted using SAS, version 9.4.

Results

The data of 354 G2 parent–G3 offspring dyads were analyzed. Overall, 14.7% of G3 participants were current cigarette smokers and 5.7% were current electronic vapor product users in 2016. About 70% were African Americans and 53.4% were females. The average age of G3 participants was 20.8 years (standard deviation, SD = 3.7). For G2 parents, 38.4% were females and 15.3% reported that they suffered from depression at some point in their lifetime. The prevalence of current cigarette smoking among offspring of the parent who suffered from depression was 22.2%, while that of their counterparts was 13.3%. The prevalence of current electronic vapor product use among offspring of the parent who suffered from depression was 9.3%, while that of their counterparts was 5.0%. The average score of the CES-D scale among offspring of the parent who suffered from depression (mean, M = 1.10, SD = 0.79) was higher than that of their counterparts (M = 0.90, SD = 0.63). In bivariate analyses with chi-square and *t* tests, the differences in variables between offspring of the parent who suffered from depression and their counterparts were not statistically significant. Table 1 presents descriptive statistics of the study sample.

Parent's depression was a significant moderator on the associations of the offspring's depressive symptoms with current cigarette smoking and electronic vapor product use. The interaction between the parent's depression and the offspring's depressive symptoms was significant in regression of both current cigarette smoking ($p = 0.040$) and current electronic vapor product use ($p = 0.039$). The increase in the odds of offspring's cigarette smoking and electronic vapor product

Table 1
Descriptive statistics of study sample

	Total		Parent who suffered from depression[a]		Parent who had NOT suffered from depression		
	(*n* = 354)		(*n* = 54)		(*n* = 300)		
Variable	*n*	%/M (SD)	*n*	%/M (SD)	*n*	%/M (SD)	*p* value[b]
Parent's sex							0.1103
Male	218	61.6	28	51.8	190	63.3	
Female	136	38.4	26	48.2	110	36.7	
Parent's age at start of the study							0.7524
Year	354	14.1 (0.8)	54	14.1 (0.7)	300	14.1 (0.8)	
Parent's age at the offspring's birth							0.1297
Year	354	21.2 (3.6)	54	20.6 (3.4)	300	21.4 (3.6)	
Neighborhood arrest rate							0.3290
Per 100 people	354	4.32 (2.00)	54	4.57 (2.07)	300	4.28 (1.99)	
African American							0.0528
No	105	29.7	22	40.7	83	27.7	
Yes	249	70.3	32	59.3	217	72.3	
Offspring's sex							0.1523
Male	165	46.6	30	55.6	135	45.0	
Female	189	53.4	24	44.4	165	55.0	
Offspring's age							0.0973
Year	354	20.8 (3.7)	54	21.6 (3.5)	300	20.7 (3.7)	
Offspring's depressive symptoms							0.0764
13-item CES-D score	354	0.93 (0.66)	54	1.10 (0.79)	300	0.90 (0.63)	
Offspring's current cigarette smoking							0.0894
No	302	85.3	42	77.8	260	86.7	
Yes	52	14.7	12	22.2	40	13.3	
Offspring's current electronic vapor product use							0.2120
No	334	94.3	49	90.7	285	95.0	
Yes	20	5.7	5	9.3	15	5.0	

n = 354
M mean, *SD* standard deviation, *CES-D* Center for Epidemiology Studies-Depression scale
[a]Offspring of parent who met the criteria for major depressive episode in the Computerized Diagnostic Interview Schedule-version IV
[b]Group differences in categorical variables were tested with chi-square tests, and continues variables were tested with *t* tests

use by their depressive symptoms differed depending on the parent's history of depression whether the parent suffered from depression or not.

