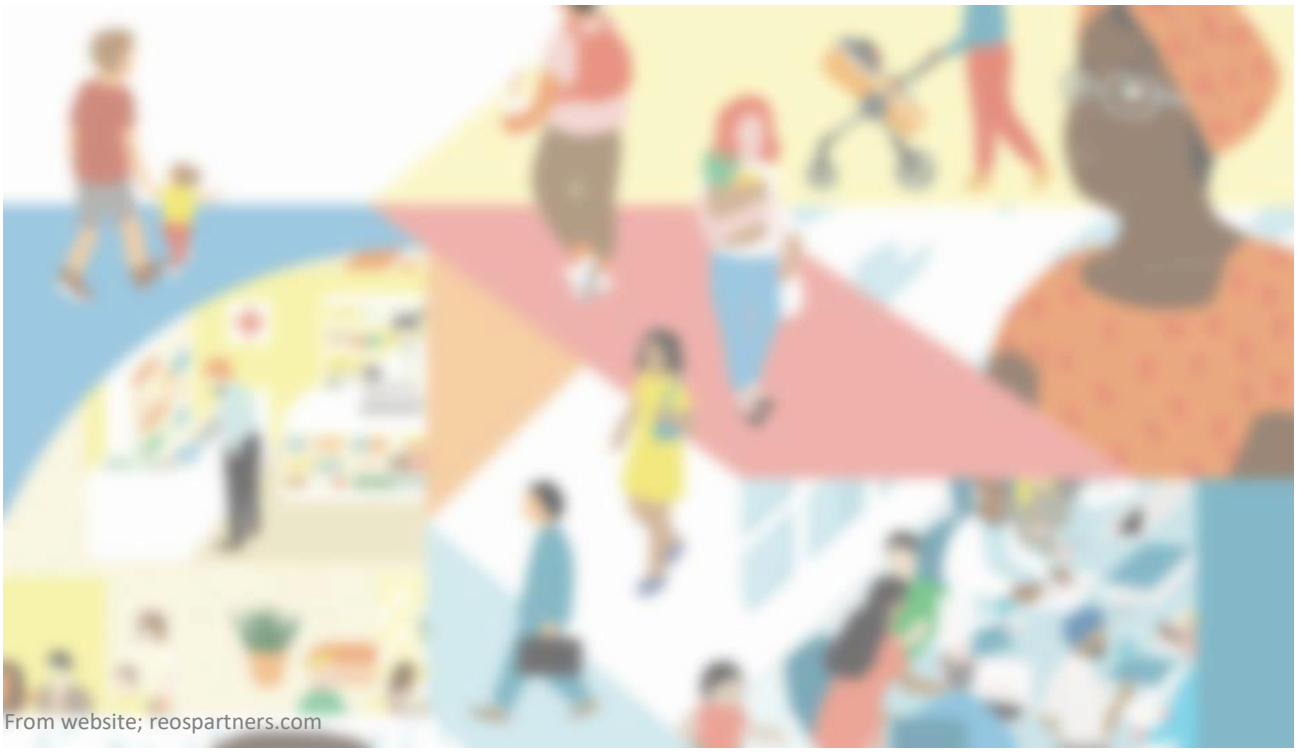
A novel approach to the analysis of health inequality in the United States of America.

The distribution of health across individuals per state, associated with health care and race/ethnicity.



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ABSTRACT

Background

Disparities in health receive a lot of scientifical and political attention. Still a lot of questions regarding this topic remain unanswered. As a result, policy makers are not able to solve this problem and health inequality continues to exist. In the United States, inequality in mortality and morbidity is observable between states and different socio-economic groups. However, little is known about the distribution of disease burden across individuals. This thesis aims to examine the distribution of health across individuals per state and its relation to the health care use, availability and racial/ ethnic composition of the population of the 50 states.

Method

Individual health states were simulated for each state in the U.S., based on morbidity data from the Global Burden of Disease study. The distribution of the health states were summarised by a Gini coefficient. A multivariate regression analysis was used to get information about the relationship between the distribution of health and health care use, availability and race/ ethnicity.

Results

The distribution of health across individuals per state, is fairly equal. The differences in the distribution of health are associated with the health care use and availability in a state. A higher number of ER visits is associated with a higher level of health inequality. In contrast, the availability of health care resources in a state is associated with a more evenly distribution of health.

Discussion

According to the results of this study, health care use and availability are related to health inequality. No association was found between the racial/ethnic composition of a state population and the distribution of health. However, there is a correlation between the population composition and the health care use and availability per state. This could imply that the racial/ethnic composition of the population is a control variable for the association between health care use, availability and the distribution of health across individuals per state.

CONTENTS

1. INTRODUCTION

There is a growing interest in the evolution and origins of health and health inequality. Health inequality is described as observable differences in health states across individuals or groups in a population (Kawachi, Subramanian, & Almeida-Filho, 2002; Gakidou, Murray, & Frenk, 2000). These differences are considered undesired because health is an intrinsic component of wellbeing Health and health care are essential to people in order to be able to function as a human being and enjoy life (O'Donnell, van Doorslaer, Wagstaff, & Lindelow, 2008; Gakidou, Murray, & Frenk, 2000). Hence, reducing disparities in health and the access to health care, is prominent on many policy agendas. However, achieving this goal is extremely challenging because health and health inequality are complex and multifaceted (National Academies of Sciences, Engineering and Medicine, 2017). Although, there is an abundance of literature on this topic, consensus regarding the drivers, definitions and the measurement of health-related inequalities is lacking. As a result, it is difficult to develop effective policies (Gakidou, Murray, & Frenk, 1999). This thesis aims to fill this void and contributes to the development of policies towards health inequalities. In particular, I study some of the drivers of health inequality using a novel empirical approach.

The country of interest for this thesis is the United States of America (U.S.). Although, reducing health inequality and improving health care access are among the main policy priorities of this country, substantial health variations continue to exist (World Health Organization, 2016; Bhattacharya, Hyde, & Tu, 2014). To illustrate this statement, the population of Minnesota has a healthy life expectancy of 70.3 years. In contrast, West-Virginia has a healthy life expectancy of 64.5 years (The US Burden of Disease Collaborators, 2018). There are still many people facing problems with access to health care facilities resulting in unmet care needs (Institute of Medicine, 2003). This issue particularly arises among individuals with a low socio-economic status (de Looper & Lafortune, 2009; Institute of Medicine, 2003). A lot of studies found that people with other ethnic backgrounds then non-Hispanic Whites, are more likely to have a lower economic status, tend to live shorter and experience more health problems during life (Williams, Priest, & Anderson, 2016; Stiglitz, 2012). Due to the disadvantaged health status, racial/ethnic minority groups often have higher or different health care needs but use health care less often (World Health Organization, 2018). These groups experience more problems with access to health care, compared to non-Hispanic Whites (Institute of Medicine, 2003; Vargas Bustamante, Morales, & Ortega, 2014; National Academies of Sciences, Engineering and Medicine, 2017; Cutler, Deaton, & Lleras-Muney, 2006).

