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Article

Disparities in individual health behaviors between medicaid expanding and non-expanding states in the U.S. [☆]

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ABSTRACT

Following the roll out of the Affordable Care Act, a significant amount of research has focused on health insurance coverage disadvantages experienced by those in states that chose not to expand Medicaid. This line of research has been used as a way to conceptualize potential disparities in future population health outcomes between states that did and did not expand Medicaid. While health insurance is certainly associated with health outcomes, health behaviors are equally, if not more, important. Therefore, to understand potential future population health outcomes - or lack thereof - this paper examines whether adults in states that did not expand Medicaid are also more likely to engage in health damaging behaviors (i.e. smoking, heavy drinking, physical inactivity, and overweight and obesity) than adults in states that expanded Medicaid. I find that those in states that did not expand Medicaid are more likely to be overweight and obese but are less likely to drink heavily compared to adults in states that did expand Medicaid. In part, higher rates of demographic and socioeconomic disadvantage explain higher rates of health damaging behaviors in states that did not expand Medicaid. This paper raises concerns about added long term consequences for population health and growing health disparities between states that did and did not expand Medicaid. Policy and practice implications of these findings are discussed.

1. Introduction

Following the roll out of the Affordable Care Act (ACA), a significant amount of research focused on variation in health insurance status outcomes as a way to conceptualize potential variation in future population health outcomes (Sommers, Maylone, Blendon, Orav, & Epstein, 2017). In particular, states that expanded Medicaid experienced significantly larger improvements in coverage rates than did states that did not expand Medicaid (Rhubart, 2016), raising serious population health concerns about diverging destinies for states that did and did not expand Medicaid. While researchers hypothesize that states that expanded Medicaid will likely experience better population health outcomes than states that did not expand Medicaid, little attention has been paid to if significant differences in other determinants of health (i.e. health damaging behaviors) exist between states that did and did not expand Medicaid.

This paper aims to 1) examine how health behaviors vary between states that did and did not expand Medicaid and 2) how these differences might be explained by individual-level proximate determinants. The findings show that adults in states that did not expand Medicaid are at significantly higher risk of being overweight or obese, but these

disparities are in part explained by higher rates of demographic and socioeconomic disadvantage in non-expansion states. To the author's knowledge, this is the first study to use nationally representative data to show disparities in health damaging behaviors between expansion and non-expansion states. As debates around health care reform continue to center on access to care, this research broadens the discussion for population health research around compounding health disadvantages in states that chose not to expand Medicaid. This paper raises important population health and policy concerns about the lack of attention to some of the strongest predictors of health outcomes (i.e. health damaging behaviors) and how they vary across Medicaid expansion status.

1.1. Medicaid expansion

Health insurance is a predictor of positive population health outcomes (Finkelstein, Taubman, & Wright, 2012, McWilliams, 2009, Hadley, 2003, Hadley, 2007). The Affordable Care Act was meant to level the playing field in access to insurance. In particular, the Medicaid expansion component of the ACA was designed to expand access to Medicaid for families and childless adults who fell below 138 percent of the Federal Poverty Line. However, following the Supreme Court's

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ruling in *National Federation of Independent Business v. Sebelius* in 2012, states could choose not to participate in the Medicaid expansion component of the ACA. By the end of 2016, 20 states had not expanded Medicaid. Research has shown that while health insurance coverage increased overall following the initial implementation of the ACA, improvements were significantly smaller in states that chose not to expand Medicaid (Rhubart, 2016). Researchers argue that with lower access to affordable care, non-expanding states will risk experiencing poorer long term population health outcomes (e.g. Moreno-Serra & Smith, 2012).

1.2. Consequences of health damaging behaviors

Hypotheses about future population health outcomes that rely solely on health insurance are problematic because health is determined by a number of factors, not solely health insurance coverage (Lantz et al., 1998). These other factors include genetics, individual health behaviors, interpersonal and community-level stressors, and social supports. This paper focuses specifically on health behaviors. Health damaging behaviors can include smoking, physical inactivity, overweight and obesity, and heavy drinking (Braveman, Egerter, & Barclay, 2011, Lantz et al., 1998).

