Cigarette Smoking, Mental Health, Depression, Maryland Behavioral Risk Factor Surveillance System Survey, 2020

Tobacco Use Insights
Volume 17: 1–10

DOI: 10.1177/1179173X241285351
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ABSTRACT

BACKGROUND: Smoking cessation is linked to improved mental health that encompasses the overall well-being and psychological functioning of an individual.

OBJECTIVE: Examine relationships between smoking, mental health, and social connectedness among adults in Maryland, US in 2020.

METHODOLOGY: This cross-sectional study used data from the Maryland 2020 Behavioral Risk Factor Surveillance System Survey of adults during the onset of COVID-19. Primary outcomes measured include demographics, depression, and number of not good mental health days among individuals with current and former smoking statuses compared to those who have never smoked.

RESULTS: Compared to those who never smoked, individuals who currently smoked had an increased relative risk of reporting 14 or more days of not good mental health (RRR = 1.63, 95% CI: 1.35-1.97, $P < .001$) and a history of depression (RRR = 1.99, 95% CI: 1.69-2.35, $P < .001$). Individuals with former smoking status also showed elevated risk, with RRR = 1.24 (95% CI: 1.06-1.45, $P = .006$) for 14 or more days of not good mental health and RRR = 1.46 (95% CI: 1.28-1.66, $P < .001$) for a history of depression. Widowed, separated, or divorced; unemployed or unable to work; without a high school diploma; or recent physical exam were inclined to have a current or former smoking status.

CONCLUSION: We identify critical subpopulations vulnerable to life-long smoking behaviors amid the COVID-19 pandemic including adults under 35 years old, and those suffering from depression, a lack of social connectedness due to unemployment, changes in marital status, and outdated physical exams. The US Surgeon General's 2023 Advisory on the epidemic of loneliness and the 2021 Youth Mental Health Report emphasize the mental health crises among the young in which these findings serve as a compelling call to action for innovating targeted public health interventions.

KEYWORDS: smoking, smoking cessation, mental health, depression, COVID-19, behavioral risk factor surveillance survey, social isolation

RECEIVED: July 8, 2024. **ACCEPTED:** September 2, 2024.

TYPE: Original Research Article

DECLARATION OF CONFLICTING INTERESTS: The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

FUNDING: The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This work was supported in part by the Maryland Cigarette Restitution Fund and the NCI Regional Oncology Center, 5P30CA006973-56. Funders had no role in conducting and writing the manuscript.

DISCLAIMER: The views expressed by authors contributing to this manuscript do not necessarily reflect the opinions of the Department of Health and Human Services, the Centers for Disease Control and Prevention, or the Maryland State Department of Health.

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Introduction

Prevention of the largest contributor to overall cancer deaths and incidence involves addressing current and former smoking in the population. Primary prevention entails limiting and potentially eliminating smoking uptake in each generation from ever starting to smoke tobacco – maximizing the people who "never smoked". Secondary prevention involves assisting those who currently smoke to quit and to stay "quit smoking", and to provide lung cancer screening to at-risk individuals, including those who currently smoke and those who used to smoke who meet screening criteria.

Data Availability Statement included at the end of the article

For many individual states in the United States (US) that have reached relatively low smoking prevalence, the goal to avert lung and other smoking-related cancers is becoming a reality. Tried and true interventions such as enacting laws to regulate indoor air, hiking taxation of nicotine products, establishing a state Quitline (a confidential and free telephone-based resource available in the States), investing in local tobacco control interventions, and restricting the age at which one can purchase cigarettes have served states like Maryland (MD) well. In 2020, MD prevalence ranked fourth lowest in the prevalence of people who are currently smoking (10.9%), and third highest in the prevalence of people who have never smoked (68.2%) among the U.S. states and Washington, DC.[1] A next step for these well performing states is to newly identify potential target populations.

During such progress, we can recognize gains in many demographic groups, though the pace of current smoking declines remains disproportionate for some subpopulations. For example, from 2001 to 2021, MD race-specific, current smoking prevalence declined by 45.6%, 55.6%, and 71.88% among White, Black, and Hispanic residents, respectively.[1] prevalence rate differences among the races and those of Hispanic ethnicity but today are however statistically nonsignificant in MD.[1] Thus, it may be time to re-examine additional demographic characterizations of those most at risk for smoking.

One subpopulation overrepresented among those who smoke is those diagnosed with mental illness.[2,3] There has long been recognition that those who are depressed, anxious, schizophrenic, or psychotic are more often people who currently or previously smoked, [3-6] though efforts to help them quit smoking or not start have been applied ineffectively.[5,7] Mental health issues may be a major reason individuals begin tobacco use as well.[3,7] One quarter of individuals who smoke report 14 or more not good mental health days in the last month, and nearly a third report a diagnosis of depression.[1] In the public health literature, number of not good mental health days[1,8] is positively correlated with stressful conditions such as experiencing a hurricane[9] and suboptimal cardiovascular health, as examples of stress, independent of depression.[10] Being a report of not good mental days in the past 30, makes this variable more contemporaneous than history of depression, which is over a lifetime.

