

Contemporary female smokers in the US are younger and of lower socioeconomic status

—A brief report of the 2008-2009 results from Sister to Sister: The Women's Heart Health Foundation Registry

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ABSTRACT

Smoking is the most common cause of premature cardiovascular disease in women, but contemporary data is lacking. We sought to investigate the differences between female smokers and nonsmokers in the US. **Methods:** Using a registry of almost 19,000 women who attended free public heart screenings sponsored by Sister to Sister between 2008 and 2009 in 17 large US cities, we compared the means for lipid values, cardiometabolic measures, and differences in sociodemographic information between smokers and nonsmokers. **Secondary outcomes were age and race-adjusted odds for obesity, the metabolic syndrome, hypertension, a non-HDL > 160 mg/dl, and a serum glucose \geq 126 mg/dl between smoking and nonsmoking women. Results:** The final sample included 18,892 women (49.8 \pm 14.3 years, 37% black, and 32% white, 14% Hispanic), with 1,216 (6.4%) current smokers. Smokers were younger than nonsmokers (45.6 \pm 13.0 vs 50.1 \pm 14.4 years, $p < 0.001$), with lower HDL levels (55.5 \pm 17.4 vs 58.6 \pm 17.4, $p < 0.001$), and higher triglycerides (148.8 \pm 103.7 vs 145.5 \pm 93, $p = 0.4082$). There were no significant differences in LDL between smokers versus nonsmokers. There were more black and white women in the smoking group. Smoking women were more likely to meet criteria for the metabolic syndrome (OR 1.22; 95% CI 1.00 - 1.49) and have a non-HDL > 160 mg/dl (OR 1.19; 1.01 - 1.39). Insurance and income data showed a significant inverse relationship between smoking prevalence and increasing household income. **Conclusions:** In this richly diverse sample of

women, female smokers were younger and of lower socioeconomic status than nonsmokers with significant differences in cardiometabolic risk factors.

Keywords: Cigarette Smoking; Cardiovascular Risk Factors; Women; Prevention

1. INTRODUCTION

Smoking is the strongest risk factor for premature cardiovascular disease (CVD) in women [1]. While it is well established that smoking triples CVD death, doubles stroke risk, and increases peripheral vascular disease 10-fold, nearly 1 in 5 women continue to smoke [2].

While smoking rates continue to decrease in men, rates of decline in women have plateaued [3,4]. Reasons for the plateau are unclear and few contemporary data exist for women. Utilizing data from a richly diverse group of community-based women, we investigated the characteristics of female smokers and nonsmokers.

2. METHODS

2.1. Study Sample

The study sample included women who attended free Sister to Sister (STS) public heart screenings held annually in 17 large US cities in 2008 and 2009 (Atlanta, GA, Baltimore, MD, Boston, MA, Chicago, IL, Dallas, TX, Detroit, MI, Jacksonville, FL, Los Angeles, CA, Miami, FL, St. Louis, MO, Tampa, FL, and Washington, DC held fairs in both 2008 and 2009, while Charlotte, NC, Indianapolis, IN, New York, NY, Philadelphia, PA, and Phoenix, AZ held fairs in 2008 only).

Screenings consisted of a standardized questionnaire

assessing sociodemographic information, current smoking status as yes/no, and personal history of CVD. In addition, cardiometabolic measurements were obtained by trained healthcare professionals. Participants who attended 2009 fairs were queried regarding annual household income and insurance status.

2.2. Outcomes

Cardiometabolic measures included a single automated blood pressure measurement, height, weight, body mass index (BMI) calculation, and waist circumference (WC) measurement taken above the iliac crest and reported to the nearest 0.1 inch. Plasma glucose and cholesterol were measured using fingerstick technology on the Cholestech® LDX Analyzer (Hayward, CA). Cholesterol measures included total cholesterol (TC), high-density lipoprotein (HDL) cholesterol, and triglycerides (TG). Non-HDL cholesterol and low-density lipoprotein (LDL) cholesterol were calculated.