Health behaviors are important to understanding population health disparities as they are empirically linked to multiple health outcomes and can ultimately lead to increased health care costs and premature death. For example, *smoking* is associated with a number of adverse health outcomes including acute myeloid leukemia and cancers of the stomach, liver, bladder, cervix, pancreas, kidney, and esophagus (Helms, King, & Ashley, 2017, Sherratt, Field, & Marcus, 2017, HHS, 2014). Stroke, cataracts, coronary heart disease, chronic obstructive pulmonary disease, pneumonia, emphysema, bronchitis, lung cancer, diabetes, cardiovascular disease, immune function issues, and overall diminished health are also more common among smokers (HHS, 2014, Sherratt et al. 2017). *Physical inactivity* is associated with chronic diseases such as cardiovascular disease, diabetes, asthma, arthritis, cancer, and hypertension as well as premature death (Warburton, Nicol, & Bredin, 2006, Humphreys, McLeod, & Ruseski, 2014). And those who are *obese* are at higher risk of chronic diseases such as cardiovascular disease, type 2 diabetes, asthma, renal diseases, and certain types of cancers (Lenz, Richter, & Muhlhauser, 2009, Guh, Zhang, Bansback, Amarsi, & Birmingham, 2009). *Heavy drinking* is also linked to a number of diseases, including tuberculosis, depression, liver cirrhosis and pancreatitis, certain types of cancers, as well as unintentional injuries (Rehm, Samokhvalov, & Neuman, 2009, Boden & Fergusson, 2011, Rehm, Taylor, & Mohapatra, 2010, Irving, Samokhvalov, & Rehm, 2009, Nelson, Jarman, & Rehm, 2013, Cherpitel, 2013). Given the severe and costly health effects of smoking, physical inactivity, overweight and obesity, and heavy drinking, hypotheses about diverging population health destinies of Medicaid expanding and non-expanding states must also account for potential variation in these health damaging behaviors.

1.3. Proximate determinants

While a state's decision whether to expand Medicaid might not inherently impact or explain variation in health behaviors, other characteristics of individuals (i.e. proximate determinants) in states that did not expand Medicaid could be responsible for variation in health behaviors. Proximate determinants - the conditions, opportunities, and resources that an individual has access to - act through health behaviors to influence population health outcomes (Link & Phelan, 1995, Lammle, Woll, Mensink, & Bos, 2013). If, in fact, there is variation in health behaviors between states that did and did not expand Medicaid, then it must be determined whether those differences can be explained by proximate determinants.

Variation in health behaviors exists across several socioeconomic determinants. Smoking (Syamlal, Mazurek, Hendricks, & Jamal, 2015,

NCHS, 2016, Barbeau, Kreiger, & Soobader, 2004, NCHS, 2007, De Vogli & Santinello, 2005, Falba, Teng, Sindelar, & Gallo, 2005), obesity (Slack, Myers, Martin, & Heymsfields, 2014, Levine, 2011) and physical inactivity (Marshall et al., 2007, Parks, Housemann, & Brownson, 2003, Braveman et al., 2011) are more common among those with lower measures of socioeconomic status (e.g. unemployed, low-income, and those with lower levels of formal education). Heavy drinking is also more common among lower socioeconomic status groups (Dávalos, Fang, & French, 2012, Cutler and Lleras-Muney, 2010, Huckle, You, & Casswell, 2010). This literature suggests that socioeconomic factors, which unevenly distribute conditions, resources, and opportunities, explain variation in health damaging behaviors.

Health behaviors also vary across demographic proximate determinants (Braveman et al., 2011, Slack et al., 2014). For example, aggregate data show higher rates of smoking among males, younger age groups, and among American Indian/Alaskan Native and multiracial adults (Garrett, Dube, Winder, & Caraballo, 2013). Rates of obesity tend to be highest among middle aged groups (age 40–59), but variation by race and ethnicity is dependent on gender (Ogden, Carroll, Fryar, & Flegal, 2015). For example, among women, obesity is most common among non-Hispanic black and Hispanic women and non-Hispanic white women (Ogden et al., 2015, Slack et al., 2014, Chang, 2006). Physical inactivity levels also tend to vary across demographic proximate determinants with those age 65 and older and Mexican American and non-Hispanic black adults having the highest rates of physical inactivity (Dai et al., 2015, Marshall et al., 2007). These differences in physical inactivity may be attributable to variation in access to environmental resources (e.g. green spaces, parks, pools, etc.) (Powell, Slater, & Chaloupka, 2004, Duncan, Kawachi, White, & Williams, 2013) as well as age induced functional limitations. Finally, heavy drinking is more common for non-Hispanic whites and some racial and ethnic minority groups, but these trends also vary by age and gender (SAMSHA, 2014, Szaflarski, Cubbins, & Ying, 2011, Delker, Brown, & Hasin, 2016, Bryant & Kim, 2012). This previous literature on proximate determinants justifies the need to incorporate socioeconomic and demographic characteristics into any analyses of health behaviors.