Most pre-existing studies on health inequality, focused on average differences in health between countries or between social groups (Oakes & Kaufman, 2006). Another, less prominent approach to health inequality research, is the examination of the distribution of different health states across individuals from a specific population (Gakidou, Murray & Frenk, 2000; Kawachi, Subramanian, & Almeida-Filho, 2002; Oakes & Kaufman, 2006). Reducing health disparities is often a trade-off between improving the average health of a population or minimising disparities in health on an individual level (Gakidou & King, 2001). Therefore, health inequality research should focus on inequalities on an average level combined with the distribution of health across individuals (Kawachi, Subramanian, & Almeida-Filho, 2002; Gakidou, Murray & Frenk, 2000; Gakidou & King, 2001). According to O'Donnell et al. (2008), analysing health inequality requires information of health combined with individual characteristics like for instance race and ethnicity. Furthermore there should be information about the community of these individuals like the availability of health care resources within the community or in the case of this study, the state of residence (O'Donnell, van Doorslaer, Wagstaff, & Lindelow, 2008). This study examines two things: (i) the distribution of health across individuals of each state in the U.S. In combination (ii) with the health care use, the availability of health care resources and the racial/ethnic composition of the population per state. In particular, this study aims to reveal how health care use, availability and race/ethnicity are associated with the distribution of health.

This paper continues as following, chapter 2 will elaborate on relevant definitions and empirical findings related to health inequality, health care use, availability, race/ethnicity and the measurement of health inequality. At the end of chapter 2, the contribution of this study will be discussed. Chapter 3, will be devoted to the methodological approach that is used to collect and analyse the data of this study and the justification of this approach. The results in chapter 4 will provide an overview of the findings of this study combined with a critical analysis. The last chapter will discuss the main findings, limitations and recommendations that arise from this study.

2. BACKGROUND

2.1 The measurement of health inequality

There are various methods to quantify population health and disparities in health. Frequently used measures of health are mortality and life expectancy. Mortality rates are often the most accurate and are available in virtually every country. The disadvantage of using mortality and life expectancy is that it does not capture meaningful aspects of health during life (Fang, et al., 2010; Folland, Goodman, & Stano, 2017; Sen, 1998). Comprehensive information on morbidity is therefore very informative, although there are often concerns about the reliability of this data. Morbidity data is mostly derived from surveys, which might cause bias because this information relies on the perception of illness and can differ a lot across individuals (Sen, 1998). Other scholars argue that mortality and morbidity should be combined to measure health (Gakidou, Murray & Frenk, 2000).

Since health inequality are observable differences in health states across individuals, measuring inequality is about comparing the distribution of these health states across individuals within a population and compare the different distributions between different populations (Kawachi, Subramanian, & Almeida-Filho, 2002; Gakidou, Murray, & Frenk, 2000). The distribution of health can be summarized by using a Gini coefficient. The Gini originally stems from the measurement of the distribution of income or wealth. It is based on the Lorenz (or concentration) curve, where on the y-axis the cumulative proportion of income, wealth or health is presented and on the x-axis the cumulative proportion of the population of the country or region of interest. The closer the curve to the diagonal the more equal the distribution is and vice versa (Folland, Goodman, & Stano, 2017; Shkolnikov, Andreev, & Begun, 2003). The area between the diagonal and the Lorenz curve divided by the whole area below the diagonal is the Gini coefficient (Shkolnikov, Andreev, & Begun, 2003). This coefficient ranges from zero to one, zero means that the distribution of income, wealth or health is perfectly equal, one means total inequality. The Gini makes it possible to compare the degree of inequality across individuals and between states over time, therefore it is a useful tool for this thesis (Dyson, van Gestel, & van Doorslaer, 2020; Folland, Goodman, & Stano, 2017; Le Grand, 1987).

2.2 Drivers of health inequality

The existence of disparities in health are broadly acknowledged but the drivers of these disparities are disputed. As mentioned in the introduction disparities in health are complex and multifaceted, it is therefore not entirely clear what causes health inequality. However, there is empirical evidence that the human biology, educational status, occupational status, income (and the distribution of income), living environment, race and ethnicity, access to good quality health care, behavioural factors and one's ability are all related to health inequality (Folland, Goodman & Stano, 2017; Stiglitz, 2012; Cutler, Lleras-Muney, & Vogl, 2008; Mackenbach, 2012; World Health Organisation, 2016). It is not entirely clear to what extent and through what mechanisms these variables operate. What is known, is that different variables are intercorrelated with one another. For that reason it is not possible to explain health inequality solely by one of these variables (Folland, Goodman & Stano, 2017; Stiglitz, 2012; Cutler, Lleras-Muney, & Vogl, 2008; Mackenbach, 2012; World Health Organisation, 2016).

In the U.S., disparities in mortality and morbidity are most prominent between age 15 and 64. This is in particular observable among racial/ethnic minority groups (Franks, Muennig, Lubetkin, & Jia, 2006; Murray, et al., 2006; Sen, 1998; The US Burden of Disease Collaborators, 2018). When focussing on this age group it is understandable that disparities in health result in large economical and societal losses. The population aged 15-64, normally run the labour market. When people become chronically ill or disabled, productivity decreases (Cutler, Deaton, & Lleras-Muney, 2006; La Veist, Gaskin , & Richard, 2011). People will be forced to drop out of the labour market or retire earlier than planned. Costs such as medical expenses will rise while wages shrink (Cutler, Deaton, & Lleras-Muney, 2006; La Veist, Gaskin , & Richard, 2011). The increase of expenses while income decreases, result in less resources to invest in health and other goods. Therefore, these issues might lead to even more health problems and a decrease in the quality of life (Cutler, Deaton, & Lleras-Muney, 2006; La Veist, Gaskin , & Richard, 2011). La Veist et al. (2011) estimate that the economic burden is approximately 300 billion dollar a year, in terms of direct, indirect costs and missed savings (La Veist, Gaskin , & Richard, 2011). Furthermore, the loss of human potential is considered to be a bereavement to society (La Veist, Gaskin , & Richard, 2011). These findings resulted in the inclusion of this particular age group as the study population of this thesis.

Health care is considered as vital to people because its contribution to health (Andersen & Newman, 2005; O'Donnell, van Doorslaer, Wagstaff, & Lindelow, 2008). Health care is also linked to disparities in health. This relation arises for instance from differences in access to care and health care resources, differences in quality of care and differences in the utilization of care (Cutler, Lleras-Muney, & Vogl, 2008; Stiglitz, 2012). Disparities in health care are differences that are not based on clinical needs or

preferences for health care services (Vargas Bustamante, Morales, & Ortega, 2014). These differences are widely observable between states, socio-economic groups and individuals (Vargas Bustamante, Morales, & Ortega, 2014). Therefore, the main focus of this thesis is the association of health care in terms of health care use and the availability of health care resources in states and the distribution of health across individuals per state. Combined with the racial/ethnic composition of the state population.

Health care availability

Health care availability is determent by several factors, among which the availability of resources and the distribution of these resources. The resources of health care consist of the number of doctors, nurses, hospital beds, medical equipment etc. that are necessary to deliver health care services. Together with investments in health by the government and the presence of timely and appropriate care these variables determine the availability of health care for the population in a particular geographic area. To give an example: the number of primary care physicians per 1,000 people of the population in the state of residence (Andersen & Newman, 2005; National Academies of Sciences, Engineering and Medicine, 2017). In some regions in the U.S. health care resources and services are scarce, for instance in rural areas in the South. Here, the health care facilities that are available are often small and have limited resources resulting in care with a quality below the standard (de Looper & Lafortune, 2009; National Academies of Sciences, Engineering and Medicine, 2017). This might lead to worse health outcomes and larger disparities in health (National Academies of Sciences, Engineering and Medicine, 2017).

