Original Research

Journal of Behavioral Health
www.scopemed.org
DOI: 10.5455/jbh.173063

Racial and ethnic disparity in smoking cessation medication use among adult smokers in the United States

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Received: November 24, 2014
Accepted: April 24, 2015
Published: May 04, 2015

ABSTRACT

Background: Smoking is a major avoidable cause of mortality and morbidity. Understanding the racial disparity in smoking cessation medication use among different racial groups can help us identify certain minority groups, who may have a barrier to receive smoking cessation medication and develop culturally appropriate interventions to these minority groups. **Objective:** This study aimed to examine racial/ethnic disparity in smoking cessation medication use among adult smokers in the United States using Medical Expenditure Panel Survey (MEPS) data from 2009 to 2010. **Methods:** This study was a retrospective cross-sectional study using MEPS data from 2009 to 2010. Multivariate logistic regression analysis was performed to investigate racial/ethnic disparity in smoking cessation medication use controlling for predisposing, enabling, and need characteristics. The outcome of interest was a dichotomous smoking cessation medication use variable. **Result:** Total sample was 7881 (weighted sample size = 78, 268, 573), mostly comprised of non-Hispanic whites (72.92%), followed by non-Hispanic blacks (12.59%), Hispanics (9.37%), and others (5.10%). Among these smokers, 3.28% of them have used smoking cessation medication. Race was a significant predictor of smoking cessation medication use. In addition, we found gender, insurance, having a usual source of healthcare, obesity were also significant predictors of smoking cessation medication use. **Conclusion:** Our finding identified the potential minority groups, which had a barrier to use smoking cessation medication and some other significant factors which were associated with smoking cessation medication use. Further research can be investigated to find the reasons for this disparity, thus improving smoking cessation treatment outcome.

KEY WORDS: Racial disparity, smoking cessation, smoking cessation medication

INTRODUCTION

Tobacco use is a major avoidable cause of mortality and morbidity, accounting for more than 480,000 deaths each year in the United States [1]. Smoking is the cause of many diseases including cardiovascular diseases, chronic obstructive pulmonary disease, stroke, and lung cancer [2]. Tobacco dependence mimics a chronic disease with only a minority of tobacco users abstinent permanently after a first quit attempt, while, most of them fail or relapse since first quit attempt. Tobacco use causes a huge economic burden to individual smokers and the whole society, accounting for 96 billion dollars' expenditure in direct medical cost each year and 97 billion dollars in lost productivity [3].

It was reported that more than 70% of the 45 million smokers were willing to quit in the United States and almost half of these smokers had an attempt to quit. Unfortunately most of those attempting failed, only 4-7% of the 19 million adults who tried to quit in year 2005 achieved successful cessation [4].

The Tobacco Use and Dependence Clinical Practice Guidelines of 2008 updated Public Health Service Clinical Practice and recommended the use of pharmacotherapy for all smokers who want to make attempts to quit, except those having contradictions or some specific population for whom insufficient evidence of effectiveness exists (i.e., pregnant women, smokeless tobacco users, light smokers, and adolescents). It has suggested smoking cessation intervention should include at least one Food and Drug Administration (FDA) approved first-line smoking cessation medication [4].

Currently, there are seven first-line medications approved by the U.S. FDA which can help increase long-term smoking abstinence rates reliably. They are varenicline, bupropion SR, and nicotine replacement therapy (NRT) including: nicotine

gum, nicotine inhaler, nicotine lozenge, nicotine nasal spray, and nicotine patch [4-6].

There are a few review and clinical trial studies, which provide such evidence that increased smoking cessation medication use led to higher abstinence rates. For instance, a review of 132 trials indicated that the risk ratio (RR) of abstinence for any form of NRT compared to control was 1.58 (95% confidence interval [CI]: 1.50-1.66) [7]. A systematic review and meta-analysis of effectiveness of smoking cessation therapies identified 12 randomized control trials, which used bupropion versus placebo and yielded odds ratios (OR) ranging from 1.72 to 2.64 compared with placebo at 3 months and yielded ORs ranging from 1.10 to 2.21 compared with placebo at 1 year [8]. Bupropion can also delay relapse after successful abstinence for the smokers [9].