Hypertension (HTN) was defined as a systolic blood pressure (SBP) ≥ 140 mmHg and/or a diastolic blood pressure (DBP) ≥ 90 mmHg. Criteria for the metabolic syndrome (MetS) were defined using the updated NCEP ATP III guidelines [5], which included 3 or more of the following: WC ≥ 35 inches, TG ≥ 150 mg/dl, HDL < 50 mg/dl, SBP ≥ 130 mmHg or DBP ≥ 85 mmHg, or a fasting glucose ≥ 100 mg/dl.

All forms and procedures were approved by Quorum Institutional Review Board (Seattle, WA).

2.3. Statistical Analysis

Descriptive and bivariate analyses were conducted to compare demographics, comorbidities, vital signs, and lab test data between smoker and non-smoker groups. Chi-square tests and Wilcoxon rank-sum tests were used for categorical variables and continuous variables, respectively. A hierarchical generalized linear model (HGLM) was developed to assess the risk difference between smoking and nonsmoking groups for each outcome measure and adjusted for age. We calculated 95% confidence intervals (CI) for each estimate obtained from the model. A dummy variable was created in the model to represent records that had missing age, and excluded records with missing BMI, vital signs, and lab test data for each outcome measure. All statistical testing was 2-sided, at a significance level of 0.05, and all analyses were conducted using SAS version 9.2 (SAS Institute Inc., Cary, NC).

3. RESULTS

Participant characteristics are listed in **Table 1**. The final sample included 18,892 women (mean age 49.8 ± 14.3 years) with 37% (7,030) non-Hispanic black women, 32% (5,991) non-Hispanic white women, 14% (2,665) Hispanic women, and 17% of women in the “other” category, which included 6% of women who

Table 1. Sister to Sister heart screening participant characteristics 2008 & 2009.

	Nonsmokers		Smokers		p-value
Number of Participants (%)	17676 (93.6)		1216 (6.7)		...
Mean Age (SD)	50.1 (14.4)		45.6 (13.0)		< 0.001
Sociodemographics	Total	%	Total	%	
Non-Hispanic Black	6529	36.9	501	41.2	...
Non-Hispanic White	5577	31.6	414	34.1	...
Hispanic	2491	14.1	174	14.3	...
Other*	3079	17.4	127	10.5	...
Lab Values	Mean	SD	Mean	SD	
Total Cholesterol (mg/dl)	194.5	42.6	192	42.6	0.0809
HDL Cholesterol (mg/dl)	58.6	17.4	55.5	17.4	< 0.001
LDL Cholesterol (mg/dl)	110.1	36.2	110.4	36.4	0.8208
Triglycerides (mg/dl)	145.5	93.0	148.8	103.7	0.4082
Non-HDL (mg/dl)	136.9	41.8	136.8	43.8	0.9626
Glucose (mg/dl)	105.5	31.8	105.9	27.9	0.7122
Cardiometabolic Measures	Mean	SD	Mean	SD	
Systolic Blood Pressure (mmHg)	126.9	19.7	125.6	19.9	0.0383
Diastolic Blood Pressure (mmHg)	77.0	12.8	78.2	13.8	0.0062
BMI (kg/m ²)	27.9	6.3	28.1	6.3	0.2649

Waist Circumference (in)	36.2	6.0	36.3	6.1	0.5724
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*Other race/ethnicity includes 6% of women with race/ethnicity other than black, Hispanic, or white and 11% of women with unknown race/ethnicity. HDL = high-density lipoprotein; LDL = low-density lipoprotein; BMI = body mass index; Ellipses (...) indicate test was not performed.