As members of the Maryland Cancer Collaborative, we have focused on tobacco use in 2020, the most recent data available, among those with mental health issues for the state of Maryland. Therefore, we hypothesized that not good mental health days and history of depression are correlated with being a person who smokes or who has quit tobacco smoking as compared to one who has never smoked in a state with low current smoking prevalence. In this cross-sectional study, we seek to learn what subpopulations with current or former smoking status, in addition to reported mental health issues would have an impact on smoking prevalence beyond that of mental health. Health care access features, physical health, social and demographic characteristics will be examined among individuals who currently or formerly smoked compared to those who never smoked.

Methods

Study Population, Study Sample, and Study Design

Maryland survey responses from the 2020 Behavioral Risk Factor Surveillance System Survey were selected due to the investigative team's interest in characterizing their state as one that had achieved a low smoking prevalence in order to more easily uncover factors correlated with smoking status and perhaps define new potential target populations for intervention. Behavioral Risk Factor Surveillance Survey (BRFSS) is conducted in partnership with state health departments and annually collects survey responses from adults about their health and factors that influence the leading causes of death through interviews conducted on both landlines and cell phones.

BRFSS Standard Data Files, Codebook, Data User Guide, appendices, data collection methods, and validation studies are available at https://www.cdc.gov/brfss/.[1] Demographic, social, health care access, health insurance coverage, health variables, and calculated variables were extracted from the 2020 BRFSS.

In this cross-sectional study, the original set of surveys numbered 14 292. Except for the variable "time since last checkup", surveys that included responses of "don't know", "refused", or missing were dropped. The analysis included 12 145 responses. Missing smoking status was by far the most common reason (1047/14 292 = 7.3%) a survey was dropped. The number of surveys dropped next for any other reasons ranged from zero (sex and age) to 397 (race and not good mental health days). This study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline. In our analysis, we encountered a high frequency of missing data points. However, upon thorough examination, we determined that these were missing completely at random (MCAR), which suggests that the missingness is independent of the study variables and the missing data itself.[11] Statistical tests were conducted to support this determination, confirming that the missingness did not introduce bias into our results. Therefore, we proceeded with the analysis without applying weights, as applying weights in the context of missing completely at random data does not affect the validity of the statistical inferences made from the data. This decision aligns with recommendations from the statistical literature on handling missing data under the assumption of missing completely at random.[12] Nonetheless, we acknowledge this methodological choice in our limitations section and suggest that future research could explore the use of imputation techniques to verify the robustness of our findings. Due to the relatively high frequency of missing values, we opted to analyze these data without weights.

Study Measures

Outcome Variable. The study's primary outcome, smoking status, was trichotomized as those who never smoked (reference, n = 7408), those who previously smoked (n = 3344), and those

who currently smoke (n = 1393). This is a CDC-calculated variable. The definitions for individuals with different smoking statuses as per BRFSS follows: An individual who currently smokes: An individual who has smoked at least 100 cigarettes in their lifetime and currently smokes every day or some days. An individual who previously smoked: An individual who has smoked at least 100 cigarettes in their lifetime but currently does not smoke at all. An individual who has never smoked: An individual who has never smoked or has smoked fewer than 100 cigarettes in their lifetime.[1]

Independent Variables. Mental health was self-reported in two questions. First being, history of depression was derived from the question "Have you ever been told you had a depressive disorder?" (Yes or No). Second, the not good mental health days variable was derived from the question, "Thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good?" (categorized as 0, 1-14, or 14 or more days).[1]

Covariates. Demographic variables of age, sex, race, and ethnicity were used. Age was recorded from six CDC imputed age groups into 18-34 years, 35-64 years, and 65 years and older (reference) to capture the experience of those just taking up the behavior, those of working age, and those who had the highest historical rates of smoking. Self-reported sex was coded as male (reference) or female. Race was recoded as non-Hispanic White (reference), non-Hispanic Black, and Hispanic. Other non-Hispanic races or non-Hispanic ethnicity or multiple races were grouped as other/multi-races due to few observations.

Social variables of education level, employment status, and marital status were defined as follows. Education level was trichotomized as having any college (reference), high school degree, and less than high school graduation schooling. Employment status was categorized as employed or self-employed full-time (reference), part-time, out of work, homemaker, student, retired, or unable to work. Marital status was categorized as married (reference), a member of an unmarried couple, divorced, widowed, or separated, and never married.

Health care variables of health care coverage, number of health care provider(s), time since last checkup; and number of days of not good physical health days were included. Health care coverage refers to possession of health insurance (Yes or No). personal physician was dichotomized into one or more provider (reference) or no provider. Time since last routine checkup was categorized as 1-2 years ago (reference), 3-5 years ago, more than 5 years ago, don't know, or never.

Not good physical health days was categorized into 0 (reference), 1-14, and 14 or more days in the past month.

Statistical Analysis. Tabulations and modelling of odds ratios and other statistics were calculated using Stata, Version 17. Chi-squared testing evaluated independence of observations, univariate logistic and multinomial logit regression derived odds ratios (ORs). *P*-values less than .05 were considered statistically significant in assessing the two outcome variables. We carried out backward elimination ($P > .05$) to ascertain the final model. Demographic variables of age, sex, race, Hispanic ethnicity were deemed covariates and were kept in the adjusted model at all stages of variable elimination.

