



Published in final edited form as:

J Dual Diagn. 2013 January 1; 9(1): 39–46. doi:10.1080/15504263.2012.749829.

Cigarette Smoking and Health Characteristics in Individuals With Serious Mental Illness Enrolled in a Behavioral Weight Loss Trial

Faith B. Dickerson, Ph.D., M.P.H.,

Sheppard Pratt, 6501 N. Charles St., Baltimore, MD 21204. fdickerson@sheppardpratt.org

Airong Yu, M.S.,

Johns Hopkins Medical Institutions, Welch Center for Prevention, Epidemiology and Clinical Research, Baltimore, MD, ayu15@jhmi.edu

Arlene Dalcin, RD, LDN,

Department of Medicine, Johns Hopkins University School of Medicine, Baltimore, MD, adalcin1@jhmi.edu

Gerald J. Jerome, Ph.D.,

Department of Medicine, Johns Hopkins University School of Medicine, Baltimore, MD

Department of Kinesiology, Towson University, Towson, MD, gjerome@towson.edu

Joseph V. Gennusa III, Ph.D., R.D., L.D.N.,

Department of Medicine, Johns Hopkins University School of Medicine, Baltimore, MD, jgennus1@jhmi.edu

Jeanne Charleston, B.S.N., R.N.,

Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, jeannec@jhmi.edu

Rosa M. Crum, M.D., M.H.S.,

Welch Center for Prevention, Epidemiology, and Clinical Research, Johns Hopkins University, Baltimore, MD

Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD

Department of Mental Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD

Department of Psychiatry and Behavioral Sciences, Johns Hopkins University School of Medicine, Baltimore, MD, rcrum@jhsph.edu

Leslie Campbell, B.A.,

DISCLOSURES

Authors Dickerson, Yu, Gennusa, Crum, Campbell, Oefinger, and Daumit report no financial relationships with commercial interests. Author Appel receives research support from McCormick's Foundation, and honoraria from Unilever, Culinary Institute of America, American Heart Association, and American Society of Nephrology. Authors Dalcin, Jerome, Charleston, and Appel make the following disclosure: Healthways, Inc. developed the website for both interventions used in the POWER trial in collaboration with Johns Hopkins investigators and provided coaching effort for the transtelephonic intervention. Healthways also provided some research funding to supplement NIH support. Under an institutional consulting agreement with Healthways, the Johns Hopkins University received fees for advisory services to Healthways during the POWER trial. Faculty members who participated in the consulting services received a portion of the University fees. On the basis of POWER trial results, Healthways developed and is commercializing a weight-loss intervention program called Innergy.tm Under an agreement with Healthways, Johns Hopkins faculty monitor the Innergy program's content and process (staffing, training, and counseling) and outcomes (engagement and weight loss) to ensure consistency with the corresponding arm of the POWER Trial. Johns Hopkins receives fees for these services and faculty members who participate in the consulting services receive a portion of these fees. Johns Hopkins receives royalty on sales of the Innergy program.

Welch Center for Prevention, Epidemiology, and Clinical Research, Johns Hopkins University, Baltimore, MD

Department of Medicine, Johns Hopkins University School of Medicine, Baltimore, MD, lcampbel@jhmi.edu

Meghan Oefinger, B.S.,

Department of Medicine, Johns Hopkins University School of Medicine, Baltimore, MD, moefing1@jhmi.edu

Lawrence J. Appel, M.D., M.P.H., and

Welch Center for Prevention, Epidemiology, and Clinical Research, Johns Hopkins University, Baltimore, MD

Department of Medicine, Johns Hopkins University School of Medicine, Baltimore, MD

Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, lappel@jhmi.edu

Gail L. Daumit, M.D., M.H.S.

Welch Center for Prevention, Epidemiology, and Clinical Research, Johns Hopkins University, Baltimore, MD

Department of Medicine, Johns Hopkins University School of Medicine, Baltimore, MD

Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD

Department of Health Policy and Management, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD

Department of Psychiatry, Johns Hopkins University School of Medicine, Baltimore, MD

Department of Mental Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, gdaumit@jhmi.edu

Abstract

Objective: Cigarette smoking is the most preventable cause of disease and death in the US. We examined the prevalence of smoking and the association between smoking status and health characteristics in persons with serious mental illness. **Methods:** A total of 291 overweight or obese adults with serious mental illness were enrolled in a behavioral weight loss trial. Cigarette smoking, co-occurring medical diagnoses, dietary intake, blood pressure, cardiovascular fitness, body mass index, quality of life, and psychiatric symptoms were assessed at baseline in 2008–2011. Fasting glucose and lipid markers were measured from blood samples. Cardiovascular risk profile was calculated based on the global Framingham Health Study Risk Equation. **Results:** A total of 128 (44%) of participants were current smokers or had smoked in the previous one year. The smokers had significantly higher diastolic blood pressure and blood triglyceride levels, and lower HDL cholesterol than the nonsmokers, adjusted for age, sex, education, and diagnosis. They were more likely to have a history of emphysema, and had a 10-year cardiovascular disease risk of 13.2%, significantly higher than the 7.4% in the nonsmokers. The smokers also had elevated ratings of psychopathology on the BASIS-24 scale. Smokers did not differ from nonsmokers in cardiovascular fitness, body mass index, depression, quality of life, or other comorbid medical diagnoses. There was no characteristic in which smokers appeared healthier than nonsmokers. **Conclusions:** The prevalence of smoking in this contemporary cohort of individuals with serious mental illness who were motivated to lose weight was more than twice that in the overall population. Smokers had more indicators of cardiovascular disease and poorer mental health than did nonsmokers. The high burden of comorbidity in smokers with serious mental illness indicates a need for broad health interventions.