listed racial and ethnic backgrounds other than black, white, or Hispanic and 11% of women with unknown race/ethnicity. Of the total, 1,216 (6.4%) were current smokers and 17,676 (93.6%) were current nonsmokers. Smokers were significantly younger (45.6 ± 13.0 years) than nonsmokers (50.1 ± 14.4 years), with higher triglycerides (148.8 ± 103.7 mg/dl vs 145.5 ± 93 mg/dl, respectively), and significantly lower HDL levels (55.5 ± 17.4 mg/dl vs 58.6 ± 17.4 mg/dl, respectively). Smokers also had a significantly lower mean systolic blood pressure compared with nonsmokers (125.6 ± 19.9 mmHg vs 126.9 ± 19.7 mmHg, respectively), but a significantly higher mean diastolic blood pressure compared with nonsmokers (78.2 ± 13.8 mmHg vs 77.0 ± 12.8 mmHg, respectively). Proportionally, there was a higher makeup of non-Hispanic black and non-Hispanic white women in the smoking group (41.2% and 34.1%, respectively) compared with the nonsmoking group (37.0% and 31.6%, respectively).

A higher proportion of smokers were obese (35.4%) and met criteria for the MetS (37.2%) compared with nonsmoking women (32.6% and 34%, respectively) (data not shown). A strong relationship between age and smoking status was observed (**Figure 1**), such that there were more smokers among the younger age groups.

Significant differences existed in insurance status between smokers and non-smokers (**Figure 2a**), where only 45% of smokers had private insurance compared with 54.8% of nonsmokers, and a higher makeup of smokers were uninsured (40.5%) or on Medicaid (5.4%) compared with nonsmokers (33.7% and 2.3%, respectively). A significant inverse relationship was observed between female smoking prevalence and annual household income (**Figure 2b**).

Risk adjusted outcomes revealed smokers had a significantly higher risk of the MetS (OR 1.22; 95% CI 1.00 - 1.49) as well as a non-HDL > 160 mg/dl (OR 1.19; 95% CI 1.01 - 1.39) compared with nonsmokers (**Table 2**).

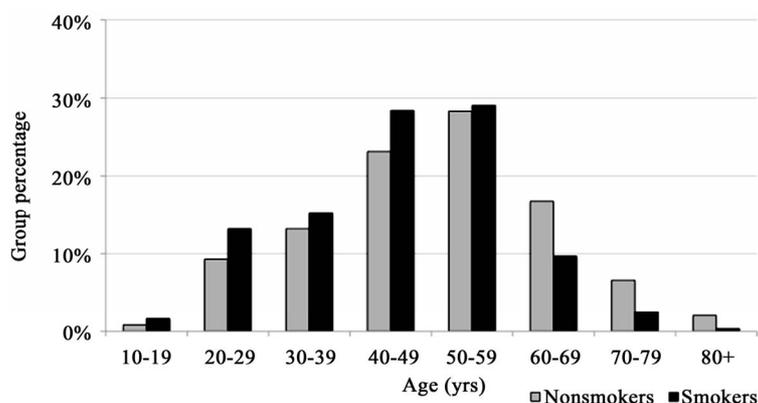


Figure 1. Smoking prevalence was higher among younger women.

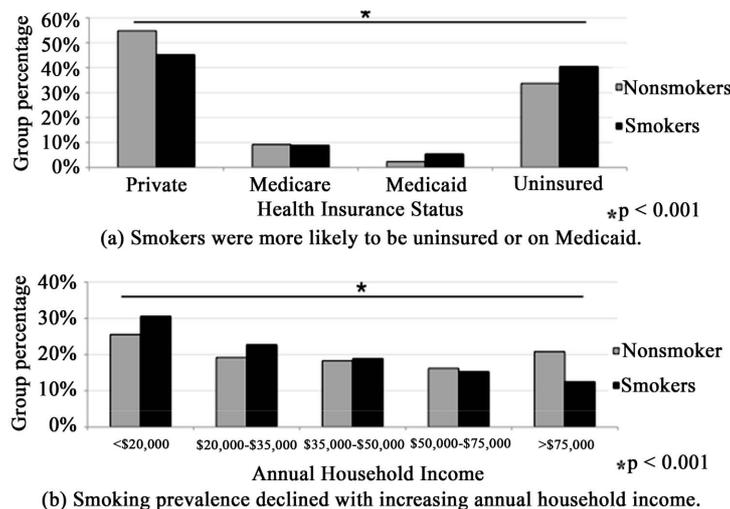


Figure 2. Socioeconomic differences between smokers and nonsmokers.

