Role of Community-level Health Behaviors and Social Determinants of Health in Preventable Hospitalizations

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ABSTRACT

Background: Hospitalizations contribute significantly to the country's health expenditures. There are factors in addition to clinical care that determines whether a community can prevent hospitalizations from certain medical conditions.

Purpose: The purpose of this paper is to explain the role of community-level health behaviors and social determinants of health (SDoH) in preventable hospitalizations.

Methods: This study used secondary data from the 2021 County Health Rankings for 8 states in HHS Region 4--Georgia, Florida, North Carolina, South Carolina, Alabama, Mississippi, Florida, and Tennessee. Descriptive analyses and multivariate linear regression were computed to examine the association between the dependent variable- preventable hospitalizations and independent variables operationalizing community health behaviors and SDoH at the county level.

Results: The results show that higher percentages of adult smokers and obese adults at the county level were associated with increased hospitalizations while higher county-level percentages of Medicare enrollees with flu vaccinations, access to exercise opportunities, and primary care physician rate could reduce preventable hospitalizations. After controlling for age, gender, and race, only higher percentages of adult smokers and Medicare enrollees with flu vaccinations were significant predictors of preventable hospitalizations.

Conclusions: Community-level determinants of health may be better predictors of preventable hospitalizations than individual and clinical factors. This indicates that community-level health promotion activities (e.g. encouraging flu vaccination) must be part of the interventions attempting to reduce preventable hospitalizations and in turn the burden on healthcare systems. Primary care providers and public health officials need to collaborate and develop innovative population health solutions to reduce inpatient hospitalizations for ambulatory care sensitive conditions.

Keywords: Community health behaviors, social determinants of health, preventable hospitalizations, ambulatory care sensitive conditions

BACKGROUND

There is a need to explore innovative ways to contain the increasing cost of health globally. While some emergency room visits are preventable, other conditions resulting in these visits can be treated as outpatient cases at retail clinics or urgent care centers (Enard & Ganelin, 2013; Weinick, Burns, & Mehrotra, 2010). Visits to the emergency room are costly and have an annual expenditure of about $4.4 billion (Weinick et al., 2010). The unnecessary utilization of the emergency room increases the cost of care and is an inefficient use of medical resources. Preventable hospitalizations are important because hospitalizations are the most significant contributor to the country's health expenditures (Agency for Healthcare Research and Quality, Rockville, MD, 2020). In 2017, preventable hospitalization for adults cost almost $34 billion in hospital bills and the top three conditions that accounted for the costliest stays were heart failure, diabetes, and Chronic Obstructive Pulmonary Disease (COPD) (Agency for Healthcare Research and

Quality, Rockville, MD, 2020). Effective management of Ambulatory Care Sensitive Conditions (ACSC) such as hypertension, diabetes, asthma, and bacterial pneumonia can prevent hospitalizations and complications (Purdy, Griffin, Salisbury, & Sharp, 2009). These conditions also increase utilization of the emergency room and hospitals with a high readmission rate from these groups of hospitalizations have to pay penalties (Agency for Healthcare Research and Quality, Rockville, MD., 2016).

Preventable hospital admissions can measure both quality and access to healthcare because it is a rate for hospital admissions that could be avoided with high-quality primary care (County Health Rankings and Roadmaps, 2021). It is important to note at this point that quality and access to healthcare is one of the domains of the social determinants of health (SDoH) and community-level differences in preventable hospital stays can be an indicator of health inequities. The conditions that affect people's health based

on where they are born and live are known as the social determinants of health (SDoH) and can be grouped into the domains of healthcare access & quality, education access & quality, social & community context, economic stability, and neighborhood & physical environment (U.S. Department of Health and Human Services, 2021; Hinton, 2018). These factors are interwoven and can lead to health conditions like hypertension and diabetes at the individual level. Social determinants of health can also occur at the population level when community-level facilitators and barriers influence an individual's health behaviors (Agency for Healthcare Research and Quality, 2020).

Modifying individual health behaviors can prevent or delay the onset of some chronic conditions (Venkat Narayan, Gregg, Fagot-Campagna, Engelgau, & Vinicor, 2000). Obesity, physical inactivity, and a high-calorie diet have been linked with an increased risk of type 2 diabetes mellitus. Older adults who smoke also have an increased risk of being hospitalized for chronic conditions such as congestive heart failure, angina, diabetes, and chronic obstructive pulmonary disease. Quitting smoking reduces both hospitalization and mortality rates (Tran, Falster, Douglas, Blyth, & Jorm, 2015). Other individual level characteristics such as old age, low income, non-adherence to both medication & lifestyle modifications, and social determinants of health (SDoH) such as neighborhood and access to healthy food contribute to increased hospitalization rates (Dowd et al., 2014; Falster et al., 2015; Freund et al., 2013; Magán, Alberquilla, Otero, & Ribera, 2011).

