Published in final edited form as:

Prev Med. 2009 November ; 49(5): 380–383. doi:10.1016/j.ypmed.2009.07.018.

Does the association between depression and smoking vary by body mass index (BMI) category?

Rachel Widome, PhD, MHS¹, Jennifer A. Linde, PhD², Paul Rohde, PhD³, Evette J. Ludman, PhD⁴, Robert W. Jeffery, PhD², and Gregory E. Simon, MD⁴

¹Center for Chronic Disease Outcomes Research (CCDOR), Minneapolis Veterans Affairs Medical Center and Department of Medicine, University of Minnesota School of Medicine, Minneapolis, MN

²Division of Epidemiology and Community Health, University of Minnesota, Minneapolis, MN

³Oregon Research Institute, Eugene, OR

⁴Center for Health Studies, Group Health Cooperative, Seattle, WA

Abstract

Objective—The purpose of this study was to explore how weight might influence the relationship between depression and smoking.

Methods—Data were obtained from a cross-sectional survey representative of women age 40–65 enrolled in Group Health Cooperative, a health plan serving members in Washington and northern Idaho (n = 4,640). We examined the relationships between depression and smoking in normal weight, overweight, and obese women using weighted multiple logistic regression with both minimal and full adjustment.

Results—Current depression was significantly associated with current smoking in obese women (adjusted odds ratio = 2.48, 95% confidence interval = 1.26–4.88) but not in underweight/normal or overweight women. Among ever smokers, obese women, but not other groups, were significantly less likely to have quit smoking in the past.

Conclusions—The association between smoking and depression in middle-aged women appears to be limited to the obese subset and may stem from a lesser likelihood of obese ever smokers to have quit. This population represents an important target for preventive medicine efforts.

Keywords

Tobacco use; depression; obesity; tobacco use cessation

Corresponding Author: Rachel Widome, PhD, MHS Center for Chronic Disease Outcomes Research (CCDOR) Minneapolis VA Medical Center One Veterans Drive (152/2E) Minneapolis, MN 55417 Phone: (612) 629-7726 Fax: (612) 727-5699 University widome@umn.edu.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Approval was obtained from the Group Health Institutional Review Board and the University of Minnesota Institutional Review Board before the research began.

Conflict of Interest statement

The authors declare that there are no conflicts of interest.

Introduction

There is a strong relationship between depression and tobacco use initiation (Rohde et al. 2003), progression to heavy smoking (Breslau, Novak, & Kessler 2004; Rohde et al. 2004a) and nicotine dependence (Breslau, Kilbey, & Andreski 1991; Breslau, Kilbey, & Andreski 1993; Breslau, Novak, & Kessler 2004; Rohde, Kahler, Lewinsohn, & Brown 2004a), though the dependency criteria may be driving this last association (Breslau & Johnson 2000) with the Diagnostic and Statistical Manual of Mental Disorders, Revised Third Edition criteria more weakly predicting cessation compared to Fagerstrom Test for Nicotine Dependence. The relationship between depression and tobacco use cessation, however, is less clear. While some research has found that depression is a barrier to cessation (Rohde et al. 2004b), other studies have concluded that there are similar rates of cessation in depressed and non-depressed smokers (John et al. 2004a; John et al. 2004b). Furthermore, depressive symptoms have been shown to be unrelated to readiness to quit (Prochaska et al. 2004) and one longitudinal study demonstrated that depressed smokers were no more likely than non-depressed smokers to persist in their smoking (Johnson & Breslau 2006).

Perhaps the inconsistent relations between smoking status and depression are due to differences in the characteristics of the people in the various studies. Depression is associated with both obesity and unhealthy weight-related behaviors such as physical inactivity and binge drinking (Fan et al. 2009; Strine et al. 2008). Smokers who have weight-related behavioral risk-factors (low physical activity, high dietary fat intake) appear to have greater nicotine dependence and are somewhat less likely to successfully quit smoking (Sherwood et al. 2000). Given this, the purpose of this study was to explore how weight might influence the relationship between depression and smoking in a sample of middle aged women. We hypothesized that the relationship between depression and smoking cessation may be different for those who are normal weight, overweight, and obese.