Definitions and Use of Inclusive Language. The manuscript has been carefully reviewed to ensure terminology that aligns with the goal of using non-stigmatizing, people-first language when discussing smoking status.[13]

Institutional Review Board (IRB) Review. The Johns Hopkins Bloomberg School of Public Health IRB found this study to be exempt as it involved publicly available data.

Results

As shown in Table 1, never, former, and current smoking statuses differed statistically by all respondent demographics, social, health care factors, physical health, and mental health. Among those who currently smoke were predominantly 35-64 years old (62.7%), male (51.0%), individuals who were White (65.8%), married (36.0%), employed (50.8%), or college-educated (46.4%). Among smoking status groups, these people reported most often 14 or more not good physical health days (14.3%), no or not recent physical checkup (7.5%), and no health insurance (8.8%). People who previously smoked were predominately older than age 65 years (49.3%), male (50.3%), individuals who were White (77.8%), married (55.5%), full-time employed (45.0%), and college-educated (66.0%), while most often possessing a personal doctor (92,2%) or having a recent physical checkup (94.4%). People who never smoked were predominately aged 35-64 (50.8%), female (58.7%), individuals who were White (64.0%), married (53.0%), full-time employed (57.5%), and college-educated (74.5%) (Table 1).

Table 2 shows the unadjusted OR of 14 or more and 1-14 not good mental health days compared to zero not good mental health days and self-reported depression compared to no depression by selected demographic, healthcare, and not good physical health factors. OR of self-reported depression and not good mental health days show statistically significant detrimental relationships of more than 4-fold.

At greatest risk for 14 or more not good mental health days are those aged under 35 (RRR = 3.61, 95% CI: 3.04 to 4.29), female (RRR = 1.82, 95% CI: 1.62 to 2.05), part of an unmarried couple (RRR = 2.86, 95% CI: 2.14 to 3.82), never married (RRR = 2.57, 95% CI: 2.23 to 2.98), out of work (RRR = 2.46, 95% CI: 2.01 to 3.00), student (RRR = 3.18, 95% CI: 3.30 to 4.41), or unable to work (RRR = 5.60, 95% CI: 4.58 to 6.83). The category of 14 or more not good physical health days (RRR = 8.98, 95% CI: 7.66 to 10.52) Education showed disparate risk. Those with less than high school and high school graduate education were at risk for not good mental health days

Table 1. Respondent baseline characteristics by smoking status, Maryland BRFSS 2020.

CHARACTERISTICS	SMOKING STATUS			
	THOSE WHO HAVE NEVER SMOKED N (%)	THOSE WHO PREVIOUSLY SMOKED N (%)	THOSE WHO CURRENTLY SMOKE N (%)	TOTAL
	(n = 7408)	(n = 3344)	(n = 1393)	(n = 12 145)
Age (Years)				
65+	2245 (30.3)	1648 (49.3)	301 (21.6)	4194 (34.5)
35-64	3762 (50.8)	1488 (44.5)	873 (62.7)	6123 (50.4)
<35	1401 (18.9)	208 (6.2)	219 (15.7)	1828 (15.1)
Sex				
Male	3063 (41.4)	1683 (50.3)	710 (51.0)	5456 (44.9)
Female	4345 (58.7)	1661 (49.7)	683 (49.0)	6689 (55.1)
Race/Ethnicity				
White	4720 (64.0)	2603 (77.8)	917 (65.8)	8260 (68.0)
Black	1697 (22.9)	478 (14.3)	323 (23.2)	2498 (20.6)
Other/Multi Races	480 (6.5)	142 (4.3)	103 (7.4)	725 (6.0)
Hispanic	491 (6.6)	121 (3.6)	50 (3.6)	662 (5.5)
Marital status				
Married	3925 (53.0)	1855 (55.5)	501 (36.0)	6281 (51.7)
Unmarried Couple	260 (3.5)	89 (2.7)	63 (4.5)	412 (3.4)
Widow, Separated, Divorced	1602 (21.6)	1013 (30.3)	482 (34.6)	3097 (25.5)
Never Married	1621 (21.9)	387 (11.6)	347 (24.9)	2355 (19.4)
Employment Status				
Employed	4258 (57.5)	1506 (45.0)	707 (50.8)	6471 (53.3)
Out of work	426 (5.8)	185 (5.5)	176 (12.6)	787 (6.5)
Homemaker	298 (4.0)	115 (3.4)	402 (2.9)	453 (3.7)
Student	290 (3.9)	7 (.2)	16 (1.2)	313 (2.6)
Retired	1885 (25.5)	1357 (40.6)	261 (18.7)	3503 (28.8)
Unable to Work	251 (3.4)	174 (5.2)	193 (13.9)	618 (5.1)
Education Status				
Any College	5518 (74.5)	2206 (66.0)	646 (46.4)	8370 (68.9)
HS Graduate	1584 (21.4)	973 (29.1)	574 (41.2)	3131 (25.8)
< High School	306 (4.1)	165 (4.9)	173 (12.4)	644 (5.3)
Physical Checkup				
1-2 Years	6796 (91.7%)	3155 (94.4)	1213 (87.1)	11 164 (91.9)
3-5 Years	366 (4.9)	112 (3.4)	76 (5.5)	554 (4.6)
>5 Years, DK, Never	246 (3.3)	77 (2.3)	104 (7.5)	427 (3.5)
Personal Doctor				
One or More	6534 (88.2)	3083 (92.2)	1158 (83.1)	10 775 (88.7)
No	874 (11.8)	261 (7.8)	235 (16.9)	1370 (11.3)
Health Insurance				
No	448 (6.0)	139 (4.2)	122 (8.8)	709 (5.8)
Yes	6960 (94.0)	3205 (95.8)	1271 (91.2)	11 436 (94.2)
Not Good Physical Health Days				
0 Days	5504 (74.3)	2338 (69.9%)	887 (63.7)	8729 (71.9)
1-14 Days	1394 (18.8)	640 (19.1)	307 (22.0)	2341 (19.3)
14+ Days	510 (6.9)	366 (10.9)	199 (14.3)	1075 (8.8)
Self-Reported Depression				
No	6382 (86.2)	2739 (81.9)	975 (70.0)	10 096 (83.1)
Yes	1026 (13.9)	605 (18.1)	418 (30.0)	2049 (16.9)
Not Good Mental Health Days				
0 Days	4783 (64.6)	2224 (66.5)	734 (52.7)	7741 (63.7)
1-14 Days	1916 (25.9)	738 (22.1)	350 (25.8)	3013 (24.8)
14+ Days	709 (9.6)	382 (11.4)	300 (21.5)	1391 (11.5)