Due to conditions that are distinctive for the health care system, such as time pressure, cost containment and complexity, health care is often not in accordance with the needs of people. These needs are based on their medical condition and preferences (Institute of Medicine, 2003). According to Murray et al. (2006), the U.S. health system is mainly focused on child and elderly care. Treatments for most leading causes of death are widely available (The US Burden of Disease Collaborators, 2018). However, the treatment for many chronic conditions, that cause disability, is lagging behind. For instance the treatment of mental health disorders and musculoskeletal disorders like lower back pain. Less resources are available for the prevention of injuries and the control of behavioural risk factors (The US Burden of Disease Collaborators, 2018). This might be one of the reasons why disparities in health are mainly observed in the age group 15-64 (Murray, et al., 2006). Furthermore, the health care system is organized and financed towards people with a considerable income level and a good understanding of the English language (Institute of Medicine, 2003). People with higher levels of

income are able to choose between different health care providers and facilities. While less prosperous individuals, with often worse health conditions, do not have these choices (Cutler, Deaton, & Lleras-Muney, 2006). Half of the U.S. population, with income levels below the average, reports unmet care needs. A quarter of the people, with income levels above the average, face a similar problem (de Looper & Lafortune, 2009). Some studies found that expanding the availability of health care resources results in an increase of the use of health care (Andersen & Newman, 2005). However, increasing the availability of health care does not necessarily resolve the unmet care needs nor reduce inequality in health care (National Academies of Sciences, Engineering and Medicine, 2017).

Health care use

The availability of health care resources and services and the accessibility of health care, contribute to the utilization of health care. Other factors that might be influential, are peoples predisposition towards health care services, the ability to use health care services and the severity of the experienced disease. When looking at the ability to use health care services, proximity, waiting lists, the price of care, insurance and income seem to play an important role (Andersen & Newman, 2005; National Academies of Sciences, Engineering and Medicine, 2017; de Looper & Lafortune, 2009). In the U.S. there is no universal health coverage which is often associated with a worse access to health care (de Looper & Lafortune, 2009). When looking at the population below age 65, 10% is uninsured (Berchick, Barnett, & Upton, 2019). Health insurance is related to high income. People with high income seem to receive more care of better quality (National Academies of Sciences, Engineering and Medicine, 2017). This group is more likely to use specialist care, dental care and preventable care, compared to disadvantaged socio-economic groups. People with a lower economic status tend to use primary care facilities more often (de Looper & Lafortune, 2009). Access to care cannot be fully explained by the presence of health insurance or income. Studies where health coverage was expanded among people with low levels of income only showed small effects on the use of health care (Cutler, Deaton, & Lleras-Muney, 2006; Murray, et al., 2006). Peoples sensitivity to prices seem to play a role in the use of all types of health care. Individuals are less sensitive to prices of hospital care and in particular emergency care (Bhattacharya, Hyde, & Tu, 2014). These types of care are often related to more severe or even life-threatening conditions (Bhattacharya, Hyde, & Tu, 2014). Therefore, it is interesting to study hospital and emergency care, because the use of these types of care are less depending on the costs. Therefore, income and insurance are less important in determining the use of these types of care, compared to other types of care (Bhattacharya, Hyde, & Tu, 2014).

The main message is that the use and availability of health care in a geographic area are related to health inequality, in the sense that when the quantity or quality of care is not corresponding to the needs of the population in the geographic area, this has implications for the distribution of health (Andersen & Newman, 2005; Cutler, Lleras-Muney, & Vogl, 2008; Stiglitz, 2012).

Race/ethnicity

Since 2010 the number of Hispanics, African-Americans, Asians and other foreign born people has increased relative to the American natives (Indian and Alaska natives) and non-Hispanic Whites. It is expected that this number will continue to grow (World Health Organization, 2016). In some states racial/ethnic minority groups already account for more than 50% of the total state population (Kaiser Family Foundation, 2020).

There is a lot of discussion on how to differentiate between race and ethnicity. These concepts seem quite similar but there are some important differences. Race is often seen as a stratification based on the external process of stereotyping. Racial categories include racial, national origins and cultural groups. An example for racial groups are Black Americans (also referred to as African-Americans) (Oakes & Kaufman, 2006; Flanagin, Frey, Christiansen, & Bauchner, 2021). Ethnicity is based on the internal process of stereotyping, meaning that people who are part of an ethnic group share certain economic, social, cultural and religious values like for instance Hispanic Americans (Flanagin, Frey, Christiansen, & Bauchner, 2021; Oakes & Kaufman, 2006). This study will use racial/ethnic minority groups when referring to the different social groups. This because the U.S. population consist of both racial and ethnic groups. Furthermore, this is in line with the data that has been used in this thesis to examine the population composition of the states (Kaiser Family Foundation, 2020). The data stems from the American Community Survey. The people that participated in this survey reported their own race or ethnicity (Kaiser Family Foundation, 2020; United States Census Bureau, 2021). The largest share of the American population, on an aggregate level, consists of non-Hispanic Whites. This will be the reference group. The racial/ethnic minority groups consists of: Blacks (also referred to as African-Americans), Hispanics, Asians, American Indian, Alaska native, Native Hawaiian, other Pacific Islander and people who reported multiple races (United States Census Bureau, 2019).

Race/ethnicity and disparities in health and health care

The diversification of the U.S. population, results in different needs and demands regarding health related services (World Health Organization, 2016). Empirical evidence showed that racial/ethnic minority groups are more likely to face problems with accessing basic necessities of life compared to non-Hispanic Whites, including health care (Williams, Priest, & Anderson, 2016; World Health

Organization, 2016). Due to worse living conditions, less financial resources, discrimination and a higher exposure to stress and environmental hazards these groups are at higher risk of becoming disabled or die prematurely (Stiglitz, 2012; Cutler, Deaton, & Lleras-Muney, 2006). To illustrate this statement, there is a 15.4 year gap in the life expectancy between Black and Asian males, in favour of the Asian males (Murray, et al., 2006). As mentioned in the introduction, the disparities in mortality and morbidity are mainly caused by chronic diseases like for instance HIV, hypertension, cardiovascular diseases, diabetes, liver cirrhosis and mental health problems. These conditions often result in higher health care needs (Murray, et al., 2006; National Academies of Sciences, Engineering and Medicine, 2017). To give an example; the African-Americans represent approximately 13% of the total U.S. population, this group however accounts for almost 50% of the incidence of HIV infections (World Health Organization, 2018). Despite, the earlier onset of illness and a higher severity of the diseases, minority groups tend to use health care less often. When they do, they spend a higher portion of their income to health care (Williams, Priest, & Anderson, 2016; O'Donnell, van Doorslaer, Wagstaff, & Lindelow, 2008). Possible reasons for the lower health care use, are differences in insurance and income. Hispanics are more likely to be uninsured, followed by African-Americans (Berchick, Barnett, & Upton, 2019). Asians form an exception to this finding. This group has a better health compared to all other groups and have income and insurance levels similar to the ones of non-Hispanic Whites (Murray, et al., 2006). African-Americans with higher health care needs use health care more often, regardless lower income and insurance levels (Murray, et al., 2006). Differences in health and health care use, continue to exist even after adjusting for income, education and behavioural effects (Cutler, Deaton, & Lleras-Muney, 2006; Sen, 1998).