Methods

Data for this study were obtained during November 2003 - February 2005 through a population-based survey of women age 40-65 enrolled in Group Health Cooperative, a health plan serving approximately 500,000 members in Washington and northern Idaho. This sample was selected for the larger study that aims to explore depression - obesity relationships because of evidence that the association between obesity and depression is stronger in women (Istvan, Zavela, & Weidner 1992) and because both this age group and women has a relatively high risk of depression compared to other age groups (Kessler et al. 2003). The membership of Group Health Cooperative includes those enrolled through employer-purchased contracts as well as risk-sharing contracts with Medicare and Medicaid. The Group Health enrollment population is demographically representative of the Greater Seattle area's population (Simon et al. 1996). Study participants were recruited from eight clinics that served higher proportions of ethnic minorities. All women over the age of 40 in the plan are periodically invited to complete breast cancer risk questionnaires as part of the Group Health Breast Cancer Screening Program (BCSP) (Taplin et al. 1990). The survey includes self-report of height and weight from which BMI (kg/m²) was calculated. The primary goal of the survey was to assess the relationship between obesity and depression. In order to have an adequate number of women with high BMIs, women in the target age group were first stratified by BMI category to oversample women with high BMIs. All women with a BMI > 30 and 12% of those with a BMI < 30 were invited to participate. A sample of women who either did not complete BCSP or whose BMI could not be determined from the questionnaire was also recruited. The overall survey response rate was 61.5%.

Surveys were conducted by telephone and included items on height, weight, race/ethnicity (American Indian or Alaskan Native, Asian, Black or African American, Native Hawaiian or other Pacific Islander, White), age, current and past tobacco use, income, marital status (never married; widowed, divorced, or separated; married), education (less than college graduate, college graduate) moderate physical activity (number of times per week), vigorous physical activity (number of times per week) and current and past depression. Current depression was assessed using the Patient Health Questionnaire (PHQ) which uses the nine American Psychiatric Association DSM-IV (American Psychiatric Association 1994) criteria for the diagnosis of major depression, lifetime depression was assessed using a modified PHQ where questions are modified to ask about the past. Current major depression was categorized as a positive response (“More than half the days” or “Nearly all days”) to at least one of two core symptoms (depressed mood or loss of interest) and a total of five positive symptoms. Weight status was classified as: underweight = BMI < 18.5, normal = BMI 18.5 – 24.9, overweight = BMI 25 – 29.1, obese = BMI > 30. For regression analyses, “underweight” and “normal” were combined due to small numbers of underweight women. Current and ever smoking were each assessed by single items (“Do you smoke cigarettes now?”, “Have you smoked at least 100 cigarettes in your entire life?”). Those who did not report current smoking but did indicate that they had smoked in the past were categorized as former smokers. All measures were self-reported.

We used both minimally and fully adjusted multiple logistic regression models to estimate associations and 95% confidence intervals. Analyses were conducted using SAS, version 9.13 (SAS Inc., Cary, NC). To account for stratified sampling procedures and differential response rates across strata, analyses incorporated sampling weights (Cochran 1977) using SAS procedures PROC SURVEYFREQ, PROC SURVEYMEANS, and PROC SURVEYLOGISTIC.

Results

Table 1 shows descriptive statistics for all independent and dependent variables by BMI category. No BMI category was significantly more likely to include either current smokers or quitters; prevalence of lifetime and current depression increased with BMI category. When we examined the associations between current major depression and current smoking, there was a nearly significant association in the minimally adjusted model (adjusted for age and race; OR = 1.70, 95% CI = 0.99 – 2.86) and a significant association in the fully adjusted model (adjusted for age, race, education, income, marital status, moderate physical activity and vigorous physical activity; OR = 2.13, 95% CI = 1.13 – 4.03). However, Table 2 shows that in both the minimally and fully adjusted models, when stratified by BMI category, current depression was associated with current smoking in obese women only. BMI category was not associated with current smoking in any models.