Based on the effect modification analysis, checking the interaction, regression models were stratified by the parent's depression. As shown in Table 2, in the combined regression models, depressive symptoms were positively associated with current cigarette smoking (adjusted odds ratio, AOR 2.25; 95% confidence interval, CI 1.36–3.74) and electronic vapor product use (AOR 2.31; 95% CI 1.13–4.73), after adjusting for parent's sex, age at start of the study, parent's age at

Table 2

Association of depressive symptoms with current cigarette smoking and electronic vapor product use by parent's history of major depressive episode

	Total			Parent who suffered from depression[a]			Parent who had NOT suffered from depression		
Variable	**AOR**	**95% CI**	*p*	**AOR**	**95% CI**	*p*	**AOR**	**95% CI**	*p*
Offspring's depressive symptoms									
Offspring's current cigarette smoking									
13-item CES-D score	*2.25*	*(1.36–3.74)*	*0.002*	*8.86*	*(1.78–43.99)*	*0.008*	1.64	(0.92–2.91)	0.094
Offspring's current electronic vapor product use									
13-item CES-D score	*2.31*	*(1.13–4.73)*	*0.022*	*8.79*	*(1.43–53.99)*	*0.019*	1.53	(0.65–3.57)	0.331

AOR adjusted odds ratio, *CI* confidence interval, *CES-D* Center for Epidemiology Studies-Depression scale (higher scores indicate more frequent depressive symptoms)

Italicized numbers indicate statistically significant results ($p < 0.05$)

[a]Offspring of parent who met the criteria for major depressive episode in the Computerized Diagnostic Interview Schedule-version IV

All other covariates were adjusted in each regression model

the offspring's birth, parent's depression, neighborhood arrest rate, race, offspring's sex, and offspring's age. However, in the stratified regression models, depressive symptoms were positively associated with current cigarette smoking (AOR 8.86; 95% CI 1.78–43.99) and electronic vapor product use (AOR 8.79; 95% CI 1.43–53.99) among only adolescents and young adults of the parent who suffered from depression, whereas no significant associations were detected among those of the parent who had not suffered from depression, after adjusting for all other covariates.

Discussion

This study examined the associations of depressive symptoms with current cigarette smoking and electronic vapor product use among adolescents and young adults, as well as the moderation effect of the parent's depression on the associations. To date, little is known about the association between depressive symptoms and electronic vapor product use among young people in the USA. In addition, the moderation effect of parent's depression on the associations of the offspring's depressive symptoms with cigarette smoking and electronic vapor product use is yet unclear. This study may be the first investigation into the moderation effect of the parent's depression on the associations found between young people's depressive symptoms and their use of nicotine-containing products. When the parent suffered from depression, adolescents and young adults who suffered from depressive symptoms more frequently were more likely to smoke cigarettes and use electronic vapor products compared with their counterparts.

Numerous studies reported a positive association between depressive symptoms and cigarette smoking.[1–3] However, the directionality of the association is still controversial because observational analyses from longitudinal studies have concluded the possibility of a bidirectional association. Theories also support both hypotheses. Individuals with depression may smoke tobacco cigarettes to alleviate their depressive symptoms.[1–3] In contrast, individuals' cigarette smoking may trigger their depressive symptoms by increasing susceptibility to stressors.[1–3,20,21] Compared with cigarette smoking, only a few research teams have reported that depressive symptoms are positively associated with electronic vapor product use.[4–6] A longitudinal study reported a predictive association of depressive symptoms with electronic vapor product use.[4] It is possible that individuals suffering from depression may use electronic vapor products to alleviate their symptoms as a self-medication method, similar with those who suffer from depression smoke tobacco cigarettes as a self-meciation.[4]

The current study also reported the positive associations of depressive symptoms with both cigarette smoking and electronic vapor product use. However, these associations were significant among only adolescents and young adults of the parent who suffered from depression. For those of the parents who had not suffered from depression, depressive symptoms were not associated with cigarette smoking and electronic vapor product use. This result was inconsistent with previous studies that simply reported a positive association between depressive symptoms and nicotine-containing product use without considering the influence of parent's depression on the association as a moderator.[1–6] The findings in this study point out examining the association of depressive symptoms with cigarette smoking and electronic vapor product use without considering the influence of parent's history of depression might produce partial results. Thus, having information about both the young people's depressive symptoms and their parents' history of major depressive episode would be helpful to identify targeted populations more accurately in cigarette smoking and electronic vapor product use prevention strategies. Additional investigations that consider the influence of the third factors including parents' depression among a larger sample of the USA are required to have a better understating about the association between depressive symptoms and nicotine-containing product use among young people in the USA. Furthermore, other parental factors significantly associated with offspring's smoking initiation, specifically parent smoking,[22] should be considered simultaneously in prevention strategies for young people's nicotine-containing product use.