2. Materials and methods

2.1. Data and measures

This paper relies on data from the 2016 Behavioral Risk Factors Surveillance System (BRFSS) survey, which is publicly available (Centers for Disease Control, 2017). BRFSS is an ongoing, state-based, telephone survey of adults in all 50 states, the District of Columbia and U.S. territories. The survey collects data on health-risk behaviors, chronic diseases and conditions, among other variables. Pregnant women were excluded from the present analyses, as their BMI and alcohol consumption measures would likely not accurately reflect their regular health behaviors. The sample was also restricted to those age 25 and older because the analyses control for educational attainment. All adults needed to be old enough to have theoretically been able to complete their schooling. While those age 65 and older do tend to have different health behaviors compared to younger cohorts (e.g. Ogden et al., 2015, Dai et al., 2015), this is accounted for by controlling for age. Moreover, those age 55 and older account for over half of all health care expenditures in the U.S. (Sawyer & Sroczynski, 2017). Therefore, including those age 65 and older allows this paper to pursue a more full understanding of adult health behaviors that are associated with deteriorated quality of life, higher health care costs, and shorter life expectancy. In addition, respondents from U.S. territories and those with missing data were also excluded from the analyses. Restricting the dataset based on pregnancy status, age, and missing data resulted in a final dataset containing 179,265 respondents, or 72.8 percent of all respondents from the 50 states and the District of Columbia.

The four health behaviors of interest in this paper include smoking

status, leisure time physical inactivity, overweight and obesity, and heavy drinking. Each of the health behaviors were dichotomous. Smoking status measures whether respondents indicated that they smoked at least some days and had smoked 100 or more cigarettes in their life. Leisure time physical inactivity measures whether respondents reported not doing any physical activity or exercise (excluding for work) in the last 30 days. Overweight and obesity measures whether respondents' BMI was greater than 25. This was calculated by BRFSS using the respondents' self-reported height and weight. BRFSS uses CDC definitions of what BMI thresholds constitute overweight and obese. A BMI of 25 to 30 is considered overweight and a BMI of over 30 is considered obese. These two categories are combined in this paper. Heavy drinking measures whether respondents indicated that they drink more than 14 [men] or 7 [women] drinks per week on average. This measure is consistent with CDC definitions of heavy drinking. All of the final dependent variables were reported by BRFSS as dichotomous variables.

The independent variable indicates whether the state had expanded Medicaid before the end of 2016. The Kaiser Family Foundation Medicaid status website was used to classify states (Kaiser Family Foundation, 2018). By the end of 2016, twenty states¹ had not expanded Medicaid and thirty states² and the District of Columbia had expanded Medicaid. A dummy variable is used to indicate state-level decisions whether Medicaid was expanded (reference category = expanded Medicaid). This variable is measured at the state-level.

To determine whether proximate determinants help to explain potential variation in health behaviors, several individual-level demographic and socioeconomic variables were controlled for. Control variables include respondent's employment status, educational attainment, income level, insurance status, sex, age, and race and ethnicity. All control variables are categorical. Education attainment categories include did not graduate from high school, graduated from high school, attended college or technical school, or graduated from college or technical school. The income categories include less than \$15,000, \$15,000 to less than \$35,000, \$35,000 to less than \$50,000, and \$50,000 or more. Employment categories include employed, out of work or unable to work, student or homemaker, and retired. A binary variable is also included for whether the respondent had any form of health insurance. Sex categories include male and female. Race and ethnicity categories include non-Hispanic white only, non-Hispanic black only, non-Hispanic other race only, non-Hispanic multiracial, and Hispanic. There were five age categories: 25 to 34, 35 to 44, 45 to 54, 55 to 64, and 65 and older. These control variables were restricted by categories provided by BRFSS.

2.2. Statistical analyses

First, weighted percentage distributions are presented for all of the model variables overall and by Medicaid expansion status (Table 1). This table also presents the significance values of the chi-square tests to determine whether there is a significant relationship between each model variable and whether respondents live in a state that expanded Medicaid. In addition, the weighted prevalence of health damaging behaviors is presented for each of the respondent characteristics (Table 2).

Because the four dependent variables are dichotomous and because the analyses must account for the clustering of individual health behaviors within states, multilevel binomial logistic regression models were used to determine whether health behaviors vary significantly between states that did and did not expand Medicaid. Random

intercepts were used to allow the intercepts to vary based on unmeasured state characteristics. The total level 2 (state) sample size was 51 and the total level 1 (adult) sample size was 179,265. Fit statistics and covariance parameter estimates are reported for each model. The fit statistics determine whether model fit is improved with the addition of the model variables. The covariance parameter estimates simply measure the variance (between states) of the model intercept. The covariance parameter estimates were then used to calculate the intraclass correlation coefficient (ICC), which measures the total variation in the probability of having a health behavior that is accounted for or explained by between state variation. The ICC was calculated using methods proposed by Sommet and Morselli (2017) (citing Snijders & Bosker, 2004).

Table 3 presents the basic fit statistics, covariance parameter estimates, and ICCs for the intercept only multilevel logistic regression models (i.e. null models) for each behavior. The values in Table 3 explain very little on their own, but can be used to compare findings from subsequent model building in Tables 4 and 5. Table 4 presents the main effects models that examine the explanatory power of Medicaid expansion (state-level variable) on likelihood of each health behavior (individual-level variable). Table 5 presents full models that include the socioeconomic and demographic control variables. All descriptive, bivariate, and multivariate analyses included the BRFSS designed sampling weight `LLCPWT`. All analyses were conducted in SAS 9.4. Analyses used the `PROC SURVEYFREQ` and `PROC GLIMMIX` functions.