Racial/ethnic disparities in smoking cessation have been consistently documented in epidemiologic studies [10-12]. The 2008 Clinical Practice Guideline recommended evaluating and enhancing smoking cessation interventions among racial and ethnic minority populations [13]. A study conducted by Cokkinides *et al* which examined racial and ethnic disparities in smoking cessation interventions using 2005 National Health Interview Survey data has shown that black and Hispanic smokers are less likely to seek advice for quitting or use any smoking cessation intervention in the quit attempt compared to white smokers and this result is consistent even after controlling for socioeconomic and health care related factors [14]. A review of published studies examining smoking cessation treatment interventions among ethnic and minority populations in the US has concluded that racial and ethnic minority populations are interested in smoking cessation and willing to quit. However, variations existed in the quitting outcomes across different studies among minority population due to variations in intervention and study design, also, the evaluations of outcomes by using pharmacotherapy are quite limited [13]. Moreover, evaluation of racial disparity in using pharmacotherapy is limited. Although there were limited evaluations of pharmacotherapy, the existing data supported use of pharmacotherapy in addition to counseling for enhancing abstinence outcomes. Further attention to the level of individual smoking, variability in smoking patterns, and use of other tobacco products is needed. Our study aims to assess whether there is also racial/ethnic disparities in smoking cessation medication use, which may affect smoking cessation treatment outcome. The primary hypothesis is race is a significant factor of using smoking cessation pharmacotherapy. There is variation in pharmacotherapy use between different ethnic groups. Secondary hypothesis is except race, there are also some other factors that might affect the use of pharmacotherapy for smoking cessation, for instance, health insurance. Understanding the racial disparity in smoking cessation medication use among different racial groups can help us identify certain specific minority groups who may have a barrier to receive smoking cessation medication and develop culturally appropriate interventions to these minority groups. Thus, understanding racial and ethnic differences in the provision or utilization of smoking cessation medication is integral in reducing tobacco use among minority groups.

METHODS

Data Sources and Study Design

A retrospective cross-sectional study was conducted by using Medical Expenditure Panel Survey (MEPS) data from 2009 to 2010. The MEPS is a panel based large-scale survey of families and individuals, their medical providers (doctors, hospitals, pharmacies, etc.), and employers across the United States, which was conducted by the agency for health research and quality [15]. MEPS includes three components: the household component (HC), the medical provider component, and the insurance component, which collects data on the specific health services that Americans use, how frequently they use them, the cost of these services, and how they are paid for, as well as data on the cost, scope, and breadth of health insurance held by and available to US workers. MEPS has a stratified multistage probability design which covers non-institutionalized US population. It provides nationally representative estimates of health care use, expenditures, sources of payment, and health insurance coverage for the US civilian non-institutionalized population. The MEPS HC also provides estimates of respondents' health status, demographic, and socio-economic characteristics, employment, access to care, and satisfaction with health care, health insurance coverage, income, and employment. Hispanics and Blacks were over-sampled among initially sampled households. Since a person-level weight was generated in MEPS, different observations in the sample had different sampling probabilities and response rates were different for different observations by sample characteristics. In addition, the observations in the sample were drawn using clustering. Therefore, in the analysis, all the estimation models are weighted using the probability weight of each person. In MEPS, each respondent's race and ethnicity information is captured and it also provides us well-defined information on smoking behavior, accurate prescription drug use information, meanwhile it can be generalized at national level, all of these strengths make MEPS an ideal database for conducting our study.

Three public use files of MEPS 2009 and MEPS 2010 were used for our analysis: (1) Full year consolidated file, (2) medical condition file, and (3) prescribed medicine file. The full year consolidated files included information of patients' demographic variables, insurance status, utilization of health service and related expenditures. The prescribed medicine files contained information of medication prescribing events, including the first prescribing date and when the medication was filled. The medical condition files provided information for identifying patients' medical conditions by using ICD-9-CM codes [15]. All adults (age ≥ 18 years) smokers were included in the study. Smokers were defined according to the report of self-administered questionnaire of currently smoking status.

Andersen's health service utilization model was used as the conceptual framework [16]. This model is the most commonly used framework for analyzing the factors which were associated with health service utilization, which classifies determinants

of an individual's health service utilization into predisposing, enabling, and need characteristics. Predisposing characteristics determine the baseline propensity of an individual to use health services. Enabling characteristics refer to the community and personal resources an individual has, to use services. Need characteristics refer to perceived and actual need of an individual, which drive the use of health services. In the original behavioral model (Andersen, 1968), race/ethnicity was categorized into predisposing variables, assuming that race was an indicator of a family's societal position and could predict their need for and utilization of health care services [17].