There are noteworthy points regarding the prevalence of current electronic vapor product use. The prevalence of current electronic vapor product use in this study (5.7%) was lower than that in other studies. For example, a report from the National Youth Tobacco Survey documented that 11.3% of adolescents were current electronic vapor product users in 2016.[23] A longitudinal study among college students aged 18–29 years reported that prevalence of current electronic vapor product use increased from 12.3 to 14.5% in November 2014–February 2015.[4] Many studies consider individuals who used electronic vapor products at least 1 day in the past 30 days prior to the interview as current users.[4–6,23] When this criterion is used, however, the simple experimenters who tried to use any electronic vapor products just one time in the past 30 days can be included in the current user group; consequently, the prevalence of current electronic vapor product use can probably be inflated.[9] In the RIGS, the data used in this study, those who used electronic cigarettes or vapor products at least once a month in the past 12 months were defined as current users. This might affect the lower prevalence of electronic vapor product use in this study, but the simple experimenters were not included in the current user group. The measurement issue can be a challenge for behavioral health researchers and practitioners to estimate the prevalence of current users more accurately. In addition, the majority of study participants are African Americans (70.3%) who have lower prevalence of electronic vapor product use compared with both adolescents and young adults in other race/ethnic groups.[10,23] This might also affect the lower prevalence of electronic vapor product use in this study.

This study has several limitations. First, cross-sectional associations of the offspring's depressive symptoms with cigarette smoking and electronic vapor product use were analyzed; consequently, true causal associations were not determined. Second, a study sample originating from a single city was used, and this may limit generalizability. Third, self-reported variables regarding participants' depressive symptoms and electronic vapor product use in the past 12 months were used, so there might be recall bias in the measures. Forth, the survey questions for electronic vapor product use did not differentiate the types of electronic vapor products, such as flavored/nicotine-free vapors and JUUL, so it was possible that users of these specific products did not report they used electronic cigarettes or vapor products. Fifth, the exclusion of some parents who did not participate in the diagnostic interview for depression might affect the results. Sixth, this study considered only one parent's depression due to the unavailability of variables for another parent's information, specifically when the parent was an offspring's mother.[13] Seventh, the insufficient sample size in some levels of independent variables likely inflated the standard errors of the estimates that should be interpreted with caution. Lastly, other potential confounding variables, such as peer's and parent's nicotine-containing product use, were not considered due to the unavailability of variables in the data. Specifically, parent's cigarette smoking was not included in the regression analysis because an insufficient number of participants had applicable variables for parent's smoking.

Implications for Behavioral Health

Despite the limitations, this study presented a novel finding that parent's depression was a significant effect modifier on the associations of the offspring's depressive symptoms with cigarette smoking and electronic vapor product use. Adolescents and young adults suffering from depressive symptoms could be susceptible to the use of combustible tobacco cigarettes and electronic vapor products when their parent suffered from depression. This population may be in need of targeted interventions in prevention strategies. Further investigations using a larger sample of US adolescents and young adults are required to confirm the association of depressive symptoms with cigarette smoking and electronic vapor product use, as well as the influence of parent's depression on this association.

Compliance with Ethical Standards

Conflict of Interest The author declare that he has no conflict of interest.