3. Results

3.1. Descriptive and bivariate statistics

Among all respondents, the most common health damaging behavior in the sample was being overweight or obese (69.14 percent) followed by physical inactivity (26.78 percent), smoking (14.29 percent) and heavy drinking (11.28 percent) (Table 1). Approximately 94.38 percent of all sample respondents had health insurance, which is slightly higher than the national average health insurance coverage rate among those age 25 and older of 90.65 percent reported by the American Community Survey for 2016 (Social Explorer, 2016). States that did not expand Medicaid had on average significantly higher rates of smoking, physical inactivity and obesity compared to states that did expand Medicaid. In contrast, states that did expand Medicaid have on average significantly higher rates of heavy drinking compared to states that did not expand Medicaid. While there are significant relationships between Medicaid expansion and each of the respondent characteristics, there are several notable findings. States that expanded Medicaid had larger shares of adults who graduated from college or technical school (31.62 percent vs. 27.48 percent), a larger share of employed adults (48.94 percent vs 44.34 percent), a larger share of adults with incomes of \$50,000 or more (53.99 percent vs. 45.84 percent), and a larger share of adults with health insurance coverage (95.61 percent vs. 92.23 percent). In addition, states that did not expand Medicaid had larger shares of non-Hispanic black adults (13.02 percent vs 8.98 percent) and a larger share of adults age 65 years and older (38.66 percent vs 36.62 percent).

Table 2 presents the weighted prevalence of health damaging behaviors by respondent characteristics. Those who graduated from high school or did not complete high school had the highest rates of smoking (20.09 percent), physical inactivity (38.22 percent) and overweight or obesity (72.45 percent). Those who were out of work or unable to work had higher rates of smoking (31.98 percent), physical inactivity (46.92 percent), and overweight or obesity (75.13 percent). The highest rates of heavy drinking, though, were among those who were employed (15.81 percent). Lower income groups had higher rates of smoking and physical inactivity, but lower rates of heavy drinking. And compared to those with health insurance, those without health insurance coverage had higher rates of smoking, physical inactivity, and heavy drinking.

¹ Non-expansion states: AL, FL, GA, ID, KS, KY, ME, MS, MO, NE, NC, OK, SC, SD, TN, TX, UT, VA, WI, WY

² Expansion states: AK, AZ, AR, CA, CO, CT, DE, DC, HI, IL, IN, IA, LA, MD, MA, MI, MN, MT, NV, NH, NJ, NM, NY, ND, OH, OR, PA, RI, VT, WA, WV

Table 1

Weighted percentage distributions for all model variables overall and chi-square tests for comparison by medicaid expansion status.
Source: Author’s analysis of data from BRFSS (2016)

Respondent Characteristics	All Respondents (N=55,531,451) Percent	Respondents in Non-Expansion States (N=20,116,323) Percent	Respondents in Expansion States (N=35,415,127) Percent	Sig.
Smoker				
No	85.71	84.97	86.14	**
Yes	14.29	15.03	13.86	
Physical Inactivity				
No	73.22	70.85	74.56	***
Yes	26.78	29.15	25.44	
Overweight or obese				
No	30.86	28.99	31.92	***
Yes	69.14	71.01	68.08	
Heavy Drinking				
No	88.72	89.73	88.14	***
Yes	11.28	10.72	11.86	
Educational Attainment				
High School Degree or Less	39.26	41.53	37.97	***
Attended College or Tech. School	30.62	30.99	30.41	
Graduated from College or Tech. School	30.12	27.48	31.62	
Employment Status				
Employed for wages or self-employed	47.28	44.34	48.95	***
Out of work or unable to work	11.75	13.50	10.76	
A homemaker or student	7.83	8.87	7.83	
Retired	33.14	34.33	32.46	
Income				
Less than \$15,000	8.58	9.40	8.11	***
\$15,000 to less than \$35,000	25.20	29.53	24.30	
\$35,000 to less than \$50,000	14.20	15.24	13.60	
\$50,000 or more	51.03	45.84	53.99	
Health Insurance Coverage				
Yes	94.38	92.23	95.61	***
No	5.62	7.77	4.39	
Sex				
Male	43.80	43.00	44.26	*
Female	56.20	57.00	55.74	
Race and Ethnicity				
White only, Non-Hispanic	75.93	76.03	75.88	***
Black only, Non-Hispanic	10.44	13.02	8.98	
Other race only, Non-Hispanic	4.71	2.83	5.78	
Multiracial, Non-Hispanic	0.99	0.91	1.03	
Hispanic	7.93	7.21	8.34	
Age				
Age 25 to 34	6.83	6.49	7.01	***
Age 35 to 44	13.11	12.26	13.59	
Age 45 to 54	19.22	19.02	19.33	
Age 55 to 64	23.49	23.56	23.46	
Age 65 or older	37.36	38.66	36.62	