Outcome Measures (Dependent Variable)

The outcome of interest was a dichotomous smoking cessation medications use variable. Any use of first-line FDA approved smoking cessation medications including bupropion, varenicline, and nicotine replacement therapies were defined as the use of smoking cessation medication, this was identified from the prescribed medicine file.

Independent Variables

Predisposing characteristics included race/ethnicity, age, gender, marital status, and education. Age was categorized into three groups: 18-39 years, 40-59 years, and 60-85 years. Marital status was categorized as married or unmarried (unmarried included widowed, divorced, separated, never married). Education was categorized into three categories: < 12 years, 12-15 years, and >15 years. Race/ethnicity was categorized into four mutually exclusive categories: Non-Hispanic Whites, non-Hispanic Blacks, Hispanic, and others (including American Indian/Alaska Native, Asians, and Native Hawaiian/Pacific Islander).

Need characteristics included obesity, activities of daily living (ADLs), instrumental ADLs (IADLs), and general health status and Charlson comorbidity index. Obesity was categorized as normal weight, overweight, obese, and extreme obese based on body mass index value: normal weight: body mass index (BMI) <25; overweight: 25≤BMI<30; obese: 30≤BMI≤40, extreme obese: BMI>40 [19]. Presence of comorbidities and patients' disease severity may affect the extent of health services and medication use. We calculated Charlson comorbidity index score and categorized it to reflect a low (score of 0-1), medium (2-3) or high (≥4) burden of comorbidity as previous studies [20-22]. ADLs/IADLs were measured as dichotomous variables based on whether or not the individual needed help to perform any ADL/IADL. Self-perceived general health status was classified into two categories: Fail/poor and excellent/very good/good health status.

Statistical Analyses (Regression Model)

All statistical analyses were performed adjusting for MEPS survey design to generalize results at national level. Univariate logistic regression models were used to estimate the unadjusted association of each independent variable with smoking cessation medication use. Colinearity of all independent variables was tested using multicolinearity test and variables were removed if correlation coefficient analysis of the variables had a value of >0.7 and if the variance inflation factor was >10. Interaction assessment was carried out using the chuck test to assess the interaction between predictors, no interaction was identified. Therefore, no interaction term was included in the multivariate models. Multivariate logistic regression was performed to examine racial/ethnic disparity in smoking cessation medication utilization controlling for predisposing, enabling and need factors. All the independent variables with $P < 0.20$ in the univariate analysis were kept and included in the final multivariate regression model. Maldonado and Greenland (1993) suggest that potential confounders be eliminated only if $P > 0.20$, in order to protect against residual confounding [23].

A priori significance level at $P < 0.05$ was used in the final multivariate regression model. OR, and 95% confidence interval were reported. SAS 9.3 was used to carry out all the statistical analyses.

RESULTS

The final cohort consisted of 7,881 adults smokers in total between 2009 and 2010 (weighted sample size = 57,073,642). All of the results are presented at weighted level in 2009 and 2010. Table 1 provides descriptive statistics for analytical cohort, most of those smokers in the cohort were non-Hispanic whites (72.92%) followed by non-Hispanic blacks (12.59%), Hispanics (9.37%) and others (5.10%). These adult smokers had a mean age of 43.08±14.92, and 55.95% of them were male smokers. In general, 3.28% of these smokers have used smoking cessation medication. Within the race category, 4.02% of non-Hispanic Whites have used smoking cessation medication which is much higher than the percentage of smokers with other races. The percentages of smokers with other races who have used smoking cessation medications are 1.74%, 1.01%, 0.59% for non-Hispanic blacks, Hispanics, and others. Other characteristics were summarized in Table 1.

Univariate Regression Results

Table 2 presented the results for univariate regression analysis. Non-Hispanic Black people (1.34% users) were significantly less likely to take smoking cessation medications compared with non-Hispanic Whites (4.02% users) (OR: 0.42, 95% CI: 0.26-0.66). Furthermore, Hispanics and others were significantly less likely to take smoking cessation medications compared with non-Hispanic Whites (OR: 0.24, 95% CI: 0.12-0.47), (OR: 0.14, 95% CI: 0.05-0.38).