Keywords

smoking; health; cardiovascular; serious mental illness; weight loss

Cigarette smoking is the single most preventable cause of disease, disability, and death in the United States (CDC, 2011). Compared with persons in the overall population, persons with serious mental illness, such as schizophrenia and bipolar disorder, are much more likely to smoke cigarettes (De Leon & Diaz, 2011; Compton et al., 2006). They are also more likely to be heavy smokers and to have longer histories of smoking (Williams et al., 2005; Tidey et al., 2005). Due in part to the high prevalence of smoking, persons with schizophrenia have double the risk for cardiovascular mortality compared with persons in the overall population (Curkendall et al., 2004).

In general, cigarette smoking is associated with increases in serum total cholesterol, low density lipoprotein cholesterol (LDL) and triglycerides as well as with decreases in the levels of high density lipoprotein cholesterol (HDL) (Erhardt, 2009; Gossett et al., 2009). In addition, cigarette smoking is associated with an increased risk of type 2 diabetes, which is also a risk factor for cardiovascular disease (Willi et al., 2007). Moreover, smoking may contribute to elevated blood pressure (Chelland et al., 2008). Although it is well established that cigarette smoking occurs disproportionately among persons with serious mental illnesses (De Leon and Diaz, 2011), the association between cigarette smoking and specific cardiovascular markers of disease and disease risk in this population has received scant attention.

One recent study of outpatients with schizophrenia in Spain found that smokers had a greater coronary heart disease event risk than nonsmokers (Bobes et al., 2010). However, the two groups did not differ significantly in lipid levels, blood pressure, body mass index (BMI), or other cardiovascular related markers. Another recent study of individuals with schizophrenia, from the US, found that smoking contributed to the elevated coronary heart disease event risk of the schizophrenia group compared to matched persons in the overall population; however, a direct comparison of the risk factors of the smokers and nonsmokers in the study population was not presented (Goff et al., 2005).

The association between cigarette smoking and psychiatric symptoms has also been the focus of investigation. Most studies have shown that cigarette smoking in persons with serious mental illness is associated with worse mental health outcomes (Dixon et al., 2007; Ziedonis et al., 2008; de Leon & Diaz, 2011; Bobes et al., 2010), though most of these studies have been carried out in schizophrenia samples rather than serious mental illness more broadly. Cigarette smoking has also been associated with abuse of other substances in persons with mental illness (Montoya et al., 2005; Ziedonis et al., 2005; Margolese et al., 2004; Bobes et al., 2010).

One limitation of the research literature is that many of the studies were performed more than a decade ago before the broad public health campaign to restrict smoking in public places, including health care settings, and the beginning of efforts to address smoking among persons with serious mental illness.

The purpose of this investigation was to study individuals with serious mental illness who were enrolled in a behavioral weight loss trial at community-based psychiatric rehabilitation programs in Maryland to determine: 1) the prevalence and severity of cigarette smoking in this contemporary cohort; 2) the association between current cigarette smoking and health characteristics and cardiovascular risk; and 3) the association between cigarette smoking and psychiatric and behavioral symptoms.

METHODS

Participants

Study participants were adults with serious mental illness who were enrolled in a randomized clinical trial of a behavioral weight loss intervention at psychiatric rehabilitation programs in Maryland, ACHIEVE (Casagrande et al., 2010). Inclusion criteria were: enrollment at a psychiatric rehabilitation program or affiliated clinic, which defined the individual as having serious mental illness (a diagnosable mental, behavioral or emotional disorder meeting criteria specified within DSM-IV, with the exception of substance use disorders and developmental disorders, and with functional impairment secondary to the disorder); age 18 and older; overweight, defined by BMI of at least 25.0 kg/m²; able and willing to give informed consent and participate in the intervention; prescribed the same psychiatric medications during the 30 days before baseline weight; and able to attend at least two intervention sessions per week. Exclusion criteria included: contraindication to weight loss such as receiving active cancer treatment; cardiovascular event within the past six months; prior or planned bariatric surgery; use of prescription weight loss medication within three months; twenty pound or greater weight loss in three months prior to baseline; inability to walk to participate in exercise class; pregnant or planning a pregnancy; and alcohol or substance use disorder, defined as either actively using substances per self report or determined to be incompatible with participation in the intervention through discussion with rehabilitation program staff. Of note, persons were enrolled in the study without regard to their smoking status. Participants were interviewed and assessed at the time of their recruitment to the trial before they were assigned to active or control study condition in the period between October 14, 2008 and February 10, 2011.

There was a complete discussion of the study with potential participants. Written informed consent was obtained after this discussion. The IRB of the Johns Hopkins School of Medicine and the Sheppard Pratt Foundation approved and monitored the study.