* = p < .05, ** = p < .01, *** = p < .001

Compared to females, males had higher rates of smoking (14.84 percent vs. 13.85 percent), overweight or obesity (76.70 percent vs. 63.25 percent), and heavy drinking (15.17 percent vs. 8.26 percent), but lower rates of physical inactivity (24.40 percent vs. 28.64 percent). Smoking was most common among non-Hispanic multiracial adults (20.75 percent) and lowest among Hispanic adults (9.72 percent). Heavy drinking was least common among non-Hispanic black adults (9.59 percent) and non-Hispanic Other Race Only adults (7.64 percent). Older age groups had higher rates of physical inactivity and overweight and obesity but lower rates of smoking and heavy drinking.

3.2. Multilevel regression model results

Table 3 presents the intercept only logistic regression models for each of the four health behaviors. The fit statistics are reported for each model. While the values have little meaning on their own, they will be used to compare partial and full models to in Tables 4 and 5.

Table 4 shows that adults in states that did not expand Medicaid were significantly more likely to be overweight or obese, but

significantly less likely to be heavy drinkers than adults in states that did expand Medicaid. There are only minor changes in the fit statistics from the intercept only models to the main effects models. This suggests that the addition of Medicaid expansion status to the models does not substantially improve the model fit. The ICC suggests that only about 1–2 percent – depending on the model – of the variation in health behaviors can be explained by state-level variation.

Once the control variables were added to the models, several changes occur (Table 5). The results show that adults in states that did not expand Medicaid were not more or less likely to smoke or be physically inactive, but were more likely to be overweight or obese. More specifically, this relationship weakened slightly when the control measures were added to the models. In addition, adults in states that did expand Medicaid were significantly more likely to drink heavily compared to adults in states that did not expand Medicaid, even after controlling for socioeconomic and demographic proximate determinants.

In addition, several interesting findings emerge from the control variables. These findings represent the effects of variables if all other

Table 2
Weighted Prevalence of Health Damaging Behaviors by Respondent Characteristics.
Source: Author’s analysis of data from BRFSS (2016)

	Smoking Wgt Pct	Physical Inactivity Wgt Pct	Overweight or Obese Wgt Pct	Heavy Drinking Wgt Pct	Wgt Freq
<u>In an Expansion State</u>					
No	15.03	29.15	71.01	10.72	201,16,323
Yes	13.86	25.44	68.08	11.86	35,415,127
<u>Education</u>					
High School or Less	20.09	38.22	72.45	10.61	21,799,884
Attended College or Tech. School	15.36	24.67	71.02	12.07	17,005,492
Graduated from College or Tech. School	5.64	14.00	62.93	11.36	16,726,074
<u>Employment Status</u>					
Employed	13.51	19.69	70.01	15.87	26,253,467
Out of or unable to work	31.98	46.92	75.13	9.93	6,526,015
Homemaker or Student	14.16	25.38	59.42	8.28	4,348,941
Retired	9.15	30.09	68.09	5.93	18,403,028
<u>Income</u>					
Less than \$15,000	26.44	45.22	70.13	8.24	4,761,739
\$15,000 to less than \$35,000	19.44	38.84	69.86	7.87	14,547,315
\$35,000 to less than \$50,000	15.37	29.16	70.91	10.12	7,882,782
\$50,000 or more	9.30	16.84	68.12	13.87	28,339,614
<u>Health Insurance Coverage</u>					
No	27.16	33.76	68.03	15.59	3,371,977
Yes	13.56	25.73	68.08	11.48	54,535,947
<u>Sex</u>					
Male	14.84	24.40	76.70	15.17	24,324,202
Female	13.85	28.64	63.25	8.26	31,207,249
<u>Race and Ethnicity</u>					
Non-Hispanic White	14.79	25.64	68.35	11.72	42,166,512
Non-Hispanic Black	15.25	31.69	78.91	9.59	5,797,776
Non-Hispanic Other Race Only	10.37	24.92	50.36	7.64	2,615,272
Non-Hispanic Multiracial	20.75	27.38	72.45	10.61	547,646
Hispanic	9.72	32.33	74.60	11.56	4,404,245
<u>Age</u>					
25–34	22.28	21.44	64.84	19.84	3,789,726
35–44	17.11	19.48	67.40	18.28	7,278,178
45–54	17.90	22.20	71.49	16.05	10,671,337
55–64	16.92	27.12	72.54	11.42	13,046,633
65+	8.32	32.46	67.20	4.73	20,745,577

Table 3
Intercept only logistic regression model results.
Source: Author’s analysis of data from BRFSS (2016)