Several characteristics were significantly associated with smoking cessation medication use among these adult smokers. Age between 40 and 59 (OR: 1.91, 95% CI: 1.31-2.78) and age between 60 and 85 (OR: 2.21, 95% CI: 1.36-3.55) were associated with higher medication use. Females (OR: 1.88, 95% CI: 1.39-2.54) and obese smokers (OR: 1.96, 95% CI: 1.28-2.99) were more likely to use smoking cessation medication. Having a usual source of

Table 1: Descriptive statistics of analytic cohort by race/ethnicity

Variables	Total, *n*=78268573 (100%)	Non-Hispanic Whites, *n*=57073642 (72.92%)	Non-Hispanic Blacks, *n*=9860689 (12.59%)	Hispanics, *n*=7335550 (9.37%)	Others, *n*=3998693 (5.10%)	*P* value
Predisposing characteristics						
Age						<0.0001*
Mean±SE	43.08±14.92	44.33±15.20	43.08±14.74	39.90±13.82	40.78±14.46	
Gender						<0.0001*
Male	55.95	54.16	55.92	68.09	59.32	
Female	44.04	45.83	44.07	31.91	40.67	
Marital status						<0.0001*
Unmarried	57.94	54.34	73.78	63.02	61.05	
Married	42.05	45.65	26.21	36.97	38.94	
Education						<0.0001*
<12	23.76	20.48	30.32	41.43	22.34	
12-15	64.53	67.04	61.37	51.95	59.39	
>15	11.70	12.47	8.30	6.61	18.25	
Enabling characteristics						
Income						<0.0001*
Poor	26.12	21.91	42.83	32.92	32.50	
Low income	16.19	15.44	17.87	21.33	13.36	
Middle income	32.04	33.66	24.53	30.07	31.06	
High income	25.63	28.97	14.75	15.66	23.06	
Health insurance coverage						<0.0001*
Public insurance	19.66	16.92	31.10	22.94	24.60	
Private insurance	55.01	60.50	38.97	36.24	50.59	
Uninsured	25.32	22.57	29.91	40.80	24.80	
Prescription Insurance Coverage						<0.0001*
Insured	50.05	55.34	36.08	31.60	42.64	
Uninsured	49.95	44.65	63.91	68.39	57.35	
Usual source of health care						<0.0001*
Yes	68.79	72.06	62.77	51.72	67.63	
No	31.20	27.93	37.22	48.27	32.36	
Urban residence						<0.0001*
MSA	79.87	76.32	88.44	93.27	84.61	
No-MSA	20.13	23.67	11.55	6.72	15.38	
Region						<0.0001*
Northeast	16.55	17.50	14.14	14.17	13.15	
Midwest	27.83	31.51	23.23	10.16	19.15	
South	38.44	35.80	56.13	38.07	33.09	
West	17.16	15.16	6.48	37.58	34.59	
Need characteristics						
Obesity						<0.0001*
Normal weight	37.62	38.80	33.96	29.33	44.94	
Overweight	33.83	33.86	31.29	36.69	34.32	
Obese	24.26	23.60	28.45	28.31	16.02	
Extreme obese	4.27	3.72	6.28	5.66	4.70	
ADL						0.3416
Yes	2.71	2.63	3.62	2.13	2.69	
No	97.28	97.36	96.37	97.86	97.31	
IADL						0.1466
Yes	6.23	6.22	7.65	4.47	6.19	
No	93.76	93.77	92.34	95.52	93.80	
General health status						0.2440
Fair/poor	78.39	79.02	76.01	77.27	77.35	
Excellent/very good/good	21.61	20.97	23.99	22.72	22.64	
Comorbidity						0.0029*
0-1comorbidity	0.44	91.59	91.92	95.87	95.89	
2-3comorbidity	0.36	6.95	6.69	3.50	3.01	
4 comorbidities or more	0.18	1.44	1.38	0.61	1.09	
Smoking cessation medication use						<0.0001*
Yes	3.28	4.02	1.74	1.01	0.59	
No	96.71	95.97	98.26	98.99	99.41	