Measures

Cigarette smoking was assessed with queries concerning current smoking, age of initiating smoking, number of cigarettes smoked currently and during the entire period that the person smoked. We defined individuals as smokers if they smoked any cigarette within the past one year (“Do you smoke cigarettes now or did you quit smoking less than one year ago?”). Persons categorized as nonsmokers were those who had never smoked or those who had previously smoked but had quit prior to one year before study enrollment; patients were categorized as nonsmokers only if they had been smoke free for one year given the high rate of recidivism of smoking in this population (Ziedonis et al., 2008).

We also measured body weight and height, from which BMI (kg/m²) was calculated. Blood pressure was measured with the OMRON HEM-907 digital device, which records blood pressure using a standard oscillometric technique (Appel et al., 2005; White et al., 2001; Vollmer et al., 2005)

Cardiorespiratory fitness was measured during submaximal bicycle ergometry testing using four 3-minute stages with increasing workloads (resistance: 0 kg, 1 kg, 2 kg, 3 kg) while maintaining a steady cadence of 50 revolutions per minute. The participants were acclimated to the bicycle and the appropriate cadence with a brief (less than three minutes) warm up at zero resistance. Tests were terminated at the completion of all four stages, volitional fatigue, achieving 85% of the predicted maximal heart rate (220 minus age), two stages with diastolic blood pressure at 110 bpm or higher, or identification of signs and symptoms contraindicated for submaximal testing. We measured total exercise time excluding warm-

up. This submaximal protocol was selected as the participants were expected to have low fitness levels.

Each participant also had a fasting blood sample drawn that was tested for total cholesterol, LDL cholesterol, HDL cholesterol, triglycerides, and fasting glucose.

Co-occurring medical diagnoses of diabetes, hypertension, and hypercholesterolemia were determined by self-report, laboratory blood measures, and medication status. Participants were categorized as having diabetes if their fasting glucose was 126mg/ml or higher, or if they were currently using oral hypoglycemic agents or insulin. Hypertension was defined as mean systolic blood pressure of 140 mmHg or higher, diastolic blood pressure of 90 or higher, or use of anti-hypertensive medication. Hypercholesterolemia was defined as LDL cholesterol of 130 mg/dl or higher, or use of cholesterol treating medication. A history of other comorbid medical conditions (e.g., emphysema, asthma, hepatitis, seizure disorder, stroke) was determined by self-report.

Cardiovascular risk profile was calculated for each participant based on the Framingham Heart Study Risk Equation (D'Agostino et al., 2008; Framingham Health Study). The variables in this model are: age, total cholesterol, HDL cholesterol, systolic blood pressure, drug treatment for hypertension, smoking, and diabetes status.

Dietary intake was measured with the one-page Food Screener questionnaire (Block et al., 2000).

Psychiatric and behavioral symptoms were measured from interview-administered instruments: the EuroQoL-5 Dimensions (EQ-5D), a brief 5-item quality of life instrument (Bobes et al., 2005); the Medical Outcomes Study Short Form Health Survey (SF-12), measuring health status in physical health and mental health domains (Jenkinson et al., 1997); the revised Behavior and Symptom Identification Scale (BASIS-24), a 24-item mental health status measure assessing six domains (depression/functioning, difficulty in interpersonal relationships, self-harm, emotional lability, psychotic symptoms, and substance abuse) (Eisen et al., 2004), and the Center for Epidemiologic Studies Depression Scale (CES-D) to measure current depression (Radloff, 1977). The primary psychiatric diagnosis was obtained from the medical record.

Statistical analyses

We compared the smokers to the nonsmokers on sociodemographic characteristics, health characteristics, cardiovascular risk, and psychiatric and behavioral measures. For the sociodemographic characteristics, categorical variables were compared with chi-square tests and continuous variables were compared by independent t-tests. Logistic regression and multiple linear regression analyses were used to determine the association between health, cardiovascular, psychiatric and behavioral variables with smoking status after adjusting for age, sex, education and diagnosis. Wald chi-square statistics or *F* statistics with *p* values are reported. A two-sided alpha level of 0.05 was used for all testing. All analyses were conducted with SAS, version 9.3.

RESULTS

Prevalence and severity of cigarette smoking

A total of 291 individuals were enrolled in the ACHIEVE Trial. Of these, 128 (44%) reported at baseline that they had smoked at least one cigarette in the past year and therefore are defined here as smokers, and 163 (56%) reported that they were nonsmokers. Of the 128 persons classified as smokers, 116 were smokers at the time of the assessment and 12 had

quit in the past year. Of the 163 nonsmokers, 123 reported that they never smoked, and 40 stated that they were former smokers but quit more than one year ago. A total of 52 persons in the sample indicated that they had successfully quit smoking; this number presents 18% of the total sample and 31% of the ever smokers in the sample.

Demographic and clinical characteristics of the smokers and the nonsmokers are shown in Table 1. Current smokers were more likely to be male than the nonsmokers ($\chi^2=3.77$, $p=0.05$). There was also a significant association between smoking status and education ($\chi^2=6.41$, $p=0.04$) with more current smokers than nonsmokers having less than high school education. Smoking status was also significantly associated with psychiatric diagnosis ($\chi^2=10.43$, $p=0.02$) with a higher percentage of smokers than nonsmokers with a diagnosis of schizophrenia and bipolar disorder and a lower percentage with major depression. Smoking status was not associated with age or race.