Although healthcare providers are known to play a significant role in preventing disease and complications of chronic medical conditions, it is also important to emphasize the role of community-level social determinants of health in clinical outcomes. Not all hospitalizations can be prevented and a community-level variation exists due to the access, quality of care available, and health-seeking behavior of the residents (CDC Morbidity and Mortality Weekly Report (MMWR), 2013). Community characteristics can influence individual health-promoting or risk behaviors that impact hospitalizations for ambulatory care sensitive conditions. Studies have shown that social determinants of health contribute more to population health than medical care. With the shift to alternative payment models such as value-based care, policymakers and payers are investing in social determinants like healthy food and access to exercise facilities to improve outcomes (NEJM Catalyst, December 1, 2017).

While several studies have been conducted in the past on the association between individual level health behaviors and preventable hospitalizations, not much is known about how community-level social determinants of health can influence this outcome. Few prior ecological studies focused on geographical measures related to racial and income differences associated with preventable hospitalizations (Falster et al.,2015; Ross, Walld, Uhanova, & Bond,2005). Therefore to fill this research gap, our study aims to examine the role of community-level health behaviors in reducing preventable hospitalizations. This study also evaluates how both community-level health behaviors and community-level social determinants of health affect preventable hospitalizations.

METHODS

Data source

This ecological study used publicly available county-level data from the 2021 County Health Rankings (CHR) databases for the States in Health and Human Services (HHS) Region 4--Georgia, Florida, North Carolina, South Carolina, Alabama, Mississippi, Florida, and Tennessee. The County Health Rankings and Roadmap program provides information on the health status of almost every county in the United States. By compiling different State and National data sources, the measures for ranking communities are combined and standardized with statistically derived weights. The rankings measure the current health status of communities and factors that may affect their health in the future (County Health Rankings and Roadmaps, 2021). Data from 735 counties in the eight states were included in the analysis. The target population for this study is adult residents in counties within the HHS Region 4 area.

Variables

The dependent variable of interest is preventable hospitalization rate and this was operationalized by the age-adjusted County Health Rankings measure of the number of discharges for Ambulatory Care Sensitive Conditions (ACSC) per 100,000 Medicare enrollees. The independent variables measuring community-level health behaviors include county-level percentages of: adult smokers measured as the percentage of the adult population who are current smokers, obese adults measured as the percentage of the adult population that reports a body mass index (BMI) greater than or equal to 30 kg/m2, flu vaccinations measured as the percentage of fee-for-service (FFS) Medicare enrollees that had an annual flu vaccination. The independent variables measuring community-level social determinants of health are county-level: number of primary care physicians per 100,000 population, access to exercise opportunities measured as the percentage of the population with adequate access to locations for physical activity, limited access to healthy food measured as the percentage of the population who are low-income and do not live close to a grocery store. The control variables are county-level: older adults operationalized as percentage of population aged 65 and older, race operationalized as percentage of the population that is non-Hispanic White, and gender operationalized as percentage of the population that is female. We addressed multicollinearity by computing the binary Pearson correlation coefficients and independent variables with a correlation of 0.5 or greater were excluded from the model.

Analysis

We performed descriptive analysis to describe the county-level characteristics of the study population and multiple linear regression to examine the factors associated with preventable hospitalizations. We computed five regression models to evaluate the effect of the independent variables on preventable hospitalization rate with and without the control variables. For counties with missing data, missing values were replaced with the mean. All analyses were performed using SPSS IBM version 25 (IBM Corp, 2017).

RESULTS

Our analysis showed the lowest mean preventable hospitalization rate of 4,640 (SD = 1,205) in South Carolina and the highest mean preventable hospitalization rate of 6,184 (SD = 2,267) in Kentucky (Figure 1).

Alabama, Florida and Mississippi had the annual mean preventable hospitalization rates of 5,853 (SD= 1,549), 5,234 (SD=1,549) and 6,088 (SD=1,636) respectively. The annual mean preventable hospitalization rates were 5,493 (SD=1,760) in Tennessee, 4,654 (SD=1,426) in North Carolina and 5,205 (SD=1,279) in Georgia.