Note. Values are presented as N (%), where N is the number of respondents and % is the percentage of the total within each category.

Table 2. RRR of not good mental health days and depression by selected demographic, health care, and not good physical health factors, Maryland, BRFSS, 2020.

	NOT GOOD MH 1 TO 14 DAYS		NOT GOOD MH 14+ DAYS		DEPRESSION	
	RRR (95% CI)	*P* VALUE	RRR (95% CI)	*P* VALUE	RRR (95% CI)	*P* VALUE
Age (Years)						
65+	Reference		Reference		Reference	
35-64	1.88 (.170 to 2.08)	.000***	1.88 (1.64 to 2.16)	.000***	1.43 (1.28 to 1.59)	.000***
<35	3.82 (3.36 to 4.35)	.000***	3.61 (3.04 to 4.29)	.000***	1.95 (1.69 to 2.24)	.000***
Sex						
Male	Reference		Reference		Reference	
Female	1.87 (1.71 to 2.04)	.000***	1.82 (1.62 to 2.05)	.000***	1.82 (1.65 to 2.01)	.000***
Race/Ethnicity						
White	Reference		Reference		Reference	
Black	.86 (.77 to .96)	.007**	.98 (.85 to 1.13)	.752	.65 (.57 to .74)	.000***
Other/Multi Races	1.04 (.88 to 1.25)	.614	1.26 (1.00 to 1.58)	.046*	.89 (.73 to 1.09)	.278
Hispanic	.68 (.56 to .83)	.560	.72 (.54 to .95)	0.018*	.49 (.38 to .64)	.000***
Marital status						
Married	Reference		Reference		Reference	
Unmarried Couple	2.31 (1.86 to 2.89)	.000***	2.86 (2.14 to 3.82)	.000***	1.74 (1.36 to 2.22)	.000***
Widow, Separated, Divorced	1.01 (.91 to 1.12)	.853	1.61 (1.40 to 1.86)	.000***	1.43 (1.27 to 1.60)	.000***
Never Married	1.73 (1.55 to 1.93)	.000***	2.57 (2.23 to 2.98)	.000***	1.83 (1.62 to 2.07)	.000***
Employment Status						
Employed	Reference		Reference		Reference	
Out of work	1.21 (1.02 to 1.44)	.031*	2.46 (2.01 to 3.00)	.000***	1.88 (1.58 to 2.24)	.000***
Homemaker	1.1 (.88 to 1.36)	.397	1.15 (.84 to 1.57)	.392	1.21 (.94 to 1.56)	.137
Student	2.73 (2.12 to 3.51)	.000***	3.18 (2.30 to 4.41)	.000***	1.64 (1.25 to 2.17)	.000***
Retired	.55 (.49 to .61)	.000***	.67 (.58 to .78)	.000***	.90 (.80 to 1.02)	.092
Unable to work	1.39 (1.13 to 1.71)	.002**	5.60 (4.58 to 6.83)	.000***	5.21 (4.39 to 6.20)	.000***
Education Status						
Any College	Reference		Reference		Reference	
HS Graduate	.76 (.69 to .84)	.000***	1.15 (1.01 to 1.31)	.032*	1.03 (.93 to 1.15)	.559
< High School	.64 (.52 to .79)	.000***	1.51 (1.20 to 1.88)	.000***	1.31 (1.08 to 1.60)	.007**
Physical Checkup						
1-2 Years	Reference		Reference		Reference	
3-5 Years	1.29 (1.07 to 1.57)	.009**	.05 (.23 to .33)	.733	.86 (.67 to 1.09)	.199
>5 Years, DK, Never	.91 (.71 to 1.15)	.423	.37 (.10 to .64)	.008**	.78 (.59 to 1.03)	.078
Personal doctor						
One or More	Reference		Reference		Reference	
None	1.14 (1.00 to 1.30)	.055	1.29 (1.08 to 1.53)	.004**	.80 (.69 to .94)	.007**
Health Insurance						
No	Reference		Reference		Reference	
Yes	1.34 (1.11 to 1.63)	.003**	.91 (.73 to 1.15)	.446	1.44 (1.15 to 1.81)	.002**
Not Good Physical Health days						
0 Days					Reference	
1-14 Days	2.57 (2.32 to 2.84)	.000***	3.06 (2.65 to 3.54)	.000***	2.37 (2.11 to 2.65)	.000***
14+ Days	1.84 (1.56 to 2.17)	.000***	8.98 (7.66 to 10.52)	.000***	4.19 (3.65 to 4.82)	.000***
Self-Reported Depression						
No	Reference		Reference		Reference	–
Yes	4.56 (4.04 to 5.14)	.000***	16.40 (14.29 to 18.82)	.000***	–	–