Among the 128 smokers, the mean age of first smoking was 15.5 ($SD=5.4$, range = 5–53). The age of initiating smoking did not differ significantly between the smokers and the nonsmokers who previously smoked. Among the smokers who were currently smoking, the average amount of cigarettes smoked per day was 15.8 ($SD=9.5$, range 2–42, $n=116$). The nonsmokers who previously smoked reported that they smoked on average 19 cigarettes per day ($SD=13.7$, range 1 – 60) during the time that they smoked. The nonsmokers who previously smoked were significantly older than the current smokers ($M= 51.5$, $SD=8.6$, years vs. $M= 44.5$, $SD=10.6$, years, $F=14.4$, $p < 0.001$).

The association between smoking, health characteristics and cardiovascular risk

As shown in Table 2, we found that the smokers had significantly elevated diastolic blood pressure compared with the nonsmokers ($F=3.74$, $p=0.05$). We also found that the smokers had significantly lower HDL cholesterol and elevated triglycerides ($F=8.01$, $p=0.005$; $F=7.72$, $p=0.006$) compared with the nonsmokers. In addition, the smokers were at increased 10-year risk of cardiovascular disease as assessed by the Framingham Heart Study Risk Equation. Smokers had a mean risk of 13.2 % of having a cardiovascular event in the next 10 years vs. 7.4 % in the nonsmokers. When smoking was removed from the cardiovascular risk calculation, the risk in both groups was similar (7.6 in the smokers and 7.4 in the nonsmokers).

There was no significant difference between smokers and nonsmokers in weight, BMI, waist circumference, systolic blood pressure, total cholesterol, LDL cholesterol, fasting glucose, exercise time on the cycle ergometer sub-maximal test, or in the prevalence of diabetes, hypertension, or hypercholesterolemia.

In terms of lifetime history of comorbid conditions, smokers had a significantly higher prevalence of emphysema than nonsmokers ($\chi^2=8.63$, $p=0.003$) as shown in Table 2. The groups did not differ significantly in the proportion who had high blood pressure, diabetes mellitus, asthma, hepatitis, seizure disorder, or stroke. Fewer than 10 participants reported kidney disease, cancer, heart attack, heart failure, or peripheral vascular disease so meaningful comparisons were not possible.

Also as shown in Table 2, responses to the dietary questionnaire indicated that the smokers had a lower number of fruit and vegetable servings per day indicating poorer dietary intake. The daily nutrient intake of total fat, saturated fat, percent fat, and dietary cholesterol did not significantly differ between groups.

The association between smoking and psychiatric and behavioral symptoms

As shown in Table 3, smokers had a lower score on the SF-12 mental health scale than nonsmokers indicating poorer mental health ($F=6.97, p=0.01$). There was not a significant difference between groups on the SF-12 physical health scale.

On the BASIS-24, the smokers had worse scores on the difficulty in interpersonal relationships subscale, the psychotic symptoms scale, the substance abuse subscale, and the overall score ($F=4.96, p=0.03$; $F=3.90, p=.05$; $F=16.03, p < 0.001$; $F=4.64, p=.03$) but not on the subscales measuring depression functioning, self-harm, or emotional lability. There were not any significant between group differences on the CES-D or the EQ-5D measuring current depression and quality of life, respectively.

DISCUSSION

In this contemporary cohort of non-institutionalized persons with serious mental illness, 44% were smokers. This prevalence is more than double that in the US overall population where the proportion of adults who smoke has declined to less than 20% (CDC, 2011). The daily consumption of cigarettes by smokers in our cohort was also greater than among current smokers in the overall population (American Lung Association, 2011). Our results are thus consistent with earlier studies showing that persons with serious mental illness are more likely to be smokers and to be heavy smokers and thus disproportionately vulnerable to the adverse effects of smoking.

When comparing the smokers to the nonsmokers in our sample, we found that the smokers had more indicators of cardiovascular disease. The 10-year cardiovascular risk was 13.2% in the smokers vs. 7.4% in the nonsmokers. Our results are consistent with those of Bobes et al. (2010) who also showed a higher 10-year cardiovascular risk in smokers than nonsmokers with serious mental illness. However, unlike in the Bobes study, we found other differences in cardiovascular risk factors between smokers and nonsmokers not found in their study. Differences in the study populations may account for some of these disparate results. The mean BMI of the total Bobes sample was in the overweight range ($M= 27.8, SD=4.9$) where our participants were obese on average; the Bobes sample was also younger than our sample.

Removing smoking from the risk calculation in our study equalized the scores in the smoking vs. the nonsmoking groups. This suggests that the higher cardiovascular risk score in our smokers was largely driven by the contribution of smoking to the model. Of note, our smokers differed from our nonsmokers in other cardiovascular risk factors not included in the Framingham model including elevated triglycerides and diastolic blood pressure. The Framingham score, while a useful algorithm to calculate cardiac risk, may not capture all of the cardiovascular risk factors in this population.

We found that the prevalence of hypertension was marginally higher in the smokers than the nonsmokers in our sample. We did not find a significant difference in the number of persons who had experienced a stroke, but we would not expect a higher prevalence of stroke in the smokers in this relatively young sample. There were no differences between smokers and nonsmokers in cardiovascular fitness as measured by total exercise time on a submaximal bicycle ergometer test. However these results should be interpreted with caution as the sample had a uniformly low fitness level at baseline and there may have been a floor effect.