Studies found that the standards of care seem to be lower in health facilities that mostly treat patients belonging to racial/ethnic minority groups, in particular Black patients. There is evidence about a higher probability of undertreatment and a late or an absent diagnosis (Franks, Muennig, Lubetkin, & Jia, 2006). Differences in the quality of care are observable across a range of conditions and health care facilities (Vargas Bustamante, Morales, & Ortega, 2014). Such differences in treatments and quality of care towards different racial/ethnic groups is considered as discrimination (Bhattacharya, Hyde, & Tu, 2014). Racism or discrimination is an often recurring problem for people belonging to minority groups and can be observed on an individual and institutional level. Discrimination is multidimensional and translates into worse living and working conditions, unsafe neighbourhoods with less facilities, resulting in a higher exposure to risk factors (Franks, Muennig, Lubetkin, & Jia, 2006; Oakes & Kaufman, 2006; Stiglitz, 2012; Williams, Priest, & Anderson, 2016). There are two types of discrimination in health care, taste based discrimination and statistical based discrimination. Taste based discrimination, is when the treatment of the patient relies on the taste or preferences of the treating physician and

not solely on the medical needs and preferences of the patient. This is therefore inefficient (Bhattacharya, Hyde, & Tu, 2014). Statistical discrimination can be translated into differences in treatment, due to the believes of the physician that genetic or biological differences in racial/ethnic groups demand a different medical treatment in order to be effective (Balsa & McGuire, 2001; Bhattacharya, Hyde, & Tu, 2014). There is evidence of physicians who were less likely to treat Black patients with a cardiac catherization when suffering from an acute myocardial infarction compared to White patients (Bhattacharya, Hyde, & Tu, 2014). Discrimination by health care professionals, are a threat to the quality of care and the relationship with the patient (Franks, Muennig, Lubetkin, & Jia, 2006). When patients do not trust their physicians they are less likely to comply with the prescribed therapy plan which may also lead to worse health-outcomes (Franks, Muennig, Lubetkin, & Jia, 2006; Bhattacharya, Hyde, & Tu, 2014).

In summary, the distribution of health, health care use, availability and race/ethnicity seem to be interrelated. Health care availability, in for instance the state of residence, is one of the requirements for people, to be able to use health care services. Simply because the absence of health care services or resources makes it impossible to use them. People belonging to racial/ethnic minority groups are more likely to have higher health care needs but use health care less often. These groups experience more barriers in accessing health care facilities. There is evidence of discrimination and differences in the quality standards of health care facilities that deliver more care to ethnic/minority groups. All these findings are believed to contribute to inequalities in the distribution of health across individuals.

Contribution of this study

What is already known?

A large body of research has been conducted to examine the existence of inequalities in health between different social groups, like racial/ ethnic groups. Most studies focused on differences between African-Americans and non-Hispanic Whites, by looking at mortality or life expectancy.

What is new?

This study examines the distribution of health across individuals of each state in the U.S., by summarising the burden of disease with a Gini coefficient. Combined with the association between health inequality and differences in health care use, availability and the racial/ethnic composition per state.

3. METHODS AND DATA

3.1 Measuring the distribution of health

Distribution of morbidity across simulated individuals

In the absence of health information on an individual level I used data from the Global Burden of Disease study (GBD), collected from the Institute for Health Metrics and Evaluation (IHME). This data provided prevalence and Years Lived with Disability (YLD) numbers and rates for 165 causes of diseases, of the population aged 20-54 years, for every state in the U.S. (Global Burden of Disease Collaborative Network, 2008; Global Burden of Disease Collaborative Network, 2013; Global Burden of Disease Collaborative Network, 2018). The data of the GBD study was imported in the Stata software package to simulate individual health states (StataCorp LLC, 2019). First, data on the prevalence and YLD were derived in order to be able to calculate disability weights. YLD is calculated as following (Note that the YLD were already present in the GBD data and therefore it was not necessary to calculate the YLD for this study):

$$YLD = I \cdot Dw \cdot L$$

The incidence (I) of a certain disease multiplied by the disability weights (Dw), corresponding to that disease, multiplied by the average duration of the disability in years (L) (Mathers, Vos, Lopez, Salomon, & Ezzati, 2001). Disability weights are based on general population surveys. The aim of these surveys is to quantify the preferences of the general population towards different health states (Mathers, Vos, Lopez, Salomon, & Ezzati, 2001; Salomon, et al., 2015). For this study, the disability weights for each of the 165 causes of diseases were calculated. This was done by dividing the corresponding YLD by the prevalence (P), see formula below:

$$Dw = YLD/P$$

The disability weights reflect the burden of a disease on a scale from zero, representing perfect health, to one, which equals death (Salomon, et al., 2015). After calculating the disability weights, the health states of the simulated individuals were determined. The health states were calculated by using the formula below:

$$hs(x) = \prod_{k=i}^{i}(1 - Dw_k)$$

Health status (h) of a particular simulant '*s*' equals 1 minus the disability weight('s) corresponding to disease 'k' . The disability weight of the simulant depends on each disease that is randomly assigned

to the simulant, going from disease 'I' to 'j'. Note that with subtracting the disability weights from 1 the scale has been reversed, meaning that from this point zero equals death and one equals perfect health (Da Costa, O'Donnell, & van Gestel, 2021). The health state of each simulant represents the burden of the assigned disease from living one year with that particular disease (Mathers, Vos, Lopez, Salomon, & Ezzati, 2001; Salomon, et al., 2015). There were 10,000 simulants, resulting in 10,000 individual health states for each state in the U.S.. Thirdly, the distribution of these health states were summarised by a Gini coefficient. In order to calculate the Gini coefficient, the 'sgini' command in Stata has been used. This command is based on the following formula:

$$G(x) = -2\,cov\,(\frac{x}{\mu(x)}, \big(1 - F(x)\big)$$

Here, 'G' refers to the Gini, 'x' to the random variable of interest, in this study this variable is represented by the health states. The health states are divided by the mean of the health states (μ(x)). F(x) stands for the cumulative distribution function of these health states (van Kerm, 2009).

3.2 Data

Data collection

The study population consists of 10,000 simulants per state. These simulants are based on the morbidity data of all inhabitants of the U.S, aged 20-54 years. Morbidity information on both sexes were included, without making a distinction between men and women. Earlier was stated that disparities in health are most prominent in age group 15-64 years. This particular age group was not available in the GBD data therefore I used data on age group 20-54 years. Data on the racial/ethnic composition of the state population, are derived from the Kaiser Family Foundation. This information is based on yearly estimates that come from the American Community Survey (United States Census Bureau, 2021; Kaiser Family Foundation, 2020). The variable names that are related to the different racial and ethnic minority groups are in line with the names used in the American Community Survey. This is considered ethically justified, because the participants of the survey reported their own race or ethnicity and were not stratified by others (United States Census Bureau, 2021). Variables related to the financial situation per state are collected from the United States Census Bureau. All data has been collected for the years 2008, 2013 and 2018. According to O'Donnell and colleagues (2008), health, health care utilization and subsidies (received through the use of health care services) are important variables in health inequality research. In this study health, health care use and the availability of health care resources will be examined. All variables, accompanied with the unit of measurement in which they appear, are presented in table 1.