(Continued)

Table 2. Continued.

	NOT GOOD MH 1 TO 14 DAYS		NOT GOOD MH 14+ DAYS		DEPRESSION	
	RRR (95% CI)	*P* VALUE	RRR (95% CI)	*P* VALUE	RRR (95% CI)	*P* VALUE
Not Good Mental Health Days						
0 Days	Reference	–	–	–	Reference	
1-14 Days	–	–	–	–	4.56 (4.04 to 5.14)	.000***
14+ Days	–	–	–	–	16.4 (14.29 to 18.82)	.000***

Note. RRR, relative risk ratio, CI, confidence interval. $P < .05$: *$P < .01$: **$P < .001$: ***.

(RRR = 1.15, 95% CI: 1.01 to 1.31) and (RRR = 1.51, 95% CI: 1.20 to 1.88, respectively), yet these groups were protected when not good mental days numbered 1-14 (RRR = .64, 95% CI: .52 to .79 and RRR = .76, 95% CI .69 to .84). Likewise, retired individuals were protected in both categories (RRR = .67, 95% CI: .58 to .78 and RRR = .55, 95% CI: .49 to .61) of not good mental health days (Table 2).

With respect to health care factors, 1-14 not good mental health days were associated with more health insurance (RRR = 1.34, 95% CI: 1.11 to 1.63) but not with having a personal physician or a physical checkup within the past 5 years. However, those with more than 14 not good mental health days were more likely to report a personal physician (RRR = 1.29, 95% CI: 1.08 to 1.53) yet less likely to have had no physical checkup in more than 5 years (RRR = .37, 95% CI: .10 to .64) (Table 2).

With respect to history of depression, many of the same population segments had greater risk including the following: those aged <35, aged 35 to 64, females, part of an unmarried couple, widowed, separated, divorced, never married; out of work , student, unable to work, less than high school education, and health insurance. Characteristics that predicted less reporting of depression included the Black race, Hispanic ethnicity, and not having a personal doctor (Table 2).

In Tables 3 and 4, we report unadjusted univariate and multinomial logit full and reduced models for individuals with current and former smoking status compared to people who have never smoked. In the univariate OR compared to full model results, there was consistency of statistical significance and direction by age, sex, all races (but not other/multi-race, marital), employment, education, physical checkup, personal doctor, self-report of depression, and not good physical days (>14 days, full model only). After adjusting for covariates, the comparison between persons who currently smoke and persons who have never smoked (RRR = 1.63, 95% CI:1.95 to 1.97, $P < .0001$) reveals that not good physical health days became nonsignificant (full model only), and not good mental health days 1-14 became borderline significant in the full model or remained significant in the reduced model. In the backward approach to the most parsimonious model, health insurance and not good physical health days were no longer significant. The level of significance and direction of ORs did not change for the study's independent variables of mental health (Table 4).

Among those who previously smoked compared to never smoked, after adjustment, there was consistency of significance and direction of ORs by age, sex, race, employment, education, and self-reported depression compared to unadjusted ORs. Being in an unmarried couple, having had a physical exam 3-5 years ago, no personal doctor, health insurance, and 1-14 not good mental health days became nonsignificant after adjustment. When contrasting the final to the full model for people who previously smoked and people who never smoked, we found no change in significance or direction of ORs for all variables except for physical checkup (3-5 years), which moved from not significant to borderline significant (Table 4).

Considering people who currently smoke and people who previously smoked compared to people who never smoked, ORs were significantly elevated for both groups regarding widowed, marital status, out of work and unable to work employment status, education up to high school, self-reported depression, and 14 or more not good mental health days, but lower ORs for never married. In the final models, ORs in both people who currently smoke and people who previously smoked, ORs were significantly less than one for females, Blacks Hispanics, and students (Table 4).

Smoking status differed in a few variables. First, compared to people who never smoked, those who currently smoke showed elevated ORs while individuals who previously smoked had ORs less than or equal to one for ages 35-64, other or multi-race, never married, physical checkup more than 5 years ago or never having a personal doctor (Tables 3 and 4).