Among ever smokers, having quit smoking in the past was not significantly associated with either past depression or current BMI category in either minimally adjusted or fully adjusted models (results not shown). However, when examining quitting by BMI status, obese women, but not other groups, were less likely to have quit smoking in the past if they reported current depression (Table 2).

Discussion

To our knowledge, this study is the first to examine the association between depression and smoking by BMI category. In a large sample of middle-aged women, we found current depression to be associated with current smoking only among the subset of women who were obese. Among ever smokers, obese women were much less likely have quit.

The prevalence of smoking in a population depends on 1) the probability of individuals to initiate the behavior and 2) the probability of the behavior persisting. Our results suggest that smoking cessation may be especially challenging for female smokers who are both depressed and obese. It is notable that depression did not appear to be a substantial barrier to cessation for women who are not obese.

This study has several limitations. First we are unable to assess whether our results may have been due to selection bias because data on the smoking habits or depression of non-responders were not collected. Though we have no reason to believe this was the case, it is possible that obese smokers suffering from depression may have been more likely to participate compared to obese smokers not suffering from depression. A second limitation is that height and weight were based on self-report and women tend to under-report weight (Pirie et al. 1981). However, a previously published analysis of these data found that the under-reporting of weight in both depressed and non-depressed obese women was minimal and similar in magnitude to that seen in normal weight women (Jeffery et al. 2008). A third limitation is the use of self-reported smoking data. Past research where self reported smoking was validated with biochemical markers of nicotine uptake has shown self-reported smoking to be reasonably valid, but it may underestimate actual smoking (Gorber et al. 2009). A fourth limitation is the relatively small number of non-obese women, as evidenced by the wide confidence intervals around these estimates in Table 2. For this reason, these estimates should be viewed as imprecise and future research is needed to better categorize the associations between smoking, depression, and obesity in these weight groups.

Though we cannot know which way causality might flow from this exploratory analysis of cross-sectional data, it appears that the combination of both depression and obesity is associated with a lower likelihood that a woman who has been a smoker will be able to quit. Future research should examine depression and tobacco use by weight category longitudinally. Additionally, research that includes measures of smoking intensity and menopausal status could provide greater insight. Tobacco cessation may be especially difficult for those who are both depressed and obese due to compounding burdens and/or a greater nicotine dependency in this population. Since health risk behaviors do tend to cluster (Klesges et al. 1990; Shah et al. 1993) and because tobacco use and obesity are leading risk factors for chronic disease, this population represents an important target for preventive medicine efforts.

Acknowledgments

This research was supported by NIMH grant R01 MH068127. R. Widome was supported by center funding for the Healthy Youth Development Prevention Research Center, cooperative agreement 1 U48 DP000063-02 from the Centers for Disease Control and Prevention. The views expressed in this article are those of the authors and do not necessarily reflect the position or policy of the Department of Veterans Affairs or the United States government.

References

- American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. 4th ed. Vol. 4th edn. American Psychiatric Association; Washington, DC: 1994.
- Breslau N, Johnson EO. Predicting smoking cessation and major depression in nicotine-dependent smokers. *Am J Public Health* 2000;90(7):1122–1127. [PubMed: 10897192]
- Breslau N, Kilbey M, Andreski P. Nicotine dependence, major depression, and anxiety in young adults. *Arch Gen Psychiatry* 1991;48(12):1069–1074. [PubMed: 1845224]
- Breslau N, Kilbey MM, Andreski P. Vulnerability to psychopathology in nicotine-dependent smokers: an epidemiologic study of young adults. *Am J Psychiatry* 1993;150(6):941–946. [PubMed: 8494073]
- Breslau N, Novak SP, Kessler RC. Psychiatric disorders and stages of smoking. *Biol Psychiatry* 2004;55(1):69–76. [PubMed: 14706427]
- Cochran, W. Sampling techniques. Wiley; New York: 1977.