Table 1
Description of the variables

Variable	Unit of measurement
Gini	On a scale from 0 to 1; 0 = perfect equality 1 = total inequality
Whites	Percentage of non-Hispanic Whites as a share of the total state population
Blacks	Percentage of Blacks as a share of the total state population
Hispanics	Percentage of Hispanics as a share of the total state population
Asians	Percentage of Asians as a share of the total state population
Other	Percentage of "other" racial/ethnic minority groups; American Indian/ Alaska native, Native Hawaiian/ Other Pacific Islander and Multiple races, as a share of the total state population
Hospital beds	The number of hospital beds per 1,000 population, per state
ER visits	The number of ER visits per 1,000 population, per state
Hospital admissions	The number of hospital admissions per 1,000 population, per state
Health expenditure	Health expenditure per capita: Total health expenditure per state divided by the total state population, in U.S. dollars
Household income	Median household income per state, in U.S. dollars

The health expenditure per state was originally reported as a total health expenditure (in thousands of dollars). In order to make this variable comparable between states the totals per state were divided by the total state population, resulting in the health expenditure per capita. These expenditures include general health related expenditures. It captures for instance health inspection, animal control to handle rabies, mosquito abatements, environmental activities (United States Census Bureau, 2006). However, this does not include hospitals, medical related vendors payments like nursing homes, crime labs (e.g., testing drugs), testing and licensing medical professionals etc. (United States Census Bureau, 2006). Information on hospital expenditures per state are available but these expenses strongly depend on the ownership type of the hospitals per state. Some states have a lot of state owned hospitals and other states have more private owned hospitals, therefore this variable is not included in this study.

Data analysis

The dataset used in this study consists of two parts. First, cross-sectional data was used to examine the relationship between the distribution of health, health care and race/ethnicity. The data stems from the year 2018. The associations found are not generalisable to other years. Secondly, panel data of the years 2008, 2013 and 2018 were used. This enables to examine changes in the study variables over time (Wooldridge, 2013). Another advantage of the use of panel data is that it allows to control for certain unobserved or unmeasured variables (Torres-Reyna, 2007; Wooldridge, 2013). Since there are a lot of factors influencing health and health inequality (see chapter 2), these unobserved and unmeasured factors are likely to be present in the relationship between the distribution of health, health care and race/ethnicity. All states and variables that were used in the cross-sectional part were also used in the three years of panel data, which makes this dataset balanced (Wooldridge, 2013). A fixed effects model was used to analyse the panel data. This model makes it possible to investigate the relationship between the explanatory variables and the Gini within the different states and controls for all time invariant differences between states (Torres-Reyna, 2007). The steps that were described in part 3.1 of this chapter, considering the simulation of individual health states and the calculation of the Gini are performed for both the cross-sectional and panel data part. In order to examine the bivariate association of the study variables, a correlation matrix was obtained, this was only done for the cross sectional part. In order to link the distribution of health across individuals per state, with the other study variables, a multivariate regression analysis has been performed. The Gini-coefficient was used as the dependent variable. The other variables were used as the independent variables (see table 1). The regression model was obtained for the cross-sectional data and the panel data. The use of the Gini coefficient in a regression analysis, has already been done in several studies. However, these studies included the Gini as an independent variable instead as a dependent variable (Deaton & Paxson, 2004; Muller, 2002; Li & Zou, 1998).

4. RESULTS

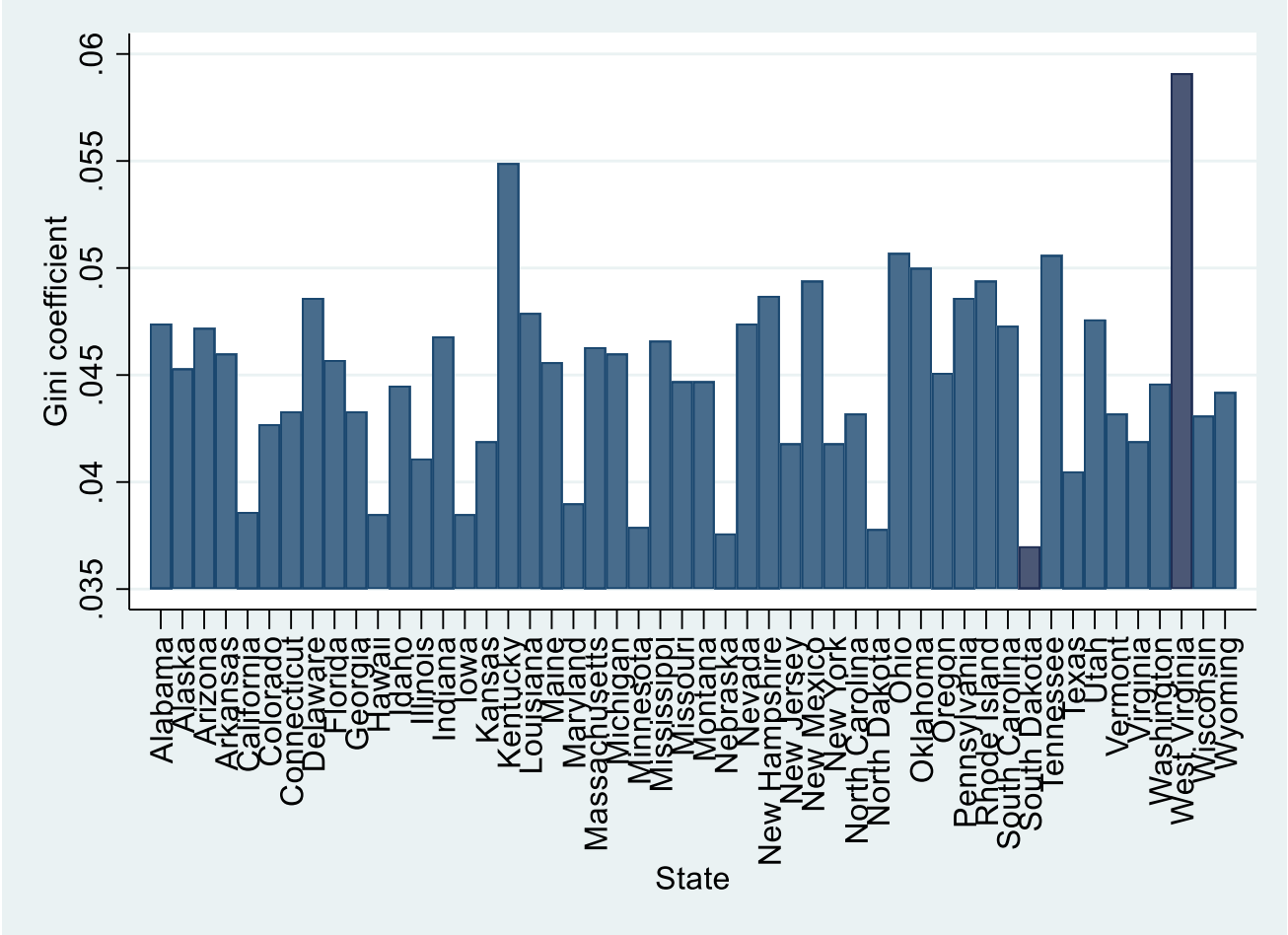
4.1 Descriptive statistics of 2018

Gini

Figure 1 represents all Gini coefficients per state (blue bars) and illustrates the differences in the distribution of health between the states. The bars corresponding to West-Virginia and South-Dakota are in dark blue. Here one can see that West-Virginia (0.0591) has the highest degree of health inequality compared to the other states. South-Dakota (0.037) has the lowest Gini coefficient, meaning that this state has the most evenly distribution of health. The Gini coefficient has a mean of 0.0449 (see table 2). The mean, minimum and maximum Gini are all close to zero. The distribution of health across individuals within states seems fairly equal. (Remember: a Gini from zero means perfect equality.)

Figure 1

Gini coefficient per state



Note: The scale of the y-axis ranges from 0.035 to 0.06

Race/Ethnicity, household income and health care

Table 2 displays the summary statistics of the state characteristics. The table includes the variables regarding the health care use, availability, financial status and racial/ethnic composition of the state population. The numbers corresponding to the variables are specific for the year 2018.