Consistent with previous studies, we found that smokers were more likely to have substance abuse and higher overall psychopathology (Ziedonis et al., 1994, 2008; de Leon & Diaz, 2011; Bobes et al., 2010; Montoya et al., 2005; Ziedonis et al., 2005; Margolese et al., 2004).

The higher ratings on the psychosis scale among the smokers are consistent with the greater proportion of persons with schizophrenia versus those with mood disorders among the smokers. We did not find an association between smoking and depression or quality of life, unlike some previous studies (Dixon et al., 2007). Differences in sample selection and in measures may account for these discrepant findings. We also found more smokers among those with schizophrenia and bipolar disorder and among males as have previous investigations (de Leon & Diaz, 2011; Baker et al., 2007).

The prevalence of smoking in our cohort is lower than that observed in other samples of persons with serious mental illness (McClave et al., 2010, Lasser et al., 2000, Hughes et al., 1986; de Leon & Diaz, 2011; Diaz et al., 2009). This may be due to the fact that our data are more current than some previous studies. Persons with serious mental illness, like those in the overall population, have been affected by smoking reduction campaigns that have been accompanied by increased restrictions on smoking in public places and increased costs of cigarettes. There also may be a selection bias in our sample in that persons who signed up for a weight loss trial may be more health conscious, although we enrolled almost a third of all clients at the rehabilitation sites.

It is also of note that a total of 52 of the 291 in the total sample (18%) and of 168 ever smokers (31%) indicated that they had quit smoking. Previous studies of serious mental illness samples have not reported the percent who quit earlier in their lives, so these data are difficult to compare with other studies. In the US overall population, the number of persons who are former smokers exceeds those who are current smokers. The fact that a sizeable number of our participants had quit smoking is consistent with other studies indicating that many persons with serious mental illness who smoke are motivated to quit and can do so (Dickerson et al., 2010). We do not have details about their quit histories such as when the quitting occurred, their motivation to quit, strategies that they used, or to what extent they received formal smoking cessation treatment. The former smokers were older on average than the current smokers which may reflect their having developed health conditions or experienced age-related changes that contributed to their motivation to quit smoking, consistent with a previous study on successful quitters in this population (Dickerson et al., 2010).

Strengths of the study are the contemporary well-characterized community cohort and extensive data collection including blood-based cardiovascular markers. Limitations of the study include that the sample is not population based but a convenience sample of trial volunteers and that we did not collect detailed information about participants' smoking histories. Another limitation was that we did not control for multiple comparisons in our analyses.

Future studies aiming to improve physical health and cardiovascular status in persons with serious mental illness should target smoking cessation along with obesity and other health factors. For cardiovascular risk reduction in this population, smoking remains one of the most important modifiable factors.

Acknowledgments

This study was funded by NIMH R01MH 080964, Randomized Trial of Achieving Healthy Lifestyles in Psych Rehabilitation (Daumit, PI).

References

American Lung Association. Trends in tobacco use Retrieved from. 2011. <http://www.lung.org/finding-cures/our-research/trend-reports/Tobacco-Trend-Report.pdf>