- Fan AZ, Strine TW, Huang Y, Murray MR, Musingo S, Jiles R, Mokdad AH. Self-rated depression and physician-diagnosed depression and anxiety in Florida adults: Behavioral Risk Factor Surveillance System, 2006. *Prev Chronic Dis* 2009;6(1):A10. [PubMed: 19080016]
- Gorber SC, Schofield-Hurwitz S, Hardt J, Levasseur G, Tremblay M. The accuracy of self-reported smoking: a systematic review of the relationship between self-reported and cotinine-assessed smoking status. *Nicotine Tob Res* 2009;11(1):12–24. [PubMed: 19246437]
- Istvan J, Zavela K, Weidner G. Body weight and psychological distress in NHANES I. *Int J Obes Relat Metab Disord* 1992;16(12):999–1003. [PubMed: 1335980]
- Jeffery RW, Finch EA, Linde JA, Simon GE, Ludman EJ, Operskalski BH, Rohde P, Ichikawa LE. Does clinical depression affect the accuracy of self-reported height and weight in obese women? *Obesity (Silver Spring)* 2008;16(2):473–475. [PubMed: 18239662]
- John U, Meyer C, Rumpf HJ, Hapke U. Depressive disorders are related to nicotine dependence in the population but do not necessarily hamper smoking cessation. *J Clin Psychiatry* 2004a;65(2):169–176. [PubMed: 15003069]
- John U, Meyer C, Rumpf HJ, Hapke U. Smoking, nicotine dependence and psychiatric comorbidity--a population-based study including smoking cessation after three years. *Drug Alcohol Depend* 2004b;76(3):287–295. [PubMed: 15561479]
- Johnson EO, Breslau N. Is the association of smoking and depression a recent phenomenon? *Nicotine Tob Res* 2006;8(2):257–262. [PubMed: 16766418]
- Kessler RC, Berglund P, Demler O, Jin R, Koretz D, Merikangas KR, Rush AJ, Walters EE, Wang PS. The epidemiology of major depressive disorder: results from the National Comorbidity Survey Replication (NCS-R). *JAMA* 2003;289(23):3095–3105. [PubMed: 12813115]
- Klesges RC, Eck LH, Isbell TR, Fullerton W, Hanson CL. Smoking status: effects on the dietary intake, physical activity, and body fat of adult men. *Am J Clin Nutr* 1990;51(5):784–789. [PubMed: 2333836]
- Pirie P, Jacobs D, Jeffery R, Hannan P. Distortion in self-reported height and weight data. *J Am Diet Assoc* 1981;78(6):601–606. [PubMed: 7252014]
- Prochaska JJ, Rossi JS, Redding CA, Rosen AB, Tsoh JY, Humfleet GL, Eisendrath SJ, Meisner MR, Hall SM. Depressed smokers and stage of change: implications for treatment interventions. *Drug Alcohol Depend* 2004;76(2):143–151. [PubMed: 15488338]
- Rohde P, Kahler CW, Lewinsohn PM, Brown RA. Psychiatric disorders, familial factors, and cigarette smoking: II. Associations with progression to daily smoking. *Nicotine Tob Res* 2004a;6(1):119–132. [PubMed: 14982696]
- Rohde P, Kahler CW, Lewinsohn PM, Brown RA. Psychiatric disorders, familial factors, and cigarette smoking: III. Associations with cessation by young adulthood among daily smokers. *Nicotine Tob Res* 2004b;6(3):509–522. [PubMed: 15203785]
- Rohde P, Lewinsohn PM, Brown RA, Gau JM, Kahler CW. Psychiatric disorders, familial factors and cigarette smoking: I. Associations with smoking initiation. *Nicotine Tob Res* 2003;5(1):85–98. [PubMed: 12745510]
- Shah M, French SA, Jeffery RW, McGovern PG, Forster JL, Lando HA. Correlates of high fat/calorie food intake in a worksite population: the Healthy Worker Project. *Addict Behav* 1993;18(5):583–594. [PubMed: 8310877]
- Sherwood NE, Hennrikus DJ, Jeffery RW, Lando HA, Murray DM. Smokers with multiple behavioral risk factors: how are they different? *Prev Med* 2000;31(4):299–307. [PubMed: 11006054]
- Simon GE, VonKorff M, Barlow W, Pabiniak C, Wagner E. Predictors of chronic benzodiazepine use in a health maintenance organization sample. *J Clin Epidemiol* 1996;49(9):1067–1073. [PubMed: 8780618]
- Strine TW, Mokdad AH, Dube SR, Balluz LS, Gonzalez O, Berry JT, Manderscheid R, Kroenke K. The association of depression and anxiety with obesity and unhealthy behaviors among community-dwelling US adults. *Gen Hosp Psychiatry* 2008;30(2):127–137. [PubMed: 18291294]
- Taplin SH, Thompson RS, Schnitzer F, Anderman C, Immanuel V. Revisions in the risk-based Breast Cancer Screening Program at Group Health Cooperative. *Cancer* 1990;66(4):812–818. [PubMed: 2386908]