There is a lot of heterogeneity in the population composition between states. The population of some states consist for 93.4% of non-Hispanic Whites, in other states this group only accounts for 20.6% of the population. When looking at the share of Black people, in some states this group represents 37.7% of the population and in other states this group only accounts for 0.4% of the population. This wide range is visible for Hispanics, Asians and to a smaller extent for 'other' minority groups as well. On average a state population is represented by 68.55% non-Hispanic Whites, 10.2% Blacks, 12.07% Hispanics, 4.3% Asians and 4.9% 'other' racial/ethnic minority groups.

When looking at the variables related to health care use: The number of ER visits varies between 269 and 683 visits per 1,000 population. The mean of this variable is 452.22 visits per 1,000 population. The number of hospital admissions varies between 72 and 143 per 1,000 population, on average there are 103.6 hospital admissions per state (per 1,000 population). The variables related to health care availability are the number of hospital beds and health expenditures by the state (per capita). The number of hospital beds are per 1,000 population and health expenditure per capita (by the state government) in U.S. dollars. The number of hospital beds varies between 1.6 and 4.8. On average states have 2.6 hospital beds per 1,000 population. Health expenditure per capita, ranges from $59.89 to $684.97 and the mean is $215.31. The median household income per state, in U.S. dollars, ranges from $42,781 to $86,345 and is on average $63,984.06. Altogether, there are substantial differences in the health care use, availability and racial/ethnic composition of the population between states.

Table 2
Summary statistics of 2018 data

Variable	Mean	SD	Min.	Max.
Gini	0.044872	0.004496	0.037	0.0591
Whites	0.68546	0.15897	0.206	0.934
Blacks	0.10196	0.094151	0.004	0.377
Hispanics	0.12072	0.10519	0.013	0.491
Asians	0.043	0.055704	0.007	0.379
Other	0.04932	0.05225	0.018	0.295
Hospital beds	2.6	0.714571	1.6	4.8
ER visits	452.22	82.36685	269	683
Hospital admissions	103.6	16.95251	72	143
Health expenditure	$215.31	$143.86	$59.89	$684.97
Household income	$63,984.06	$10,005.47	$42,781	$86,345

Correlation of the Gini, race/ethnicity, income and health care

When looking at the bivariate correlation of the Gini and the racial/ethnic composition of the state population, there is a negative correlation between the share of Asians of the total state population, and the distribution of health. This implies that when a large share of the state population consist of Asians, this is correlated with a more evenly distribution of health (see table 3 and appendix A; *gini, household income and health care*). This finding might be explained by the better health states of Asians compared to other racial/ethnic groups, including non-Hispanic Whites (Murray, et al., 2006).

The number of ER visits and the number of hospital admissions are both positively correlated with the Gini. This means that a higher amount of health care use, in terms of the number of hospital admissions and ER visits, is associated with more inequality in health. When the population of a state experience more health problems, due to for instance a higher prevalence of injuries, it is plausible that these people tend to use health care more often. In particular when the symptoms of these injuries are severe. The number of hospital beds, ER visits and hospital admissions are positively correlated with one another. This might be explained by the fact that when the health care use increases, more resources such as hospital beds are needed. There is also empirical evidence where was stated that an

increase of the health care availability is associated with an increase in the health care use (Andersen & Newman, 2005).

When more people visit the ER, this is associated with an increase in the number of hospital admissions. Since ER visits are often based on severe, life threatening conditions it is logical that people who visit the ER are likely to be admitted to the hospital.

The median household income is negatively correlated with the Gini. When the median household income increases, health tends to be more evenly distributed compared to states with lower levels of income. Income is negatively correlated with the number of ER visits, hospital admissions and the number of hospital beds, implying that a higher median household income of a state is associated with less hospital visits, in that state. This is in line with the empirical evidence in the literature, where is found that people with a higher economic status are often healthier compared to people with a lower economic status and are therefore less likely to be admitted to the hospital (Cutler, Lleras-Muney, & Vogl, 2008). Furthermore, people who are healthy are often active on the labour market and have higher income levels than unhealthy people, who are less productive (La Veist, Gaskin , & Richard, 2011). Income is positively correlated with the health expenditure per capita, per state. In other words, states with a higher median household income tend to spent more on public health compared to states with lower levels of income. It is plausible that the states with a less healthy population spend more on hospitals (remember that hospital expenses are not included in the health expenditure variable) and have to compensate this with lower expenditures on public health. Although, the described correlations are not very strong, they indicate a relation between the variables (see table 3 and appendix A; *gini, household income and health care*).

Correlation of race/ethnicity, income and health care

The racial/ethnic composition of the state population and the health care variables are correlated in several ways. When a larger share of the state population consist of Asians, Hispanics or 'other' racial/ethnic groups this is negatively correlated with the number of hospital beds, ER visits and hospital admissions. When looking at the percentage of Blacks, as a share of the state population, this is positively correlated with the number of ER visits and the number of hospital admissions. When comparing these correlations to the literature discussed in chapter 2, it could be plausible that the share of Asians in the population is negatively correlated with health care use because of their better health status (Murray, et al., 2006). Hispanics and 'other' racial/ethnic groups are more likely to be uninsured and experience more barriers related to for instance the language and proximity (Institute of Medicine, 2003). This might result in a lower use of health care, despite the higher needs (Berchick,

Barnett, & Upton, 2019; National Academies of Sciences, Engineering and Medicine, 2017). Black people have higher health care needs and regardless of lower income and insurance levels they use health care slightly more often, compared to other racial/ethnic groups (Murray, et al., 2006).

States with a larger share of the population, consisting of non-Hispanic Whites, are correlated with a higher number of hospital beds and with the number of ER visits. When looking at the empirical evidence, White people often live in areas with better and more health care facilities and use health care more often compared to Hispanics, Asians and 'other' racial/ethnic minority groups (Williams, Priest, & Anderson, 2016). They experience less barriers to access health care facilities (Murray, et al., 2006). The median household income, per state, is positively correlated with the share of Asians in the state population but negatively correlated with the percentage of Blacks. This is in line with the empirical evidence where Asians often have higher or similar income levels as non-Hispanic Whites (Williams, Priest, & Anderson, 2016). Blacks often have lower income levels compared to other racial/ethnic groups (Williams, Priest, & Anderson, 2016; Murray, et al., 2006). The described correlations are not very strong but indicate that there is a relationship between the variables (see table 3 and appendix A; *race/ethnicity, household income and health care*).