- Appel LJ, Sacks FM, Carey VJ, Obarzanek E, Swain JF, Miller ER III, OmniHeart Collaborative Research Group. Effects of protein, monounsaturated fat, and carbohydrate intake on blood pressure and serum lipids: Results of the OmniHeart randomized trial. *JAMA: The Journal of the American Medical Association*. 2005; 294(19):2455–2464.10.1001/jama.294.19.2455 [PubMed: 16287956]
- Baker A, Richmond R, Haile M, Lewin TJ, Carr VJ, Taylor RL, Moeller-Saxone K. Characteristics of smokers with a psychotic disorder and implications for smoking interventions. *Psychiatry Research*. 2007; 150(2):141–152.10.1016/j.psychres.2006.05.021 [PubMed: 17289155]
- Block G, Gillespie C, Rosenbaum EH, Jenson C. A rapid food screener to assess fat and fruit and vegetable intake. *American Journal of Preventative Medicine*. 2000; 18(4):284–288.10.1016/S0749-3797(00)00119-7
- Bobes J, Arango C, Garcia-Garcia M, Rejas J. Healthy lifestyle habits and 10-year cardiovascular risk in schizophrenia spectrum disorders: An analysis of the impact of smoking tobacco in the CLAMORS schizophrenia cohort. *Schizophrenia Research*. 2010; 119(1–3):101–109.10.1016/j.schres.2010.02.1030 [PubMed: 20219322]
- Bobes J, García-Portilla P, Sáiz PA, Bascarán T, Bousoño M. Quality of life measures in schizophrenia. *European Psychiatry*. 2005; 20(Suppl 3):S313–S317.10.1016/S0924-9338(05)80182-8 [PubMed: 16459242]
- Casagrande SS, Jerome GJ, Dalcin AT, Dickerson FB, Anderson CA, Appel LJ, Daumit GL. Randomized trial of achieving healthy lifestyles in psychiatric rehabilitation: The ACHIEVE trial. *BMC Psychiatry*. 2010; 10:108–120.10.1186/1471-244X-10-108 [PubMed: 21144025]
- Centers for Disease Control. Vital signs: Current cigarette smoking among adults aged 18 years - United States, 2005–2010. *Morbidity and Mortality Weekly*. 2011; 60(35):1207–1212. Retrieved from http://www.cdc.gov/mmwr/mmwr_wk/wk_pvol.html.
- Centers for Disease Control. Cigarette smoking among adults – United States, 2002. *Morbidity and Mortality Weekly Report*. 2004; 53(20):427–431. Retrieved from http://www.cdc.gov/mmwr/mmwr_wk/wk_pvol.html. [PubMed: 15163928]
- Centers for Disease Control. Quitting smoking among adults – United States, 2001–2010. *Morbidity and Mortality Weekly Report*. 2011; 60(44):1513–1519. Retrieved from http://www.cdc.gov/mmwr/mmwr_wk/wk_pvol.html. [PubMed: 22071589]
- Centers for Disease Control. Chronic disease prevention and health promotion Tobacco use: Targeting the nation’s leading killer at a glance 2011. 2011. Retrieved from <http://www.cdc.gov/chronicdisease/resources/publications/aag/osh.htm>
- Chelland Campbell S, Moffatt RJ, Stamford BA. Smoking and smoking cessation– the relationship between cardiovascular disease and lipoprotein metabolism: A review. *Atherosclerosis*. 2008; 201(2):225–235.10.1016/j.atherosclerosis.2008.04.046 [PubMed: 18565528]
- Compton MT, Daumit GL, Druss BG. Cigarette smoking and overweight/obesity among individuals with serious mental illnesses: A preventive perspective. *Harvard Review of Psychiatry*. 2006; 14(4):212–222.10.1080/10673220600889256 [PubMed: 16912007]
- Curkendall SM, Mo J, Glasser DB, Rose Stang M, Jones JK. Cardiovascular disease in patients with schizophrenia in Saskatchewan, Canada. *Journal of Clinical Psychiatry*. 2004; 65:715–720.10.1016/j.annepidem.2005.04.008 [PubMed: 15163261]
- D’Agostino RB Sr, Vasan RS, Pencina MJ, Wolf PA, Cobain M, Massaro JM, Kannel WB. General cardiovascular risk profile for use in primary care: The Framingham Heart Study. *Circulation*. 2008; 117(6):743–753.10.1161/CIRCULATIONAHA.107.699579 [PubMed: 18212285]
- de Leon J, Diaz FJ. Genetics of schizophrenia and smoking: An approach to studying their comorbidity based on epidemiological findings. *Human Genetics*. 2012; 131(6):877–901.10.1007/s00439-011-1122-6 [PubMed: 22190153]
- Diaz FJ, James D, Botts S, Maw L, Susce MT, de Leon J. Tobacco smoking behaviors in bipolar disorder: A comparison of the general population, schizophrenia, and major depression. *Bipolar Disorder*. 2009; 11(2):154–165.10.1111/j.1399-5618.2009.00664
- Dickerson F, Bennett M, Dixon L, Burke E, Vaughan C, Delahanty J, DiClemente C. Smoking cessation in persons with serious mental illnesses: The experience of successful quitters. *Psychiatric Rehabilitation Journal*. 2011; 34(4):311–316.10.2975/34.4.2011.311.316 [PubMed: 21459747]