References

1. Weinberger AH, Kashan RS, Shpigel DM, et al. Depression and cigarette smoking behavior: a critical review of population-based studies. *American Journal of Drug & Alcohol Abuse*. 2016;43(4):416–431.
2. Fluharty M, Taylor AE, Grabski M, et al. The association of cigarette smoking with depression and anxiety: a systematic review. *Nicotine & Tobacco Research.* 2016;19(1):3–13.
3. Chaiton MO, Cohen JE, O'Loughlin J, et al. A systematic review of longitudinal studies on the association between depression and smoking in adolescents. *BMC Public Health*. 2009;9(1): 356.
4. Bandiera FC, Loukas A, Li X, et al. Depressive symptoms predict current E-cigarette use among college students in Texas. *Nicotine & Tobacco Research*. 2017;19(9): 1102–1106.
5. Cummins SE, Zhu SH, Tedeschi GJ, et al. Use of e-cigarettes by individuals with mental health conditions. *Tobacco Control*. 2014;23(suppl 3):iii48–53.
6. Bandiera FC, Loukas A, Wilkinson AV, et al. Associations between tobacco and nicotine product use and depressive symptoms among college students in Texas. *Addictive Behaviors*. 2016;63:19–22.
7. Center for Behavioral Health Statistics and Quality. *2016 National Survey on Drug Use and Health: Methodological summary and definitions.* Rockville, MD: Substance Abuse and Mental Health Services Administration; 2017.
8. Wang TW, Gentzke A, Sharapova S, et al. Tobacco product use among middle and high school students — United States, 2011–2017. *Morbidity & Mortality Weekly Report.* 2018;67:629–633. https://doi.org/10.15585/mmwr.mm6722a3.
9. U.S. Department of Health and Human Services. *E-Cigarette Use among Youth and Young Adults. A Report of the Surgeon General*. Atlanta, GA: U.S. Department of Health and Human Services, Office on Smoking and Health. 2016. Available at https://www.cdc.gov/tobacco/data_statistics/sgr/e-cigarettes/. Accessed on August 8, 2018.
10. Phillips E, Wang TW, Husten CG, et al. Tobacco product use among adults — United States, 2015. *Morbidity & Mortality Weekly Report*. 2017;66:1209–1215. https://doi.org/10.15585/mmwr.mm6644a2.
11. Augustyn MB, Fulco CJ, Henry KL. Intergenerational continuity in depression: The importance of time-varying effects, maternal co-morbid health risk behaviors and child's gender. *Journal of Youth & Adolescence*. 2018;1–26.
12. Mikkonen J, Moustgaard H, Remes H, et al. Intergenerational transmission of depressive symptoms–The role of gender, socioeconomic circumstances, and the accumulation of parental symptoms. *Journal of Affective Disorders*. 2016;204:74–82.
13. Thornberry TP, Henry KL, Krohn MD, et al. Key findings from the Rochester Intergenerational Study. In: Eichelsheim VI, van de Weijer SGA, eds. *Intergenerational continuity of criminal and antisocial behavior: An international overview of current studies*. London, England: Rougledge:2018:214–234.
14. Thornberry TP. Three-generation studies: methodological challenges and promise. In: Shanahan MJ, Mortimer JT, Johnson MK, eds. *Handbook of the life course, Vol. 2*. New York, NY: Springer;2016:571–596.
15. Radloff LS. The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement*. 1977;1(3):385–401. https://doi.org/10.1177/014662167700100306.
16. Cosco TD, Prina M, Stubbs B, et al. Reliability and validity of the Center for Epidemiologic Studies Depression Scale in a population-based cohort of middle-aged US adults. *Journal of Nursing Measurement*. 2017:25(3):476–485.
17. Robins LN, Cottler LB, Bucholz KK, et al. *The Diagnostic Interview Schedule for DSM-IV (DIS-IV).* St. Louis, MO: Washington University School of Medicine; 2000.
18. Endicott J. Diagnostic interview schedule: reliability and validity. *Archives of General Psychiatry.* 1981:38(11):1300–1300.
19. Pratt L, Brody DJ. Depression in the U.S. household population, 2009–2012. *NCHS data brief 172.* 2014:1–8.
20. Boden JM, Fergusson DM, Horwood LJ. Cigarette smoking and depression: tests of causal linkages using a longitudinal birth cohort. *British Journal of Psychiatry.* 2010;196:440–446. https://doi.org/10.1192/bjp.bp.109.065912.
21. Taylor G, McNeill A, Girling A, et al. Change in mental health after smoking cessation: systematic review and meta-analysis. *BMJ*. 2014;348:g1151. https://doi.org/10.1136/bmj.g1151.
22. Fleming CB, Kim H, Harachi TW, et al. Family processes for children in early elementary school as predictors of smoking initiation. *Journal of Adolescent Health*. 2002:30(3):184–189.
23. Jamal A, Gentzke A, Hu SS, et al. Tobacco use among middle and high school students — United States, 2011–2016. *Morbidity & Mortality Weekly Report.* 2017;66:597–603. https://doi.org/10.15585/mmwr.mm6623a1.