Tables 1, 2, and 3 present the unstandardized coefficients(B), standard error, estimated standardized regression coefficients(β), and the adjusted R2 from the regression models.

The regression analysis reported in Table 1 showed that percentages of Medicare enrollees with flu vaccinations (Bflu vaccination= -30.2), adult smokers (Bsmokers=161.6), and adults with obesity (Bobesity=29.6) were significantly associated with preventable hospitalization rate at p<0.003. However, after controlling for sociodemographic characteristics, only percentages of Medicare enrollees with flu vaccinations (Bflu vaccination= -28) and adult smokers (Bsmokers=202.3) were associated with preventable hospitalization rate at p<0.001. The regression model for community-level health behavior variables accounted for 23% of the dependent variable variation, which increased to 27% after controlling for age, gender, and race.

The SDoH regression model shown in Table 2 showed a significant relationship between primary care physician rate (β=|-0.09|), the percentage of the population with access to exercise opportunities (β=|-0.24|), and preventable hospitalization rate at p<0.05. Both variables remained significant even after controlling for sociodemographic characteristics. In contrast, the percentage of the population with limited access to healthy food was not significantly associated with the preventable hospitalization rate.

Table 3 presents the regression analysis of community-level health behaviors and SDoH after controlling for age, gender, and race. Among independent variables associated with preventable hospitalization rate, the percentage of adult smokers expressed the highest magnitude of the association (Bsmoking= 193.2), followed by the percentage of Medicare enrollees with flu vaccinations (Bflu vaccinations= -31.9). The variables explained about 28% of the variation in the regression model.

Figure 1
Descriptive Statistics for Preventable Hospitalization Rate by State
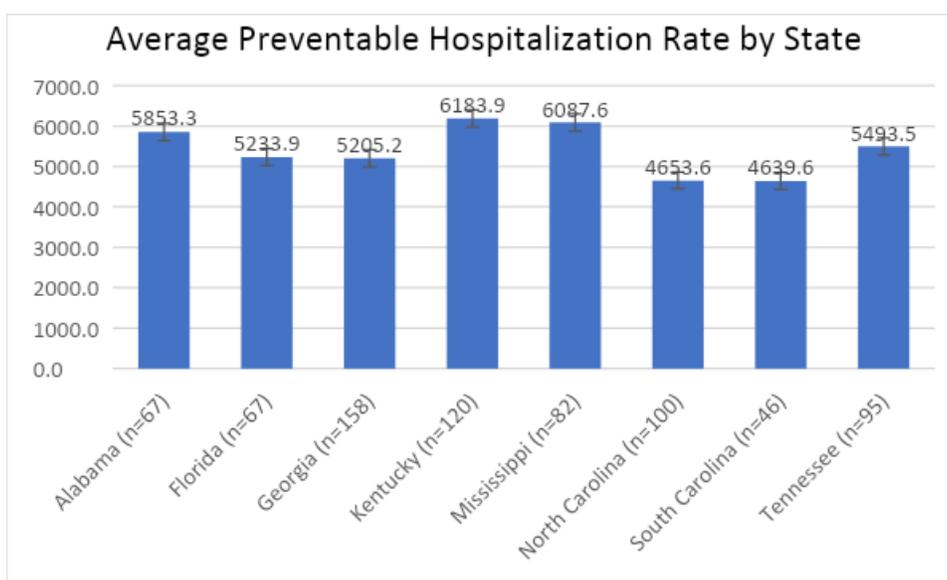
Note: County Health Rankings Data, 2021. n= number of counties

Table 1

Linear regression analysis of community-level health behaviors associated with preventable hospitalization rate

Community-level health behaviors	Not adjusted for demographic characteristics				Adjusted for demographic characteristics			
	Unstandardized regression coefficients(B)	Standard error	Estimated standardized regression coefficient (β)	P-value	Unstandardized regression coefficient (B)	Standard error	Estimated standardized regression coefficient (β)	P-value
% of Medicare enrollees with flu vaccinations	**-30.2**	**7.77**	**-0.15**	**<0.001**	**-28.04**	**8.15**	**-0.14**	**<0.001**
% of adult smokers	**161.59**	**17.14**	**0.35**	**<0.001**	**202.3**	**19.68**	**0.44**	**<0.001**
% of adults with obesity	**29.64**	**10.03**	**0.10**	**0.003**	10.14	10.74	0.04	0.345
% of the population aged 65 and older					**-66.29**	**12.52**	**-0.18**	**<0.001**
% of the population that is female					**74.25**	**22.63**	**0.11**	**<0.001**
% of the Population that is non-Hispanic white					-2.97	3.12	-0.04	0.342
Adjusted R2 value	**0.23**						**0.27**	

Note: Bolded values are significant at p<0.05. The variables reflect rates and percentages at the county level.