Discussion

Our findings suggest that self-reported history of depression and 14 or more not good mental health days were about twice as common among people who currently smoke and those who previously smoked compared to those who never smoked. Any not good mental health days were associated with a higher likelihood of current smoking, while for people who previously smoked, only 14 or more days of not good mental health was important. Encinosa and colleagues[14] reported a greater number of cigarettes smoked among those with mental and behavioral health issues. Self-reported depression played a significant role in predicting both current and former smoking status as demonstrated by Steinberg and colleagues[15] who also suggest

Table 3. RRR of those who currently smoke or those who previously smoked compared to those who have never smoked by selected demographic, health care, and physical and mental health factors, Maryland, BRFSS, 2020.

	THOSE WHO CURRENTLY SMOKE VS THOSE WHO HAVE NEVER SMOKED				THOSE WHO PREVIOUSLY SMOKED VS THOSE WHO HAVE NEVER SMOKED			
	UNIVARIATE RRR		FULL MODEL RRR		UNIVARIATE RRR		FULL MODEL RRR	
	RRR (95% CI)	*P* VALUE	RRR (95% CI)	*P* VALUE	RRR (95% CI)	*P* VALUE	RRR (95% CI)	*P* VALUE
Age (Years)								
65+	Reference				Reference			
35-64	1.73 (1.50 to 1.99)	.000***	1.80 (1.47 to 2.20)	.000***	.54 (.49 to .59)	.000***	.69 (.61 to .78)	.000***
<35	1.17 (.97 to 1.40)	.107	1.03 (.78 to 1.35)	.847	.20 (.187 to .24)	.000***	.33 (.27 to .40)	.000***
Sex								
Male	Reference				Reference			
Female	.68 (.60 to .76)	.000***	.60 (.53 to .69)	.000***	.70 (.64 to .76)	.000***	.62 (.57 to .68)	.000***
Race/Ethnicity								
White	Reference				Reference			
Black	.51 (.46 to .57)	.000***	.76 (.65 to .89)	.001**	.51 (.46 to .57)	.000***	.57 (.50 to .64)	.000***
Other/Multi Races	.54 (.44 to .65)	.000***	1.17 (.92 to 1.49)	.212	.54 (.44 to .65)	.000***	.74 (.60 to .90)	.003**
Hispanic	.45 (.37 to .55)	.000***	.29 (.20 to .41)	.000***	.45 (.37 to .55)	.000***	.63 (.50 to .79)	.000***
Marital Status								
Married	Reference				Reference			
Unmarried Couple	1.90 (1.42 to 2.54)	.000***	1.79 (1.30 to 2.46)	.000***	.72 (.57 to .93)	.010*	1.15 (.88 to 1.50)	.312
Widow, Separated, Divorced	2.36 (2.05 to 2.71)	.000***	2.27 (1.95 to 2.65)	.000***	1.34 (1.21 to 1.47)	.000***	1.21 (1.09 to 1.35)	.000***
Never Married	1.68 (1.44 to 1.95)	.000***	1.46 (1.22 to 1.75)	.000***	.51 (.45 to .57)	.000***	.85 (.74 to .98)	.023*
Employment Status								
Employed	Reference				Reference			
Out of work	2.49 (2.05 to 3.102)	.000***	1.92 (1.55 to 2.36)	.000***	1.23 (1.02 to 1.47)	.027*	1.30 (1.07 to 1.57)	.007**
Homemaker	.81 (.58 to 1.14)	.219	.89 (.62 to 1.29)	.544	1.09 (.87 to 1.36)	.444	.99 (.78 to 1.26)	.947
Student	.33 (.20 to .55)	.000***	.34 (.20 to .59)	.000***	.07 (.03 to .14)	.000***	.14 (.06 to .30)	.000***
Retired	.83 (.72 to .97)	.019*	1.02 (.83 to 1.26)	.823	2.04 (1.86 to 2.23)	.000***	1.24 (1.09 to 1.41)	.001**
Unable to work	4.63 (3.78 to 5.68)	.000***	1.91 (1.50 to 2.45)	.000***	1.96 (1.60 to 2.40 ()	.000***	1.35 (1.08 to 1.68)	.009**
Education Status								
Any College	Reference				Reference			
HS Graduate	3.10 (2.73 to 3.51)	.000***	2.92 (2.55 to 3.34)	.000***	1.54 (1.40 to 1.69)	.000***	1.53 (1.38 to 1.69)	.000***
< High School	4.83 (3.94 to 5.92)	.000***	4.56 (3.60 to 5.78)	.000***	1.35 (1.11 to 1.64)	.003**	1.46 (1.17 to 1.81)	.001**
Physical Checkup								
1-2 Years	Reference				Reference			
3-5 Years	1.16 (.90 to 1.50)	.244	1.04 (.79 to 1.38)	.770	.66 (.53 to .82)	.000***	.83 (.65 to 1.043)	.109
>5 Years, DK, Never	2.37 (1.87 to 3.00)	.000***	1.73 (1.30 to 2.31)	.000***	.67 (.52 to .87)	.003**	.74 (.56 to .99)	.044*
Personal Doctor								
One or More	Reference				Reference			
None	1.52 (1.30 to 1.78)	.000***	1.29 (1.05 to 1.58)	.016*	.63 (.55 to .73)	.000***	1.00 (.84 to 1.20)	.956
Health Insurance					Reference			
No	Reference				Reference			
Yes	.67 (.54 to .83)	.000***	1.04 (.80 to 1.35)	.751	1.48 (1.22 to 1.80)	.000***	1.05 (.84 to 1.31)	.681
Not Good Physical Health days								
0 Days	Reference				Reference			
1-14 Days	1.37 (1.19 to 1.58)	.000***	1.12 (.96 to 1.31)	.155	1.08 (.97 to 1.20)	.148	1.09 (.97 to 1.22)	.147
14+ Days	2.42 (2.03 to 2.89)	.000***	1.17 (.95 to 1.46)	.146	1.69 (1.46 to 1.95)	.000***	1.17 (1.00 to 1.38)	.046*
Self-Reported Depression								
No					Reference			
Yes	2.67 (2.34 to 3.04)	.000***	1.97 (1.67 to 3.32)	.000***	1.37 (1.23 to 1.53)	.000***	1.44 (1.27 to 1.64)	.000***
Not Good Mental Health Days								
0 Days	Reference				Reference			
1-14 Days	1.22 (1.06 to 1.40)	.004**	1.14 (.98 to 1.34)	.087	.83 (.75 to .91)	.000***	1.01 (.91 to 1.13)	.803
14+ Days	2.76 (2.36 to 3.22)	.000***	1.57 (1.29 to 1.91)	.000	1.16 (1.01 to 1.33)	.031*	1.19 (1.02 to 1.40)	.030*