	Smoking	Physically Inactive	Overweight or Obese	Heavy Drinking
<u>Fit Statistics</u>				
-2 Log Likelihood	45,092,911	63,992,898	68,283,255	38,901,082
AIC	45,092,915	63,992,902	68,283,259	38,901,086
BIC	45,092,919	63,992,905	68,283,263	38,901,090
Cov. Para. Est. (St. Error)	0.069 (0.014)	0.074(0.015)	0.032 (0.006)	0.071(0.014)
ICC	0.0205	0.0220	0.0096	0.0211

Individual N = 179,265, State N = 51

model variables were held constant. For example, holding all other variables constant, compared to those who graduated from college or technical school, those who had a high school degree or less were nearly three times more likely to smoke, 76 percent more likely to be physically inactive, and 40 percent more likely to be overweight or obese. And those who attended some college or technical school were nearly four times more likely to smoke, three times more likely to be physically inactive, and 40 percent more likely to be overweight or obese, than those who graduated from college or technical school, net of all other model variables. Compared to those who were employed, those who were out of work were nearly two times more likely to smoke

and three times more likely to be physically inactive. Compared to those who made \$50,000 or more, those in all other income groups were significantly more likely to smoke and be physically inactive, but significantly less likely to be heavy drinkers, net of all other model variables. And those who made less than \$15,000 were significantly less likely to be overweight or obese than those who made \$50,000 or more. Those who had health insurance were less likely to smoke and be physically inactive, but were slightly more likely to be overweight or obese. Females were less likely to be overweight or obese and to drink heavily, compared to males. And compared to non-Hispanic whites, non-Hispanic black adults and Hispanic adults were less likely to smoke or drink heavily, but were more likely to be overweight or obese. Compared to adults age 25 to 34, all other age groups were significantly more likely to be overweight or obese, and significantly less likely to drink heavily, when holding all other model variables constant. Again, these effects assume all other model variables are held constant.

The fit statistics (-2 Log Likelihood, AIC, and BIC) in these final models are all substantially smaller than in the intercept models. Therefore, the models presented in Table 5 have substantially improved model fit. The ICC’s for these models, however, suggest that only about 1–2 percent – depending on the model – of the variation in health behaviors can be explained by state-level variation.

4. Discussion

This paper raises important population health and public health

Table 4
Main effects multilevel logistic regression model results.
Source: Author’s analysis of data from BRFSS (2016)

	Smoking	Physically Inactive	Overweight or Obese	Heavy Drinking
<u>Medicaid Expansion (ref: Expanded)</u>				
Did Not Expand Medicaid	1.083 (0.932–1.257)	1.170 (0.992–1.381)	1.118* (1.013–1.234)	0.829* (0.718–0.958)
<u>Fit Statistics</u>				
-2 Log Likelihood	45,092,910	63,992,894	68,283,250	38,901,076
AIC	45,092,916	63,992,900	68,283,256	38,901,082
BIC	45,092,922	63,992,905	68,283,262	38,901,087
Cov. Para. Est. (St. Error)	0.067 (0.013)	0.082(0.020)	0.029 (0.006)	0.063(0.012)
ICC	0.0200	0.0243	0.0087	0.0188

Odds Ratios with Confidence Intervals in Parentheses; * = P < .05; ** = P < .01; *** = P < .001; Individual N = 179,265, State N = 51

Table 5
Multivariate multilevel logistic regression model results.
Source: Author’s analysis of data from BRFSS (2016)