ADLs: Activities of daily living, IADLs: Instrumental activities of daily living, CI: Confidence interval, OR: Odds ratio

health care (OR: 4.24, 95% CI: 2.55-7.07) was associated with higher smoking cessation medication use. Individuals who needed help with IADLs (OR: 2.64, 95% CI: 1.66-4.18) were more likely to use smoking cessation mediation. Those having private insurance (OR: 5.42, 95% CI: 2.93-10.05) or public insurance (OR: 6.16, 95% CI: 3.11-12.21) were more

Table 2: Univariate logistic regression model results for smoking cessation medication use among adult smokers

Variables	OR	95% CI	*P* value
Predisposing characteristics			
Age			
18-39	Reference		<0.0001*
40-59	1.91	1.31-2.78	
60-85	2.21	1.36-3.55	
Race/ethnicity			<0.0001*
Whites	Reference		
Blacks	0.42	0.26-0.66	
Hispanics	0.24	0.12-0.47	
Others	0.14	0.05-0.38	
Gender			<0.0001*
Male	Reference		
Female	1.88	1.39-2.54	
Marital status			0.94
Unmarried	Reference		
Married	0.987	0.68-1.43	
Education			0.65
<12	Reference		
12-15	1.06	0.69-1.65	
>15	1.32	0.71-2.44	
Enabling characteristics			
Income			
Poor	Reference		0.04*
Low income	0.61	0.36-1.02	
Middle income	0.93	0.62-1.41	
High income	1.33	0.88-2.02	
Health insurance coverage			<0.0001*
Uninsured	Reference		
Private insurance	5.42	2.93-10.05	
Public insurance	6.16	3.11-12.21	
Prescription insurance coverage			0.03*
Uninsured	Reference		
Insured	1.46	1.03-2.07	
Usual source of health care			<0.0001*
Yes	4.24	2.55-7.07	
No	Reference		
Urban residence			0.13*
MSA	1.51	0.88-2.61	
No-MSA	Reference		
Region			0.04*
Northeast	Reference		
Midwest	0.90	0.48-1.68	
South	0.48	0.25-0.94	
West	0.82	0.40-1.69	
Need characteristics			
Obesity			0.0058*
Normal weight	Reference		
Overweight	1.13	0.75-1.68	
Obese	1.96	1.28-2.99	
Extreme obese	1.94	0.89-4.26	
ADL			0.04*
Yes	1.95	1.02-3.74	
No	Reference		
IADL			<0.0001*
Yes	2.64	1.66-4.18	
No	Reference		
General health status			0.003*
Fair/poor	Reference		
Excellent/very good/good	1.66	1.18-2.33	
Comorbidity			0.0002*
0-1 comorbidity	Reference		
2-3 comorbidity	1.63	1.02-2.63	
4 comorbidities or more	4.37	2.01-9.49	

CI: Confidence interval, OR: Odds ratio, ADLs: Activities of daily living, IADLs: Instrumental activities of daily living, CI: Confidence interval, OR: Odds ratio

likely to use smoking cessation medication compared to those without health insurance. Furthermore, those with prescription insurance coverage were more likely to use smoking cessation medication compared to those without prescription insurance coverage (OR: 1.46, 95% CI: 1.03-2.07). Furthermore, smokers who have a medium burden of comorbidity (OR: 1.63, 95% CI: 1.02-2.63) or a high burden of comorbidities (OR: 4.37, 95% CI: 2.01-9.49) were more likely to use smoking cessation medications than those with a low burden of comorbidities.

Multivariable Logistic Regression Results

Table 3 presented the results for multivariable regression analysis. We performed multi co-linearity tests for each independent variable and no co-linearity within the independent variables was detected. After controlling for the variables in the multivariate model, race, gender, insurance coverage, having a usual source of healthcare and obesity were significant predictors of smoking cessation medication use among adult smokers. Race was a significant predictor of smoking cessation medication use. The findings indicated that non-Hispanic blacks were less likely to use smoking cessation medication compared to non-Hispanic Whites (OR: 0.46, 95% CI: 0.28-0.74). Furthermore, Hispanics and others were significantly less likely to take smoking cessation medications compared with non-Hispanic Whites (OR: 0.29, 95% CI: 0.14-0.59), (OR: 0.15, 95% CI: 0.05-0.44). Female smokers were more likely to use smoking cessation medication compared with male smokers (OR: 1.56, 95% CI: 1.15-2.10). Smokers having public insurance (OR: 3.88, 95% CI: 1.70-8.86) or private insurance (OR: 3.05, 95% CI: 1.45-6.41) were more likely to use smoking cessation medication compared with those without health insurance. Obese people were more likely to use smoking cessation medication compared to smokers with normal weight (OR: 1.94, 95% CI: 1.23-3.03). In addition, smokers those who had a usual source of health care were more likely to use smoking cessation medication compared with those without a usual source of health care (OR: 2.03, 95% CI: 1.15-3.56).