Table 2. Risk adjusted outcomes in Sister to Sister women.

Group	Obesity	MetS	HTN	Non-HDL > 160	Glucose \geq 126
	OR (95% CI)				
Age-Adjusted	1.00 (1.00 - 1.01)	1.02 (1.02 - 1.03)	1.04 (1.04 - 1.05)	1.02 (1.02 - 1.03)	1.03 (1.02 - 1.03)
Nonsmoker	1.00 (reference)				
Smoker	1.12 (0.98 - 1.28)	1.22 (1.00 - 1.49)	1.02 (0.87 - 1.19)	1.19 (1.01 - 1.39)	1.15 (0.94 - 1.41)

Odds ratios were drawn from a logistic model adjusted for age and race. Reference Groups: Nonsmokers reference for comparison with smokers. BMI = Body Mass Index; MetS = Metabolic Syndrome; OR = Odds Ratio; 95% CI = 95% Confidence Interval; Obesity defined as BMI \geq 30. MetS defined as any combination of 3 or more of the following: waist circumference \geq 35 in, triglycerides \geq 150 mg/dl, HDL < 50 mg/dl, SBP \geq 130 mmHg or DBP \geq 85 mmHg, and/or fasting glucose > 100 mg/dl.

4. COMMENTS

In this cross-sectional analysis of a richly diverse sample of community women in the US, smokers were younger, with lower HDL cholesterol levels, higher TG levels, and a higher proportion of women who met criteria for the MetS. The prevalence of smoking decreased with increasing annual household income, and a higher proportion of women who smoked were uninsured or on Medicaid.

Our findings are consistent with US data from the 2008 National Health Interview Survey, where prevalence of smoking was highest among adults < 65 years of age [1]. Further, results from the Nurses' Health Study showed that women who start smoking before the age of 15 have the highest risk of CVD mortality (relative risk 9.94; 95% CI 5.15 - 19.19) [6]. These findings illustrate the importance of aggressive smoking prevention efforts directed towards younger women given that it negates otherwise typical cardioprotection in a premenopausal woman.

Women smokers had an average HDL cholesterol 3 mg/dl lower than nonsmoking women—translating into a 12% increased risk for CVD [7]. This was coupled with increased rates of obesity and the MetS, each increasing CVD risk. While we expected to see hyperglycemia in the smoking group given earlier reports of the association between cigarette smoke and insulin resistance [8-12], this was not the case, although increased rates of obesity and the MetS may be earlier markers.

Our overall smoking rate was notably low (6.7%) and may be a reflection of health-seeking persons who attend health screenings. These women would be less likely to smoke or continue smoking given their concern for overall wellness, although we also captured a substantial number of women without health coverage looking for free services. Therefore, we feel our results are generalizable and our findings are consistent with previous investigations [1,13].

Although this study adds to the outdated body of literature on the differences between smokers and nonsmokers, this study does have limitations. First, while

the majority of women attending the fair were fasting, some were not. Fasting status was recorded at the time of testing, but a non-fasting state could result in elevated glucose, TG, and LDL. Second, a single blood pressure measure was taken for most women, which may have overestimated mean blood pressure measures, although women with high readings received additional confirmatory measures, which would increase the accuracy of high findings. Third, former smoking status was not collected and many women may have been former smokers. However, cardiovascular risk drops precipitously after smoking cessation and approaches that of nonsmokers within several years [6,14,15]. Fourth, we were unable to account for medication use, which could have resulted in the under-estimation of HTN, hyperlipidemia, and hyperglycemic rates if controlled.

5. CONCLUSION

Female smokers who attended STS heart screening fairs in 2008 and 2009 were younger than nonsmokers and of lower socioeconomic status with significantly lower levels of HDL cholesterol and higher risk of the MetS. Taken together, these differences substantially increase a female smoker's risk of a cardiovascular event, and signal the need for more aggressive smoking prevention programs targeted at younger populations from lower socioeconomic neighborhoods.

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