- Dixon L, Medoff DR, Wohlheiter K, DiClemente C, Goldberg R, Kreyenbuhl J, Davin C. Correlates of severity of smoking among persons with severe mental illness. *American Journal of Addictions*. 2007; 16(2):101–110.10.1080/10550490601184415
- Eisen SV, Normand SL, Belanger AJ, Spiro A III, Esch D. The Revised Behavior and Symptom Identification Scale (BASIS-R): Reliability and validity. *Medical Care*. 2004; 42(12):1230–1241.10.1097/00005650-200412000-00010 [PubMed: 15550803]
- Erhardt L. Cigarette smoking: An undertreated risk factor for cardiovascular disease. *Atherosclerosis*. 2009; 205:23–32.10.1016/j.atherosclerosis.2009.01.007 [PubMed: 19217623]
- Framingham Heart Study. General cardiovascular disease (10 year risk). 2008. Retrieved from <http://www.framinghamheartstudy.org/risk/gencardio.html>
- Goff DC, Sullivan LM, McEvoy JP, Meyer JM, Nasrallah HA, Daumit GL, Lieberman JA. A comparison of ten-year cardiac risk estimates in schizophrenia patients from the CATIE study and matched controls. *Schizophrenia Research*. 2005; 80:45–53.10.1016/j.schres.2005.08.010 [PubMed: 16198088]
- Gossett LK, Johnson HM, Piper ME, Fiore MC, Baker TB, Stein JH. Smoking intensity and lipoprotein abnormalities in active smokers. *Journal of Clinical Lipidology*. 2009; 3(6):372–378.10.1016/j.jacl.2009.10.008 [PubMed: 20161531]
- Hughes JR, Hatsukami DK, Mitchell JE, Dahlgren LA. Prevalence of smoking among psychiatric outpatients. *American Journal of Psychiatry*. 1986; 143(8):993–997. [PubMed: 3487983]
- Jenkinson C, Layte R, Jenkinson D, Lawrence K, Petersen S, Paice C, Stradling J. A shorter form health survey: Can the SF-12 replicate results from the SF-36 in longitudinal studies? *Journal of Public Health Medicine*. 1997; 19(2):179–186. [PubMed: 9243433]
- Lasser K, Boyd JW, Woolhandler S, Himmelstein DU, McCormick D, Bor DH. Smoking and mental illness: A population-based prevalence study. *JAMA: The Journal of the American Medical Association*. 2000; 284:2606–2610.10.1001/jama.284.20.2606 [PubMed: 11086367]
- Margolese HC, Malchy L, Negrete JC, Tempier R, Gill K. Drug and alcohol use among patients with schizophrenia and related psychoses: Levels and consequences. *Schizophrenia Research*. 2004; 67:157–166.10.1016/S0920-9964(02)00523-6 [PubMed: 14984874]
- McClave AK, McKnight-Eily LR, Davis SP, Dube SR. Smoking characteristics of adults with selected lifetime mental illnesses: Results from the 2007 National Health Interview Survey. *American Journal of Public Health*. 2007; 100(12):2464–2472.10.2105/AJPH.2009.188136 [PubMed: 20966369]
- Montoya ID, Herbeck DM, Svikis DS, Pincus HA. Identification and treatment of patients with nicotine problems in routine clinical psychiatry practice. *American Journal on Addictions*. 2005; 14:441–454.10.1080/10550490500247123 [PubMed: 16257881]
- Radloff L. The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement*. 1977; 1:385–401.10.1177/014662167700100306
- Tidey JW, Rohsenow DJ, Kaplan GB, Swift RM. Cigarette smoking topography in smokers with schizophrenia and matched non-psychiatric controls. *Drug and Alcohol Dependence*. 2005; 80:259–265.10.1016/j.drugalcdep.2005.04.002 [PubMed: 15869844]
- Virdis A, Giannarelli C, Neves MF, Taddei S, Ghiadoni L. Cigarette smoking and hypertension. *Current Pharmaceutical Design*. 2010; 16(23):2518–2525.10.2174/138161210792062920 [PubMed: 20550499]
- Vollmer WM, Appel LJ, Svetkey LP, Moore TJ, Vogt TM, Conlin PR, DASH Collaborative Research Group. Comparing office-based and ambulatory blood pressure monitoring in clinical trials. *Journal of Human Hypertension*. 2005; 19:77–82.10.1038/sj.jhh.1001772 [PubMed: 15361888]
- White WB, Anwar YA. Evaluation of the overall efficacy of the Omron office digital blood pressure HEM-907 monitor in adults. *Blood Press Monitor*. 2001; 6(2):107–110.10.1097/00126097-200104000-00007
- Willi C, Bodenmann P, Ghali WA, Faris PD, Cornuz J. Active smoking and the risk of type 2 diabetes: A systematic review and meta-analysis. *JAMA: The Journal of the American Medical Association*. 2007; 298:2654–2664.10.1001/jama.298.22.2654 [PubMed: 18073361]

- Williams JM, Ziedonis DM, Abanyie F, Steinberg ML, Foulds J, Benowitz NL. Increased nicotine and cotinine levels in smokers with schizophrenia and schizoaffective disorder is not a metabolic effect. *Schizophrenia Research*. 2005; 79:323–335. [PubMed: 15961287]
- Ziedonis DM, Kosten TR, Glazer WM, Frances RJ. Nicotine dependence and schizophrenia. *Hospital & Community Psychiatry*. 1994; 45(3):204–206. [PubMed: 7910577]
- Ziedonis DM, Smelson D, Rosenthal RN, Batki SL, Green AI, Henry RJ, Weiss RD. Improving the care of individuals with schizophrenia and substance use disorders: Consensus recommendations. *Journal of Psychiatric Practice*. 2005; 11:315–339. [PubMed: 16184072]
- Ziedonis D, Hitsman B, Beckham JC, Zvolensky M, Adler LE, Audrain-McGovern J, Riley WT. Tobacco use and cessation in psychiatric disorders: National Institute of Mental Health report. *Nicotine and Tobacco Research*. 2008; 10(12):1691–1715.10.1080/14622200802443569 [PubMed: 19023823]

Table 1Sociodemographic Characteristics of Smokers ($n=128$, 44%) and Nonsmokers ($n=163$, 56%)

Variable	Smokers	Nonsmokers	Test Statistic	<i>p</i> -value
Age, <i>M</i> (<i>SD</i>)	44.5 (10.6)	45.9 (11.8)	$T=-1.1$	0.28
Male, <i>n</i> (%)	72 (56.3)	73 (44.8)	$\chi^2=3.77$	0.05
Race, <i>n</i> (%)			$\chi^2=0.96$	0.62
White	70 (54.7)	93 (57.1)		
African-American	52 (40.6)	59 (36.2)		
Other	6 (4.7)	11 (6.8)		
Education, <i>n</i> %			$\chi^2=6.41$	0.04
Not high school graduate	48 (37.5)	39 (23.9)		
High school graduate	49 (38.3)	73 (44.8)		
Some college	31 (24.2)	51 (31.3)		
Psychiatric Diagnosis, <i>n</i> (%)			$\chi^2=10.43$	0.02
Schizophrenia	78 (60.9)	91 (55.8)		
Bipolar disorder	34 (26.6)	30 (18.4)		
Major depression	12 (9.4)	23 (14.1)		
Other	4 (3.1)	19 (11.7)		

Table 2Health Characteristics of Smokers ($n=128$, 44%) and Nonsmokers ($n=163$, 56%)