DISCUSSION

Our study has indicated that race was a significant predictor of smoking cessation medication use. Non-Hispanic blacks, Hispanics, and other races were less likely to use smoking cessation medication compared to non-Hispanic Whites, consistent with previous literature [11]. In 2000, the quit ratio which was defined as percentage of lifetime smokers who have quit smoking was lower among blacks (37.5%) compared to whites (50.4%) [7]. In our study, we found non-Hispanic blacks were less likely to use smoking cessation medication compared to non-Hispanic Whites, which may partly explain the lower quit ratio among blacks compared to whites. It was also consistent with centers for disease control report that non-Hispanic whites (36.1%) were more likely to use counseling and/or medications than non-Hispanic blacks (21.6%) or Hispanics (15.9%) and cessation was more likely among non-Hispanic whites (6.0%) than among non-Hispanic blacks (3.3%) [24]. We also found that female smokers were more

Table 3: Multivariate logistic regression model results for smoking cessation medication use among adult smokers

Variables	OR	95% CI	*P* value
Predisposing characteristics			
Age			0.2416
18-39	Reference		
40-59	1.41	0.94-2.11	
60-85	1.20	0.69-2.07	
Race/ethnicity			<0.0001*
Whites	Reference		
Blacks	0.46	0.28-0.74	
Hispanics	0.29	0.14-0.59	
Others	0.15	0.05-0.44	
Gender			0.0039*
Male	Reference		
Female	1.56	1.15-2.10	
Enabling characteristics			
Income			0.2187
Poor	Reference		
Low income	0.63	0.37-1.08	
Middle income	0.82	0.50-1.34	
High income	1.06	0.66-1.71	
Health insurance coverage			0.0028*
Public insurance	3.88	1.70-8.86	
Private insurance	3.05	1.45-6.41	
Uninsured	Reference		
Prescription insurance coverage			0.3884
Insured	0.75	0.39-1.43	
Uninsured	Reference		
Usual source of health care			0.0135*
Yes	2.03	1.15-3.56	
No	Reference		
Urban residence			0.0501
MSA	1.71	1.00-2.91	
No-MSA	Reference		
Region			0.1222
Northeast	Reference		
Midwest	0.98	0.51-1.91	
South	0.61	0.31-1.19	
West	1.12	0.53-2.33	
Need characteristics			
Obesity			0.0280*
Normal weight	Reference		
Overweight	1.22	0.81-1.84	
Obese	1.94	1.23-3.03	
Extreme obese	1.76	0.79-3.77	
ADL			0.5096
Yes	0.78	0.37-1.63	
No	Reference		
IADL			0.0630
Yes	1.66	0.97-2.85	
No	Reference		
General health status			0.4837
Fair/poor	Reference		
Excellent/very good/good	1.13	0.79-1.61	
Comorbidity			0.0613
0-1 comorbidity	Reference		
2-3 comorbidity	1.11	0.64-1.92	
4 comorbidities or more	2.72	1.18-6.26	

CI: Confidence interval, OR: Odds ratio, ADLs: Activities of daily living, IADLs: Instrumental activities of daily living, CI: Confidence interval, OR: Odds ratio