Table 2

Linear regression analysis of social determinants of health (SDoH) associated with preventable hospitalization rate

Social determinants of health and demographic characteristics	Not adjusted for demographic characteristics				Adjusted for demographic characteristics			
	Unstandardized regression coefficients(B)	Standard error	Estimated standardized regression coefficient (β)	P-value	Unstandardized regression coefficient (B)	Standard error	Estimated standardized regression coefficient (β)	P-value
Primary care physicians per 100,000 population	**-5.39**	**2.5**	**-0.09**	**0.031**	**-7.2**	**2.58**	**-0.12**	**0.005**
% of population with limited access to healthy foods	3.83	9.93	0.01	0.7	4.45	10.89	0.02	0.683
% of population with access to exercise opportunities	**-16.78**	**2.84**	**-0.24**	**<0.001**	**-16.98**	**2.84**	**-0.25**	**<0.001**
% of the population aged 65 and older					**-54.92**	**13.54**	**-0.15**	**<0.001**
% of the population that is female					50.7	26.98	0.07	0.061
% of the population that is non-Hispanic white					3.05	3.33	0.04	0.36
Adjusted R2 value	**0.09**						**0.10**	

Note: Bolded values are significant at p<0.05. The variables reflect rates and percentages at the county level.

Table 3

Linear regression analysis of community-level health behaviors and social determinants of health associated with the preventable hospitalization rate

Community-level health behaviors, social determinants of health, and demographic characteristics	Adjusted for demographic characteristics			
	Unstandardized regression coefficient (B)	Standard error	Estimated standardized regression coefficient (β)	P-value
% of Medicare enrollees with flu vaccinations	**-31.94**	**8.24**	**-0.16**	**<0.001**
% of adult smokers	**193.18**	**21.28**	**0.43**	**<0.001**
% of adults with obesity	6.62	11.05	0.02	0.549
Primary Care Physicians per 100,000 population	2.41	2.43	0.04	0.322
% of the population with limited access to healthy foods	-9.6	9.86	-0.04	0.331
% of the population with access to exercise opportunities	-4.43	2.73	-0.06	0.105
% of the population aged 65 and older	**-63.59**	**12.45**	**-0.17**	**<0.001**
% of the population that is female	**103.78**	**25.13**	**0.15**	**<0.001**
% of the population that is non-Hispanic white	-2.97	3.5	-0.04	0.397
Adjusted R2 value	**28%**			

Note: Bolded values are significant at p<0.001. The variables reflect rates and percentages at the county level.

DISCUSSION

Using the county-level data and a quantitative research design, our study examined the role of community-level health behaviors and the social determinants of health in preventable hospitalizations. The current study draws its inspiration from the existing body of research that suggests outpatient healthcare is critical to reducing preventable hospitalizations. Various studies have shown that hospitalizations from ambulatory care sensitive conditions may be better predicted by other factors than the quality of primary care (Magán et al., 2011; Purdy et al., 2009). The patient's role in self-management is crucial but often under-emphasized since all the pressure is on the primary care provider (Freund et al., 2013). However, there is a need to examine factors outside of the hospital system that interacts to cause these hospitalizations (Sentell et al., 2016). Most of the existing body of literature on this topic focuses predominantly on the clinician and patients' role, while insufficient emphasis is placed on how communities in which patients reside can affect hospitalizations from ambulatory care-sensitive conditions (ACSC). The community in which people are born and reside can

influence an individual's self-efficacy in managing chronic conditions. Communities that enable health promoting behaviors through policies, public health campaigns and resources are more likely to engage their residents to practice these behaviors at the individual level. These findings suggest that interventions can be implemented from different approaches including individual, clinical and population health levels.

This study showed the effect of community-level health behaviors and community-level social determinants of health in preventing hospitalizations. The results demonstrated that community-level health risk behaviors such as smoking and adults with obesity were positively associated with preventable hospitalizations at p<0.001 in at least one of the regression models. In contrast, community-level health-promoting behaviors like flu vaccination and access to exercise opportunities were negatively associated with preventable hospitalizations at p< 0.001 in at least one of the regression models.