Note. RRR, relative risk ratio, CI, confidence interval. $P < .05$: *$P < .01$: **$P < .001$: ***.

Table 4. RRR of those who currently smoke or those who previously smoked compared to those who have never smoked by selected demographic, health care, and physical and mental health factors, Maryland, BRFSS, 2020.

	THOSE WHO CURRENTLY SMOKE VS THOSE WHO HAVE NEVER SMOKED		THOSE WHO PREVIOUSLY SMOKED VS THOSE WHO HAVE NEVER SMOKED	
	FINAL MODEL RRR		FINAL MODEL RRR	
	RRR (95% CI)	*P* VALUE	RRR (95% CI)	*P* VALUE
Age (Years)				
65+	Reference		Reference	
35-64	1.90 (1.56 to 2.31)	.000***	.69 (.61 to .78)	.000***
<35	1.09 (.83 to 1.43)	.558	.32 (.26 to .40)	.000***
Sex				
Male	Reference		Reference	
Female	.60 (.53 to .69)	.000***	.62 (.56 to .68)	.000***
Race/Ethnicity				
White	Reference		Reference	
Black	.76 (.65 to .89)	.001**	.56 (.50 to .64)	.000***
Other/Multi Races	1.17 (.92 to 1.49)	.209	.74 (.60 to .90)	.003**
Hispanic	.28 (.20 to .40)	.000***	.62 (.50 to .78)	.000***
Marital status				
Married	Reference		Reference	
Unmarried Couple	1.78 (1.30 to 2.45)	.000***	1.14 (.88 to 1.49)	.322
Widow, Separated, Divorced	2.28 (1.95 to 2.65)	.000***	1.21 (1.09 to 2.35)	.000***
Never Married	1.46 (1.22 to 1.75)	.000***	.85 (.73 to .98)	.023*
Employment Status				
Employed	Reference		Reference	
Out of work	1.92 (1.56 to 2.37)	.000***	1.31 (1.08 to 1.58)	.006**
Homemaker	.90 (.62 to 1.29)	.568	1.00 (.79 to 1.26)	.977
Student	.35 (.20 to .59)	.000***	.14 (.065 to .30)	.000***
Retired	1.04 (.84 to 1.28)	.744	1.25 (1.10 to 1.42)	.001***
Unable to work	2.02 (1.60 to 2.55)	.000***	1.42 (1.14 to 1.76)	.002**
Education Status				
Any College	Reference		Reference	
HS Graduate	2.92 (2.56 to 2.34)	.000***	1.53 (1.38 to 1.69)	.000***
< High School	4.57 (3.61 to 5.78)	.000***	1.46 (1.18 to 1.81)	.001***
Physical Checkup				
1-2 Years	Reference		Reference	
3-5 Years	1.03 (.78 to 1.37)	.820	.82 (.65 to 1.03)	.095
>5 Years, DK, Never	1.72 (1.30 to 2.29)	.000***	.74 (.56 to .99)	.040*
Personal Doctor				
One or More	–	–	–	–
None	–	–	–	–
Health Insurance				
No	–			
Yes	–			
Not Good Physical Health days				
0 Days	–	–	–	–
1-14 Days	–	–	–	–
14+ Days	–	–	–	–
Self-Reported Depression				
No	Reference		Reference	
Yes	1.99 (1.69 to 2.35)	.000***	1.46 (1.28 to 1.66)	.000***
Not Good Mental Health Days				
0 Days	Reference		Reference	
1-14 Days	1.17 (1.00 to 1.36)	.045*	1.03 (.93 to 1.15)	.579
14+ Days	1.63 (1.35 to 1.97)	.000***	1.24 (1.06 to 1.45)	.006

Note. RRR, relative risk ratio, CI, confidence interval. $P < .05$: *$P < .01$: **$P < .001$: ***.

typical public health smoking cessation interventions may not be reaching adults with poor mental health.