	Smoking	Physically Inactive	Overweight or Obese	Heavy Drinking
<u>Medicaid Expansion (ref: Did Expand)</u>				
Did Not Expand Medicaid	0.992 (0.894–1.101)	1.096 (0.981–1.224)	1.098* (1.008–1.197)	0.871^ (0.755–1.006)
<u>Educational Attainment (ref: Graduated from College/Tech. School)</u>				
Attended College/Tech School	3.898*** (3.889–3.908)	2.851*** (2.846–2.856)	1.462*** (1.459–1.464)	1.126*** (1.124–1.129)
High School or Less	2.902*** (2.894–2.909)	1.763*** (1.760–1.766)	1.414*** (1.412–1.416)	1.227*** (1.224–1.229)
<u>Employment Status (ref: Employed)</u>				
Out of work or unable to work	2.015*** (2.010–2.020)	3.009*** (3.002–3.016)	1.340*** (1.337–1.343)	0.609*** (0.607–0.611)
A homemaker or student	1.270*** (1.258–1.282)	0.933*** (0.924–0.941)	1.116*** (1.107–1.125)	0.828*** (0.824–0.832)
Retired	1.007*** (1.004–1.010)	1.073*** (1.071–1.075)	1.009*** (1.008–1.011)	0.908*** (0.906–0.911)
<u>Income (ref: (\$50,000 or more)</u>				
Less than \$15,000	1.711*** (1.707–1.716)	1.337*** (1.334–1.340)	0.898*** (0.896–0.900)	0.886*** (0.883–0.889)
\$15,000 to less than \$35,000	1.292*** (1.288–1.295)	1.242*** (1.239–1.244)	1.027*** (1.025–1.029)	0.832*** (0.829–0.834)
\$35,000 to less than \$50,000	1.224*** (1.221–1.227)	1.154*** (1.152–1.156)	1.067*** (1.065–1.069)	0.906*** (0.903–0.908)
<u>Health Insurance (ref No)</u>				
Yes	0.631*** (0.629–0.632)	0.732*** (0.730–0.734)	1.210*** (1.207–1.213)	0.958*** (0.955–0.962)
<u>Sex (ref: Male)</u>				
Female	0.901*** (0.900–0.903)	1.198*** (1.196–1.199)	0.498*** (0.497–0.499)	0.506*** (0.505–0.506)
<u>Race & Ethnicity (ref: Non-Hisp. White only)</u>				
Non-Hisp. Black Only	0.779*** (0.776–0.781)	1.097*** (1.095–1.100)	1.768*** (1.764–1.772)	0.748*** (0.745–0.750)
Non-Hisp. Other Race Only	0.759*** (0.755–0.762)	1.363*** (1.359–1.368)	0.527*** (0.526–0.528)	0.503*** (0.500–0.505)
Multiracial, Non-Hispanic	1.295*** (1.286–1.304)	1.066*** (1.059–1.073)	1.237*** (1.229–1.244)	0.794*** (0.787–0.800)
Hispanic	0.409*** (0.408–0.411)	1.201*** (1.198–1.204)	1.439*** (1.435–1.442)	0.771*** (0.768–0.773)
<u>Age (ref: Age 25 to 34)</u>				
Age 35 to 44	0.805*** (0.803–0.808)	0.967*** (0.964–0.970)	1.215*** (1.211–1.218)	0.875*** (0.787–0.800)
Age 45 to 54	0.758*** (0.755–0.760)	1.051*** (1.048–1.054)	1.414*** (1.410–1.418)	0.731*** (0.729–0.733)
Age 55 to 64	1.618*** (0.616–0.620)	1.275*** (1.272–1.279)	1.417*** (1.413–1.420)	0.490*** (0.489–0.492)
Age 65 or older	0.276*** (0.275–0.277)	1.763*** (1.757–1.768)	1.107*** (1.104–1.110)	0.191*** (0.190–0.192)
<u>Fit Statistics</u>				
-2 Log Likelihood	41,001,755	59,235,430	65,747,060	38,553,209
AIC	41,001,797	59,235,472	65,747,102	38,553,251
BIC	41,001,837	59,235,513	65,747,143	38,553,291
Cov. Para. Est. (St. Error)	0.032 (0.006)	0.037(0.006)	0.022 (0.004)	0.060 (0.012)
ICC	0.0096	0.111	0.0066	0.0179

Odds Ratios with Confidence Intervals in Parentheses; * = P < .05; ** = P < .01; *** = P < .001; Individual N = 179,265, State N = 51

concerns about the lack of attention to some of the strongest predictors of health and their proximate determinants and how they vary between Medicaid expanding and non-expanding states. More specifically, these analyses examine whether adults in states that chose not to expand Medicaid were more likely than adults in states that did expand Medicaid to smoke, be physically inactive, be overweight or obese, or drink heavily. The initial Chi-Square tests showed higher rates of smoking, physical inactivity, and overweight and obesity in non-expansion states but higher rates of heavy drinking in expansion states. In the multilevel logistic regression models that account for the clustering of individuals within states, the findings suggest that on average adults in states that did not expand Medicaid were significantly more likely to be overweight or obese but significantly less likely to drink heavily

compared to those in states that did expand Medicaid. For overweight or obesity, the relationship with Medicaid expansion lessened when the control variables were added. This, coupled with the descriptive analyses, suggests that higher rates of overweight or obesity in states that did not expand Medicaid can in part be explained by higher rates of socioeconomic and demographic disadvantage in these states.

Model controls were not able to explain the relationship between Medicaid expansion and heavy drinking. This may be explained by unaccounted for cultural or religious factors that lead to higher rates of abstinence from alcohol in states that did not expand Medicaid, many of which are in the South and Midwest. Alternatively, the greater risk of overweight and obesity in the non-expansion states might require these populations to take medications for weight-related conditions that

cannot be mixed with alcohol. However, these hypotheses cannot be confirmed with the present data.

Some of the findings relating to the proximate determinants (i.e. control variables) align with previous literature (e.g. those from lower socioeconomic status groups having higher risks of smoking, physically inactivity, and overweight or obesity) (e.g. NCHS, 2016, Slack et al., 2014). In contrast, this study contradicts some of the literature on heavy drinking (Dávalos et al., 2012, Cutler and Lleras-Muney, 2010, Huckle et al., 2010) with its findings that those whose incomes fell below \$15,000 were actually significantly less likely to be overweight or obese and all three income groups were significantly less likely to drink than those who made \$50,000 or more. The racial and ethnic proximate determinants aligned with previous literature that shows minority groups are at higher risk for physical inactivity and obesity, but at lower risk for heavy drinking (e.g. SAMSHA, 2014, Szafarski et al., 2011, Dai et al., 2015).