Table 3

Correlation matrix

Variable	Gini	Whites	Blacks	Hispanics	Asians	Other	Hospital beds	ER visits	Hospital admissions	Health expenditure	Household income
Gini	1										
Whites	0.2209	1									
Blacks	0.0741	-0.3546*	1								
Hispanics	-0.1328	-0.6703***	-0.143	1							
Asians	-0.3504*	-0.6276***	-0.1124	0.219	1						
Other	-0.1692	-0.3876**	-0.3166*	0.0531	0.6067***	1					
Hospital beds	0.003	0.3913**	0.1122	-0.4648***	-0.3577*	-0.0758	1				
ER visits	0.6015***	0.2969*	0.3451*	-0.3961**	-0.4011**	-0.3065*	0.4115**	1			
Hospital admissions	0.3512*	0.1913	0.3972**	-0.2819*	-0.323*	-0.3913**	0.636***	0.6404***	1		
Health expenditure	-0.1177	-0.0614	-0.0793	-0.0917	0.2621	0.2347	-0.1052	-0.0914	-0.2791*	1	
Household income	-0.4408**	-0.0527	-0.3211*	0.0457	0.4734***	0.1434	-0.4635***	-0.5555***	-0.4503**	0.3157*	1

* p < 0.05, ** p < 0.01, *** p < 0.00

Inscription

- no correlation (or insignificant)
- very weak correlation
- weak correlation
- moderate correlation
- strong correlation

4.2 Descriptive statistics of panel data

Change of the variables over time

The summary statistics of the panel data, corresponding to the years 2008, 2013 and 2018, are represented in table 4. These results imply that health inequality has increased over time. The mean, minimum and maximum Gini coefficient of the year 2018 are larger than the ones of 2008 and 2013. In 2008 the mean Gini coefficient was 0.04007, in 2018 this was 0.044872. The results of the variables related to race/ethnicity display the growing diversification of the population, that is in line with the empirical findings described in chapter 2. Here was stated that the population belonging to racial/ethnic minority groups is growing relative to the non-Hispanic Whites (World Health Organization, 2016). When looking at health care related variables, the number of ER visits increases over the years. The difference between the state with the lowest number of ER visits (per 1,000 population) and highest number is growing. To illustrate this, in 2008 the difference between the lowest and highest number of ER visits was 377 visits per 1,000 population per year (652-275=377). In 2018 this difference was 414 visits per 1,000 population per year (683-269=414). In contrast, the number of hospital admissions decreases over time, as well as the number of beds. The decline in the number of hospital beds goes on a lingering pace, the difference in the average number of beds for the years 2008 (2.852) and 2018 (2.6) is only 0.252 bed per 1,000 population. These findings imply that over time, there are more ER visits per state but these visits are less likely to result in hospital admissions, compared to the year 2008. When explaining these results in accordance with the correlations of the 2018 data (see table 3) one could argue the following: the Gini and the number of ER visits are positively correlated. The increase of the number of ER visits might therefore be associated with the increase of the Gini. The decrease of the number of hospital beds might be explained by the decrease of the number of hospital admissions over time. These variables are positively correlated with one another and logically when the demand of hospital beds declines (due to a lower number of hospital admissions), the supply of beds will decline as well. However, these arguments need more evidence to hold and will be analysed with the regression model in table 5. Finally, the average of the median household income increases over time, as well as the level of heterogeneity in this variable. The health expenditure per capita remains fairly stable over time.

Table 4

Summary statistics panel data

Year	2008				2013				2018			
Variable	Mean	SD	Min.	Max.	Mean	SD	Min.	Max.	Mean	SD	Min.	Max.
Gini	0.04007	0.00305	0.0337	0.0471	0.04212	0.003694	0.0349	0.0524	0.044872	0.004496	0.037	0.0591
Whites	0.73036	0.153157	0.236	0.954	0.70482	0.156645	0.217	0.941	0.68546	0.15897	0.206	0.934
Blacks	0.09794	0.094223	0.003	0.373	0.1006	0.094496	0.009	0.376	0.10196	0.094151	0.004	0.377
Hispanics	0.09872	0.099037	0.01	0.453	0.11144	0.102191	0.012	0.473	0.12072	0.10519	0.013	0.491
Asians	0.03418	0.055474	0	0.386	0.03888	0.055792	0.01	0.383	0.043	0.055704	0.007	0.379
Other	0.04054	0.048687	0.012	0.277	0.0455	0.0511	0.014	0.288	0.04932	0.05225	0.018	0.295
Hospital beds	2.852	0.84134	1.7	5.4	2.674	0.719356	1.7	4.9	2.6	0.714571	1.6	4.8
ER visits	422.98	82.51666	275	652	433.06	82.79638	286	628	452.22	82.36685	269	683
Hospital admission	116.04	19.93045	83	156	105.02	17.95287	77	143	103.6	16.95251	72	143
Health expenditure	$209.16	$116.62	$83.26	$551.42	$195.43	$120.80	$55.29	$486.6	$215.31	$143.86	$59.89	$684.97
Household income	$59,252.66	$9,198.382	$42,611	$77,369	$58,520.96	$10,099.16	$34,916	$78,249	$63,984.06	$10,005.47	$42,781	$86,345

4.3 The association of the distribution of health, health care and race/ethnicity in 2018 and over time

Regression results 2018

Table 5 represents the regression results of the association between the distribution of health, health care use, availability and race/ethnicity, based on the data of 2018 and the panel data. In this paragraph I will focus on the results of the year 2018. A first remark is that the coefficients of the variables with a significant result are very small. To illustrate this statement: the number of ER visits per 1,000 population, have a positive association of 0.00002 with the Gini coefficient, meaning that when the number of ER visits increases with one unit this is associated with an increase of the Gini by only 0.05%. This percentage is calculated by dividing the coefficient for the number of ER visits (see table 5) by the mean Gini of 2018 (see table 4), multiplied by 100 (0.00002/ 0.044872*100). The results are considered statistically significant when the p-value is below a critical value of 0.05. The association hold when keeping all other conditions constant (ceteris paribus). The number of hospital beds per 1,000 population in a state have a negative association of -0.00483 on the Gini coefficient, this implies that the presence of a larger number of hospital beds tends to have a small contribution to a more evenly distribution of health. This effect is quite substantial namely -10.74%. In contrast, the number of hospital admissions, are associated with a small increase of the Gini. An additional hospital admission is associated with an increase of 0.00014 (0.31%). Finally, a higher median household income tends to have a slight decreasing effect on the Gini coefficient of -1.58E-07. In this regression model, 61.74% of the variation in the Gini coefficient, is associated with the variables in the model.

Regression results 2018 and panel data

The results of the panel data, corresponding to the years 2008, 2013 and 2018, show the following (see table 5): The number of ER visits has a positive association with the Gini, implying that when ER visits varies across time by one unit, this is associated with an 0.00002 increase of the Gini coefficient. In contrast, when the number of hospital beds varies over time with one unit, this is associated with a decrease of the Gini by -0.00364. The median household income is associated with a decrease of -1.62E-07 on the Gini, meaning that the distribution of health tends to become more even when the median household income of a state increases over time. In the panel data model, 56.02% of the variation in the Gini coefficient, is associated with the variables in the model. When comparing the two regression models, most coefficients become smaller over time. However the coefficients from the variables that continue to be significant remain fairly stable over time. The variable “hospital

admissions" becomes insignificant over time. This implies that the number of hospital admissions per 1,000 population is not associated with the distribution of health over time.

When comparing the results of both regression models to the empirical findings, it is plausible that the number of ER visits per 1,000 population has a positive association with health inequality. This because the population of states with more ER visits, apparently have higher health care needs due to worse health states. ER visits are often related to severe health conditions or life threatening situations. This might result in a less equal distribution of health compared to states where the population is healthier and have a lower number of ER visits. The negative association between the number of hospital beds and the Gini might be explained by the idea that the presence of health care resources reduces the risk of unmet care needs. Finally, the negative relation between income and health inequality is in line with the previously discussed assumption: it is likely that states with a healthier population have higher median household incomes than states with a less healthy population. Because healthier individuals are often more active on the labour market (La Veist, Gaskin , & Richard, 2011). Based on the regression results, there is no direct association between the racial/ethnic composition of the state population and the distribution of health.