The current study found that counties with a high percentage of adult smokers had higher preventable hospital stays.

Smoking has been linked with an increased hospitalization risk for medical conditions such as COPD, diabetes complications, angina, and chronic heart failure (Tran et al., 2015). Also, findings from this study align with a previous study by the National Library of Medicine in 2004 that observed a reduction in hospital admission rate of myocardial infarction by 8% because of a comprehensive smoking ban in New York state (Juster et al., 2007). Tobacco cessation has also been associated with a reduction in pneumonia hospitalizations which is one of the ACSC (Cecere et al., 2012). A reduced number of preventable hospital stays found in counties with high flu vaccination rates was expected due to the improved health outcomes associated with flu vaccination. This is consistent with a 2021 study that found a negative correlation between the percentage of Flu vaccinations and the rate of preventable hospitalization in Maryland (Lubov, 2021).

This study reported that counties with a high number of primary care physicians had reduced preventable hospitalizations and supports a 2016 study that found an inverse association between the number of primary care physicians and preventable hospitalizations (Lin, Eberth, & Probst, 2016). Still, the association was no longer significant after controlling for modifiable health behaviors and sociodemographic factors. While access to and quality of primary care are important social determinants of health, reducing preventable hospitalizations is not limited to health factors. This finding supports the notion of non-medical factors outside the hospital that contribute to preventable hospitalizations.

Seventy-five percent of adult Americans are not getting the ideal level of physical activity, and physically unfit people are more likely to have conditions that cause preventable hospitalizations (Centers for Disease Control and Prevention, 2019). Obesity and physical inactivity are significantly related to increased health care costs and encouraging people to become more physically active could reduce annual hospital admissions by 4.6% (Powell & Greenberg, 2019; Pronk, Goodman, O'Connor, & Martinson, 1999). To our surprise, our results showed that the percentage of obese adults and the percentage of the population with access to healthy food were not statistically significantly associated with preventable hospitalizations. Despite the non-statistical significance of percentages of obese adults, population with limited access to healthy food, population with access to exercise opportunities after controlling for confounders, these variables can be significant public health factors associated with improving health outcomes. Targeting health behaviors such as smoking and flu vaccination at the community level can improve health status and reduce hospital care utilization. Developing interventions and policies to address SDoH differences at the community level can improve population health. Living in a neighborhood with access to primary care physicians, healthy food, and exercise facilities still requires individual engagement to improve health outcomes (Freund et al., 2013). There is a need for policies and programs targeted at both individual-level and community-level social determinants of health to maximize

impacts on ACSC. Supporting interventions targeted at only the individual-level of SDoH may not be sufficient to reduce preventable hospitalizations because populations have the same level of exposure to social determinants of health at the community-level despite everyone's unique needs (Agency for Healthcare Research and Quality,2020). Safe communities that provide sidewalks and bike lanes are likely to have more residents engaged in the physical activities of walking and biking.

This study's findings should be interpreted within the context of its limitations. A limitation of this study is that the dataset owners derived the dependent variable using the 2018 Medicare claims data with a population comprised of mostly 65 years and older who have ambulatory care sensitive conditions (ACSC), and so the findings may not be generalized to the younger population. This is an ecological study and does not address causality at the individual level. Regardless of its limitations, this study fills an important research gap on the association between community-level social determinants of health and preventable hospital stays. These results provide an overview of the potential role of community health behaviors and community-level social determinants of health that can be targeted to reduce health costs. Future research may need to use the socio-ecological model to measure the cross-cutting influences at all levels to fully understand the relative contribution of the social, cultural, community, and organizational, as well as interpersonal and intrapersonal factors contributing to ACSC hospitalizations.

CONCLUSION

Inpatient hospitalizations for ACSC by definition are preventable but not limited to only proper and timely access to outpatient clinical care. The current study shows that county-level proportions of the population with risk factors such as percentage of adults smoking was associated with a higher county-level preventable hospitalization rate. Preventive health behaviors such as the percentage of Medicare enrollees with flu vaccinations were negatively associated with counties' ACSC hospitalization levels. Our study findings imply that for interventions to be effective, a holistic approach that targets social determinants of health at both the individual level such as health education and the community-level should be developed. Health care providers and public health practitioners need to collaborate to reduce unnecessary and preventable hospitalizations proactively. Policymakers should take a systemic approach that offers solutions involving individuals, communities, and healthcare systems.

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