likely to use smoking cessation medication compared to male smokers. This finding was also consistent with the previous literature which found male smokers were less likely to be screened for smoking, to receive cessation advice or receive any smoking cessation aids [14]. However, researchers have found a significant difference in quitting success between men and women, past quitting attempts, medication adherence, body mass index, stress, depression, and education level are all factors that impact a person's chances of quitting smoking successfully. Some factors played a more important role for women's chance of successful quitting while other factors are attributable more to men's quitting, which explained that females use smoking medications more, but have lower quit rates than men. Further smoking cessation intervention should pay more attention to female smokers and address potential barriers to smoking cessation for female smokers. In addition to race and gender, our study also revealed that other factors such as, insurance status, having a usual source of healthcare, obesity are associated with smoking cessation medication use. Our finding that those with public or private insurance were more likely to take smoking cessation medication was consistent with the Clinical Practice Guideline for Treating Tobacco Use and Dependence, in the guideline, it has been noted that making smoking cessation covered by insurance plans will increase the likelihood of receiving cessation treatment and having a successful outcome of quitting. However, having prescription insurance coverage was not a significant predictor of cessation medication use. Since among different types of NRT, which is the most commonly used smoking cessation medication [25], some types are over-the-counter (OTC), which can be available at local pharmacy, prescription insurance may not affect use of these types of medication, since there is a large proportion of NRT users, there may be a large proportion of them choosing OTC NRTs. In addition, obese smokers were more likely to use smoking cessation medication. A potential reason could be that those obese smokers may have more concern about their health status. Furthermore, the number of cigarettes smoked per day and having smoking-related conditions were associated with smoking cessation aids use in previous reports [14]. However, in our study we found comorbidity was not a significant predictor and were not able to assess the number of cigarettes smoked per day as this information is not available in MEPS dataset.

Strength

This study used MEPS data, a nationally representative data, which provides accurate prescribing information and also has a good external validity [15]. Furthermore, oversampling of the minority population in MEPS makes it an ideal database to study racial/ethnic disparity. In MEPS, each member of the sampled family needs to report their race and ethnicity. The premise of oversampling Hispanics and Blacks in MEPS allows the provision of reliable estimates for these subpopulations. A previous study by Wang *et al* has categorized race groups into non-Hispanic Whites, non-Hispanic Blacks, and Hispanic Whites which aimed at examining race effects across these different race groups [26]. The racial groups included in the study conducted by Mehta *et al* were non-Hispanic Whites, non-Hispanic Blacks, Hispanics, and other races which aimed at assessing disparities in anti-obesity medication use using MEPS data [27]. Our study also included these four racial groups, the rich information of racial groups in MEPS data makes our result reliable and also are more generalizable compared to studies

which use most other data sources. In our study, we found there was a racial disparity in smoking cessation medication use among adult smokers. Since smoking cessation medication plays an important role in reducing tobacco use, our finding identified the potential minority groups which had barrier to use smoking cessation medication and some other significant factors which were associated with smoking cessation medication use. Further research can be investigated to find the reasons for this disparity thus improving smoking cessation treatment outcome.

Limitation

However, this study has some limitations. This study is a cross-sectional study, which limits the ability to make causal inferences. In MEPS dataset, BMI was calculated using self-reported height and weight, as a result, the possibility of reporting errors existed, which may also affect the normal weight, overweight, obese, and extreme obese category among adult smokers. In our analysis, the dependent variable was the use of any type of cessation medication. However, this database could not capture any information about non-prescription medications for smoking cessation treatment. Some forms of NRT were provided as prescription and some were provided as OTC, For instance, nicotine gum, nicotine patch, and nicotine lozenges which are different types of NRT, are available OTC at local pharmacy, which cannot be captured in MEPS, it might be challenging to examine each of the NRTs using MEPS database, which is a limitation of using MEPS database. Furthermore, various characteristics such as nicotine dependence, physician specialty, smoking cessation counseling, and previous quitting attempts are significant factors determining smoking cessation medication use. However, these factors were not controlled for because they were not available in the MEPS dataset. In addition, there may be some unobservable factors as potential confounding which may also contribute to smoking cessation medication use. In our study, we could not control these factors. Furthermore, in MEPS, data are collected by a self-report survey, which may lead to self-report bias in our study.

CONCLUSION

In summary, our study identified the potential minority groups, which had a barrier to use smoking cessation medication and some other significant factors, which were associated with smoking cessation medication use.

FUTURE STUDY

Future study may need to investigate race disparity in the use of each type of cessation medication (varenicline, bupropion, and NRT). Future studies should also investigate the underlying reasons for the ethnic disparity in smoking cessation medication use and tailor culturally appropriate interventions to specific minority groups, for instance, combined pharmacotherapy or pharmacotherapy combined with counseling or other behavioral intervention like motivational interview or other phone call intervention to improve the treatment outcomes among minority groups.

DECLARATION

Ethical approval: The study was approved by the IRB at the University of Houston.

Publication statement: This study has not been published elsewhere, and it has not been submitted simultaneously for publication elsewhere.

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Source of Support: Nil, Conflict of Interest: None declared.