4.1. Implications for policy and practice

The findings from this paper point to varied experiences (i.e. proximate determinants) and health behaviors between states that did and did not expand Medicaid. These findings show the need for a targeted approach to improving population health outcomes. Those in states that did not expand Medicaid are at higher risk for costly morbidities including cardiovascular disease, type 2 diabetes, asthma, renal diseases (Lenz et al., 2009, Guh et al., 2009). On the other hand, adults in states that did expand are at higher risk of liver cirrhosis, pancreatitis, tuberculosis and unintentional injury (Rehm et al., 2009, Boden & Fergusson, 2011, Rehm et al., 2010, Irving et al., 2009, Nelson et al., 2013, Cherpitel, 2013).

The health and healthcare needs of states that did and did not expand Medicaid will continue to diverge unless avenues are created to encourage targeted health promoting behaviors. In particular, leaders in states that chose not to expand Medicaid should focus on creating equitable access to healthful diet and exercise to address higher rates of obesity and overweight. In states that expanded Medicaid, these efforts should include the promotion and subsidizing of behavioral health resources to address heavy drinking. These programs should be tailored to reach populations that are at higher risk of negative health behaviors (e.g. Braveman et al., 2011, Slack et al., 2014, De Vogli & Santinello, 2005, Falba et al., 2005).

At the same time, health promotion activities that do not address the proximate determinants of these disparities will likely be unsuccessful. States that did not expand Medicaid have larger shares of adults from lower socioeconomic groups. Given that previous research has linked low socioeconomic status to higher rates of negative health behaviors (e.g. Barbeau et al., 2004, De Vogli & Santinello, 2005, Falba et al., 2005, Levine, 2011, Parks et al., 2003, Braveman et al., 2011, Dávalos et al., 2012), addressing these proximate determinants will be critical in creating similar population health destinies for all adults regardless of which state they are in.

4.2. Limitations

There are several limitations to this study. First, the BRFSS data used in these analyses rely on self-reports from respondents. Therefore, respondents may have underreported their health behaviors. In addition, Hispanics appear to be underrepresented in the 2016 BRFSS data. While BRFSS has taken steps to provide more accurate estimates (e.g. via a Spanish-language survey instrument and sample weighting to adjust for underrepresentation) (CDC, 2017), this continued underrepresentation – possibly due to cultural differences in willingness to participate – should lead to caution in interpreting the race and ethnicity variables. Potential proximate determinants of health behaviors that were not included in this research include place of birth and industry or occupation (e.g. Syamlal et al., 2015, Gu, Charles, Ma,

Andrew & Fekedulegn, 2016, Bosdriesz, Lichthart, Witvliet, Busschers, Stronks, & Kunst, 2013, Goel, McCarthy, Phillips, & Wee, 2004). BRFSS does not ask questions related to nativity (Johnson, Blewett, & Davern, 2010) and therefore, the current research was not able to control for respondent's place of birth. While a question is asked related to industry and occupation, it was an open-ended question and the responses have not been recoded, stream-lined, etc.

This study did not examine interactions between model variables. For example, while some literature has shown gendered phenomenon to demographic and socioeconomic disparities in health behaviors (e.g. Ogden et al., 2015), this could not be accounted for in the present study. In addition, while the analyses control for the individual-level proximate determinants of health behaviors, it is not possible to account for the local environments in which respondents live. This is due to the fact that BRFSS does not release county-level FIPS codes for respondents. Therefore, local factors (e.g. recreational space, food deserts) that influence obesity, physical inactivity, smoking, or alcohol consumption cannot be accounted for (e.g. Yen, Michael, & Perdue, 2010, Humpel, Owen, & Leslie, 2002).

4.3. Conclusion

This paper found that adults in states that did not expand Medicaid are 1) at a socioeconomic disadvantage and 2) are on average more likely to be overweight or obese, but on average less likely to drink heavily compared to those in states that expanded Medicaid. These findings raise further concerns over the diverging population health destinies between states that did and did not expand Medicaid. As local, state, and national leaders attempt to find ways to address poor population health outcomes and subsequently rising health care costs, a larger focus must be placed on health behaviors. Future research should explore the interactive effects of individual and contextual determinants of health behaviors. In addition, future research should examine disparities in other determinants of population health (e.g. food insecurity, access to primary and preventive care, etc.) across states that did and did not expand Medicaid. To truly understand future population health outcomes across heterogeneous contexts in the US, researchers and policy makers should be focusing on the disparities that exists across all predictors of health.

Declarations of interest

None.

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