Variable	Smokers $n=128$ (44%)	Nonsmokers $n=163$ (56%)	Test Statistic	p -value ^I
Health Factors, $M(SD)$				
Weight (lbs)	227.9 (47.5)	224.3 (45.8)	$F=0.01$	0.91
BMI (kg/m ²)	36.1 (7.6)	36.4 (7.0)	$\chi^2=0.02$	0.88
BMI (kg/m ²) ≥ 30 n (%)	102 (79.7)	132 (81.0)	$\chi^2=0.01$	0.92
BMI (kg/m ²) ≥ 40 n (%)	31 (24.2)	45 (27.6)	$\chi^2=0.28$	0.60
Waist circumference (cm)	117.6 (15.5)	116.5 (15.5)	$F=0.18$	0.67
Exercise time (mins)	6.7 (2.9)	6.8 (3.0)	$F=1.24$	0.27
Sbp (mm Hg)	120.5 (13.2)	117.9 (13.4)	$F=1.69$	0.19
Dbp (mm Hg)	76.3 (8.9)	74.0 (9.1)	$F=3.74$	0.05
Total Cholesterol	178.2 (40.2)	178.5 (38.5)	$F=0.05$	0.83
LDL cholesterol (mg/dl)	98.6 (33.8)	99.6 (32.2)	$F=0.00$	0.98
HDL cholesterol (mg/dl)	43.0 (12.0)	48.9 (14.9)	$F=8.01$	0.005
Triglycerides(mg/dl)	185.4 (106.4)	148.6 (88.0)	$F=7.72$	0.006
Fasting glucose (mg/dl)	107.7 (33.9)	102.9 (31.1)	$F=1.05$	0.31
Risk of cardiovascular event	13.2 % (11.9)	7.4 % (7.2)	$F=38.7$	< .001
Medical conditions, n (%)				
Diabetes	35 (27.3)	48 (29.5)	$\chi^2=0.74$	0.48
Hypertension	85 (66.4)	90 (55.2)	$\chi^2=3.67$	0.06
Hypercholesterolemia	65 (50.8)	75 (46.0)	$\chi^2=0.90$	0.34
Emphysema	13 (10.2)	3 (1.8)	$\chi^2=8.63$	0.003
Asthma	28 (21.9)	33 (20.3)	$\chi^2=0.039$	0.84
Hepatitis	11 (8.6)	8 (4.9)	$\chi^2=0.85$	0.36
Seizure Disorder	15 (11.8)	21 (12.8)	$\chi^2=0.004$	0.95
Stroke	5 (3.9)	10 (6.1)	$\chi^2=0.44$	0.51
Dietary Intake, $M(SD)$				
Total fat (gms)	92.4 (25.8)	89.7 (26.0)	$F=0.49$	0.48
Saturated fat (gms)	28.0 (9.6)	26.1 (9.9)	$F=0.49$	0.48
Percent fat (% Kcal)	34.5 (6.4)	33.8 (6.5)	$F=0.49$	0.48
Dietary cholesterol (gms)	290.7 (90.7)	270.6 (96.0)	$F=0.50$	0.48
Fruit and vegetable servings	3.5 (2.1)	4.0 (2.1)	$F=3.98$	0.047
Dietary fiber (gms)	14.7 (6.5)	15.4 (6.5)	$F=3.55$	0.06

Note: BMI = body mass index; Sbp = systolic blood pressure; Dbp = diastolic blood pressure; LDL = low density lipoprotein; HDL = high density lipoprotein.

^I Adjusted for age and sex, education, diagnosis

Table 3Psychiatric and Behavioral Symptoms in Smokers ($n=128$, 44%) and Nonsmokers ($n=163$, 56%)

Variable	Smokers	Nonsmokers	Test Statistic	<i>p</i> -value ¹
SF-12				
Physical health scale	45.3 (10.2)	43.4 (10.1)	$F=0.49$	0.48
Mental health scale	43.8 (10.9)	46.6 (10.6)	$F=6.97$	0.01
CES-D	20.8 (11.6)	19.2 (10.9)	$F=3.5$	0.06
EQ-5D	0.8 (0.2)	0.8 (0.2)	$F=0.26$	0.61
BASIS-24				
Depression functioning subscale	1.3 (0.8)	1.3 (0.8)	$F=1.49$	0.22
Difficulty in interpersonal relationships subscale	1.4 (0.8)	1.2 (0.7)	$F=4.96$	0.03
Self-harm subscale	0.3 (0.6)	0.2 (0.5)	$F=0.58$	0.47
Emotional lability subscale	1.5 (1.0)	1.4 (0.9)	$F=3.09$	0.08
Psychotic symptoms subscale	1.1 (1.1)	0.9 (0.9)	$F=3.90$	0.05
Substance abuse subscale	0.4 (0.6)	0.1 (0.4)	$F=16.03$	< 0.001
Overall BASIS-24 summary score	1.2 (0.6)	1.1 (1.6)	$F=4.64$	0.03

Note: SF-12 = Short Form Health Survey (range 0–100, higher scores indicate better functioning); CES-D = Center for Epidemiologic Studies Depression Scale (range 0–60, higher scores indicate a higher level of depression); EQ-5D = EuroQoL-5 Dimensions (range 0–1, higher indicates better quality of life); BASIS-24 = revised Behavior and Symptom Identification Scale (range 0–4, higher scores indicate the greater or more frequent the problem or symptoms).

¹Adjusted for age and sex, education, and diagnosis