Table 1

Description of the sample by weight category. November 2003 - February 2005, Group Health Cooperative, USA.

										obese		overweight		normal weight		underweight		overall	
Categorical variables:																			
		n	weighted n	%	n	weighted n	%	n	weighted n	n	weighted n	%	n	weighted n	%	n	weighted n	n	p-value*
Ever smoker	no	11	30.0	60.2	370	1046.0	58.3	388	637.7	1735	791.3	52.7	1735	637.7	52.7	2504	791.3	2504	0.053
	yes	7	19.8	39.8	265	746.9	41.7	337	573.2	1483	745.8	47.3	1483	573.2	47.3	2092	745.8	2092	
Current smoker	no	15	41.2	82.7	576	1635.0	91.0	656	1104.0	2911	1369.0	90.9	2911	1104.0	90.9	4158	1369.0	4158	0.37
	yes	3	8.6	17.3	60	160.9	9.0	70	110.1	308	168.6	9.1	308	110.1	9.1	441	168.6	441	
Quitter (among ever smokersno only)	no	3	8.6	43.6	59	158.3	21.2	68	105.0	302	166.5	18.3	302	105.0	18.3	432	166.5	432	0.28
	yes	4	11.2	56.4	206	588.6	78.8	269	468.3	1181	579.2	81.7	1181	468.3	81.7	1660	579.2	1660	
Current depression	no	19	52.9	100	630	1779.0	98.2	697	1151.0	3015	1420.0	93.7	3015	1151.0	93.7	4361	1420.0	4361	<.001
	yes	0	0.0	0	12	32.3	1.8	35	77.8	229	125.6	6.3	229	77.8	6.3	276	125.6	276	
Lifetime depression	no	19	52.9	100	620	1753.0	96.9	682	1125.0	2933	1376.0	92.2	2933	1125.0	92.2	4254	1376.0	4254	<.001
	yes	0	0.0	0.0	21	55.5	3.1	47	95.6	310	169.3	7.8	310	95.6	7.8	378	169.3	378	
Race	American Indian or Alaskan Native	0	0.0	0.0	7	21.3	1.2	23	19.4	162	73.2	4.7	162	19.4	1.6	192	73.2	192	<.001
	Asian	5	13.2	23.9	66	182.6	10.1	48	97.1	99	51.6	3.3	99	97.1	7.9	218	51.6	218	
Marital status	Black or African American	1	3.0	5.5	25	64.7	3.6	53	87.8	351	166.9	10.8	351	87.8	7.2	430	166.9	430	
	Native Hawaiian or Other Pacific Islander	1	3.0	5.5	5	14.2	0.8	7	7.3	20	15.7	1.0	20	7.3	0.6	33	15.7	33	
	White	13	36.1	65.1	541	1532.0	84.4	600	1017.0	2612	1239.0	80.1	2612	1017.0	82.8	3766	1239.0	3766	
	never married, or divorced, or separated	5	14.7	27.9	51	144.6	8.0	67	109.6	421	205.4	13.3	421	109.6	8.9	544	205.4	544	<.001
College graduate	married	3	8.1	15.4	136	375.5	20.7	172	292.6	887	433.4	28.0	887	292.6	23.8	1198	433.4	1198	
	no	11	30.0	56.7	457	1295.0	71.3	493	829.1	1937	907.6	58.7	1937	829.1	67.3	2898	907.6	2898	
	yes	6	17.3	31.2	153	410.5	22.8	256	409.5	1519	713.5	46.2	1519	409.5	33.3	1934	713.5	1934	<.001
		14	38.1	68.8	487	1394.0	77.2	476	819.1	1723	831.8	53.8	1723	819.1	66.7	2700	831.8	2700	
Continuous variables:																			
		n	Mean	SE	n	Mean	SE	n	Mean	n	Mean	SE	n	Mean	SE	Mean	SE	Mean	p-value^
Age		20	50.4	1.6	644	51.6	0.3	733	53.0	3245	52.0	0.2	3245	52.0	0.2	52.1	0.2	52.1	0.15
Monthly income		10	3028.5	309.4	492	3737.7	110.8	531	3780.8	2444	3409.3	74.8	2444	3409.3	145.3	3631.3	74.8	3631.3	0.024
Times/week moderate physical activity		18	6.3	1.1	639	6.6	0.1	729	5.5	3234	4.5	0.1	3234	4.5	0.2	5.6	0.1	5.6	<.001
Times/week vigorous physical activity		18	3.8	0.9	640	5.0	0.2	728	3.9	3235	2.6	0.1	3235	2.6	0.2	3.9	0.1	3.9	<.001