Consistent with previous literature,[16,17] those with current and former smoking status in our study exhibited an increased psychological distress measured by not good mental health days.[18] The American Lung Association[19] reports that 35% of people who use heated tobacco products also have been diagnosed with a behavioral health disorder.[19,20] Moreover, lifetime smoking rates are higher in patients diagnosed with major depression disorder, bipolar disorder, schizophrenia, and other psychotic disorders compared to adults with no mental illness.[4,16,21] Our study confirms that those with a history of depression are at risk for being an individual with current or former smoking status. This study revealed that depression and not good mental health days are independently predictive factors of smoking status. This may occur because each measure, although capturing an aspect of mental health status, pertains to different time spans. Not good mental health days is asked in the context of the last 30 days, while the history of depression considers a lifetime perspective.

A key aspect that surfaces from our study is that after adjustment for demographic, social, and mental and physical health factors, the only health care variable to remain significant is the recency of physical checkup and the effect differed by smoking status comparison. Those who currently smoke compared to those who never smoked had an excess of not recent physical exam checkup, while those who formerly smoked had fewer reports of not recent physical exam checkup.

Previous research studies role of physicians in offering smoking cessation advice is a tool that can notably influence and motivate quit attempts.[22,23] Furthermore, the findings[24] of a systematic review revealed that a brief interaction with a physician can increase the quit rate by 3% to 6%, indicating that physician advice is one of the strongest predictors of cessation behavior.[25,26] Our study confirms this and underscores the importance of bridging this gap to reduce smoking. This suggests that the vulnerable population of those who currently smoke might be doubly marginalized, facing challenges related to both their mental health status and inadequate health care access.

In addition to a lack of connectedness to the health care system, demographic and social data pointed towards the indicators of social isolation[27,28] and perhaps loneliness.[29,30] Both marital and employment status – not being out of work or unable to work – played protective roles against current smoking, indicating possible buffers against the deleterious influences of isolation.[31] At the same time, never married, widowed, separated, or divorced individuals were less often people who previously smoked.[32]

Coinciding with the onset of the SARS-COVID-19 pandemic, year 2020 demographic data highlighted a dearth of connectedness factors predicting smoking status.[33] In a separate look of not good mental health days prevalence over time (BRFSS 2013-2021) among individuals who smoke reveals a decline since 2017, whereas the history of depression peaked in 2018 among those who currently smoke. Conversely, among individuals who formerly smoked, the prevalence of not good mental health days has been increasing since 2016-18 (data not shown).[1]

Compared to 2019 and 2021, the 2020 prevalence of 14 or more not good mental health days, and history of depression among people who currently smoke and people who previously smoked in 2020 is statistically the same (BRFSS, data not shown.[1] Thus, 2020 does not seem to be a particular year when mental health perturbations increased, though smoking did and smoking cessation attempts declined.[18] To gain a more comprehensive understanding of smoking and smoking cessation behaviors, it will be important to examine trends across multiple years, considering the pre-, peri-, and post-COVID eras. Such analysis could confirm that indicators suggestive of social isolation and loneliness have a detrimental impact on health, as evidenced in smoking cessation dynamics, further emphasizing the intricate connection between mental well-being and smoking. These population segments have also been identified in various contemporaneous studies focusing on the intersection of COVID-19 and smoking status.[34-36]

In conclusion, our findings reveal a dual predictive nature of both the history of depression and not good mental health days for smoking status – a connection that, to our knowledge, remains unique and has not been shown elsewhere in the literature. The identification of not good mental health days indicates an expanded population who may be in transitional states regarding smoking and smoking cessation. With raised sensitivity to COVID-related loneliness and isolation,[27,36] the imperative now is to engage these remaining subpopulations of those who currently smokes and those who used to smoke, with an emphasis on reaching additional individuals in need of effective smoking cessation advice.[37,38]

Limitations

The study's findings on mental health and smoking behaviors are based on self-reported data from participants in Maryland during 2020, which may not apply broadly due to potential reporting biases and regional differences. Additionally, causal inferences over time cannot be drawn from the cross-sectional nature of BRFSS data. The analysis excluded survey weights and adjustments for missing data, which could alter the results. Lastly, as only cigarette smoking was considered, the broader impact of nicotine addiction from various sources remains unaddressed.

Conclusion

Our study has identified population subsets at risk for current smoking: individuals experiencing depression and/or reporting not good mental health days. Effective tobacco prevention programs in Maryland must address these challenges by integrating targeted education and treatment. These findings not

only lay the groundwork for targeted public health efforts within the state but also have the potential to inform broader strategies for smoking avoidance and cessation. Future research should leverage findings from this COVID-impacted year for effective targeted interventions and policies.

Author Contributions

Khushbu Balsara was responsible for formal analysis, data curation, writing - original draft, review & editing, project administration. Ali Iftikhar, Panagis Galiatsatos, Carlo DiClemente, and Brian Mattingly were responsible for writing - review & editing. Norma F. Kanarek was responsible for conceptualization, data curation, methodology, writing - original draft, review & editing, supervision, and project administration.

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Data Availability Statement

The data underlying this article are available in open database of Centers for Disease Control and Prevention (CDC), Behavioral Factor Risk Surveillance System (BRFSS), at https://www.cdc.gov/brfss/annual_data/annual_data.htm

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