Note: Due to small cell counts in the underweight category, underweight and normal weight categories were combined for statistical tests. Totals for each category range from 4,596 to 4,640 due to missing data on certain survey items.

* Rao-Scott Chi square test for differences between BMI categories

^ Weighted t-test for differences between BMI categories

Table 2

Associations between current depression and current smoking and quitting smoking by weight status. November 2003 - February 2005, Group Health Cooperative, USA.

	Model 1 [*]				Model 2 [^]					
	n	n weighted	Prevalence of current smoking or quitting smoking in depressed (weighted %)	Prevalence of current smoking or quitting smoking in non-depressed (weighted %)	OR	95% CI	n	n weighted	OR	95% CI
Associations between current depression and current smoking:										
underweight/normal	650	1835.9	1.30	3.82	1.07	0.12	449	1415.2	1.52	0.15
overweight	724	1213.3	2.38	2.40	0.91	0.20	527	894.7	1.78	0.41
obese	3216	1536.4	11.26	3.26	2.46 ^a	1.39	2439	1158.2	2.48 ^b	1.26
Ever smokers: associations between current depression and having quit smoking in the past:										
underweight/normal	272	761.6	2.57	8.33	0.75	0.07	212	601.8	0.7	0.07
overweight	337	573.2	4.71	5.05	1.17	0.25	241	421.8	0.75	0.17
obese	1482	745.4	21.99	7.14	0.40 ^c	0.21	1114	558.5	0.43 ^d	0.20

Note: The Breslow-Day test of homogeneity of the depression and current smoking relationship across weight category strata had $p = 0.09$. The Breslow-Day test of homogeneity of depression and quitting smoking relationship across weight category strata had $p = 0.11$.

In this sample of middle-aged women ($n=4,640$), smoking and depression were associated only in obese women. It may stem from a lifetime lesser likelihood of obese smokers to have quit.

* Model 1 is adjusted for age and race

^ Model 2 is adjusted for age, race, education, income, marital status, moderate physical activity and vigorous physical activity