Table 5

Regression model 2018 data and panel data

	2018 data		Panel data	
Gini	β (s.e.)	CI (95%)	β (s.e.)	CI (95%)
Whites	0.06123 (0.2497)	-0.44384 - 0.56630	0.01902 (0.08503)	-0.34682 - 0.38487
Blacks	0.04846 (0.24929)	-0.45577 - 0.55269	0.01241 (0.08481)	-0.35251 - 0.37734
Hispanics	0.05461 (0.24946)	-0.44997 - 0.55918	0.01811 (0.08453)	-0.34559 - 0.38181
Asian	0.03784 (0.25039)	-0.46861 - 0.54430	0.00160 (0.08316)	-0.35622 - 0.35942
Other	0.08023 (0.24950)	-0.42443 - 0.58490	0.03797 (0.08690)	-0.33590 - 0.41185
Hospital beds	-0.00482 (0.00108) ***	-0.0070 - -0.00263	-0.00364 (0.00057) *	-0.00608 - -0.0012
ER-visits	0.00002 (8.96E-06) *	3.09E-06 - 0.00004	0.00002 (1.53E-06) **	0.00001 - 0.00002
Hospital admissions	0.00014 (0.00005) **	0.00004 - 0.00024	0.00008 (0.00002)	-0.00002 - 0.00018
Health expenditure	2.48E-06 (3.56E-06)	-4.72E-06 - 9.67E-06	1.05E-06 (1.02E-06)	-3.34E-06 - 5.44E-06
Household income	-1.56E-07 (7.37E-08) *	-3.05E-07 - -6.93E-09	-1.62E-07 (1.36E-08)**	-2.20E-07 - -1.04E-07
Constant	-0.01596 (0.25045)	-0.52255 - 0.49062	0.02708 (0.08438)	-0.3360 - 0.39013
R2	0.6174		0.5602	

Standard errors are shown in parentheses. * p < 0.05, ** p < 0.01, *** p < 0.00

5. DISCUSSION

This final chapter will provide an answer to the research question, accompanied with other relevant findings and the general meaning of these findings. Furthermore, the limitations and recommendations will be discussed.

Main findings

According to the results of this study, there is a quite evenly distribution of health across individuals per state and there are small differences between states. The variation in the distribution of health between states is associated with differences in the state characteristics. More specifically, by the health care use and availability per state. Health care use in terms of ER visits is associated with an increase of health inequality, this association continues to exist over time. In contrast, the availability of health care resources in terms of the number of hospital beds is negatively associated with the Gini coefficient. These findings might be explained by the fact that ER visits are often related to severe health problems. This results in higher morbidity rates in states with more ER visits. This results in larger differences in health states between individuals of the state population, with therefore a less equally distribution of health across these individuals. The availability of health care resources contributes to the availability of health care services. When health care of appropriate quality is available to people who are in need of health care this might result in a decrease of health disparities.

The level of health inequality, across individuals aged 20-54 years, found in this study is quite low. This is quite surprising because the empirical evidence showed that within this age group the disparities in mortality and morbidity are higher as compared to children and elderly (Murray, et al., 2006; Sen, 1998). A plausible explanation might be that the causes of diseases that are most prominent in this group, are accompanied with mild symptoms. Since the health states that were simulated for this study, were based on disability weights, it might be the case that due to the mild symptoms the disability weights are low. This line of reasoning is based on the assumption that most causes of morbidity and mortality are chronic conditions, often resulting in sudden deaths without people experiencing a lot of burden during the life course (Franks, Muennig, Lubetkin, & Jia, 2006). There are scholars who opt for using mortality rates to solve this problem or to use a combination of mortality and morbidity rates (Sen, 1998; Gakidou, Murray, & Frenk, 2000). Another plausible explanation of this finding could be that the average health, of the people in this age group, is quite well. Resulting in lower morbidity rates, corresponding to this age group.

Although, there is no direct association between health inequality and race/ethnicity there is an association between health care use and availability and race/ethnicity. The share of the state population belonging to Blacks is related to a higher number of ER visits and hospital admissions (both per 1,000 population). As mentioned earlier, this might be explained by the higher morbidity rates among this group (Murray, et al., 2006; Franks, Muennig, Lubetkin, & Jia, 2006). The Hispanics and 'other' minority groups, are negatively correlated with the use of health care. Despite, the higher morbidity rates it seems that these groups face more problems with the access to health care facilities. These problems can be related to lower income and insurance rates, language barriers, cultural differences and geographical factors (Vargas Bustamante, Morales, & Ortega, 2014; Institute of Medicine, 2003). Furthermore, there is evidence that racial/ ethnic minority groups receive lower quality of care compared to non-Hispanic Whites, this might lead to worse health outcomes and can be considered as discrimination (Cutler, Deaton, & Lleras-Muney, 2006). The share of Asians in a state population is negatively correlated with health care use and the availability of hospital beds. This groups is often healthier compared to other racial/ ethnic groups (Murray, et al., 2006). In conclusion, race and ethnicity are associated with health care use and availability. It might be that race and ethnicity have an influence on the distribution of health through health care. With the growing diversification in mind it is advisable that states aim to improve the availability and accessibility of health care facilities, with special attention to racial and ethnic minority groups.

Limitations

The morbidity data used in this study stems from the GBD study, of the IHME. The GBD data is criticized by several scholars, mainly because the lack of clarity on the imputation methods that are used for the GBD data (Shiffman & Shawar, 2020). However, in the absence of more comprehensive and accurate data, the GBD data is widely used in esteemed pre-existing studies that are related to global health, inequality of health and many more. The IHME collaborates with the WHO and The Lancet (The Lancet, n.d.).

The interpretation of the Gini coefficient could be another limitation. It is possible to interpret the different coefficients from one state relative to the Gini from another state but it remains unclear what the exact meaning of a certain Gini is. Furthermore, it could be plausible that using disability weights as a measure for morbidity is not sensitive enough to capture disparities in health. Availability of data that link the prevalence and morbidity or mortality measures directly to the different racial/ethnic groups would be an improvement for conducting this kind of studies. As well as the wider availability of data on different types of health care. Despite, the limited availability of data related to health care

variables, the datasets of the different years that were used in this study were balanced. Which means that all variables collected from one year were also collected from the other years.

Recommendations

When evaluating the methodological approach, I would argue that it is informative to look at the distribution of health across individuals between states. Furthermore, I would conclude that the Gini coefficient is feasible as a dependent variable in a regression model. On top of that I would encourage other researchers to put emphasis on the distribution of health, across individuals, when examining health inequality. Combined with the use of data on morbidity and mortality of different age groups. The variation in health states across individuals might be more prominent then. It is advisable to increase the number of observations by including more countries or by looking for instance at county level data (when this is available). This might improve the statistical power. Based on the results of this study combined with the empirical findings of previous studies, I would argue that policymakers should aim to develop interventions that reduce risks for chronic diseases and injuries and execute these on a state and community level. This could be done by contributing a reasonable part of the public health expenditures to the investment in interventions that support prevention, primary care and lifestyle programs, since these types of care seem to be important in improving health. Furthermore, health care availability is associated with a reduction in the disparities in health. Therefore it is advisable to improve access of health care facilities and improve the quality of care. To decrease boundaries in the use of health care by racial and ethnic minority groups, it could be beneficial to create awareness about the presence of discrimination in the health care sector. This could be assessed by making health care workers more conscious about the intrinsic component of discrimination and by promoting the diversification of health care professionals. Finally, policy makers and researchers should be aware of the fact that health disparities are complex and solutions to reduce these disparities should focus on the multifaceted character of this problem.

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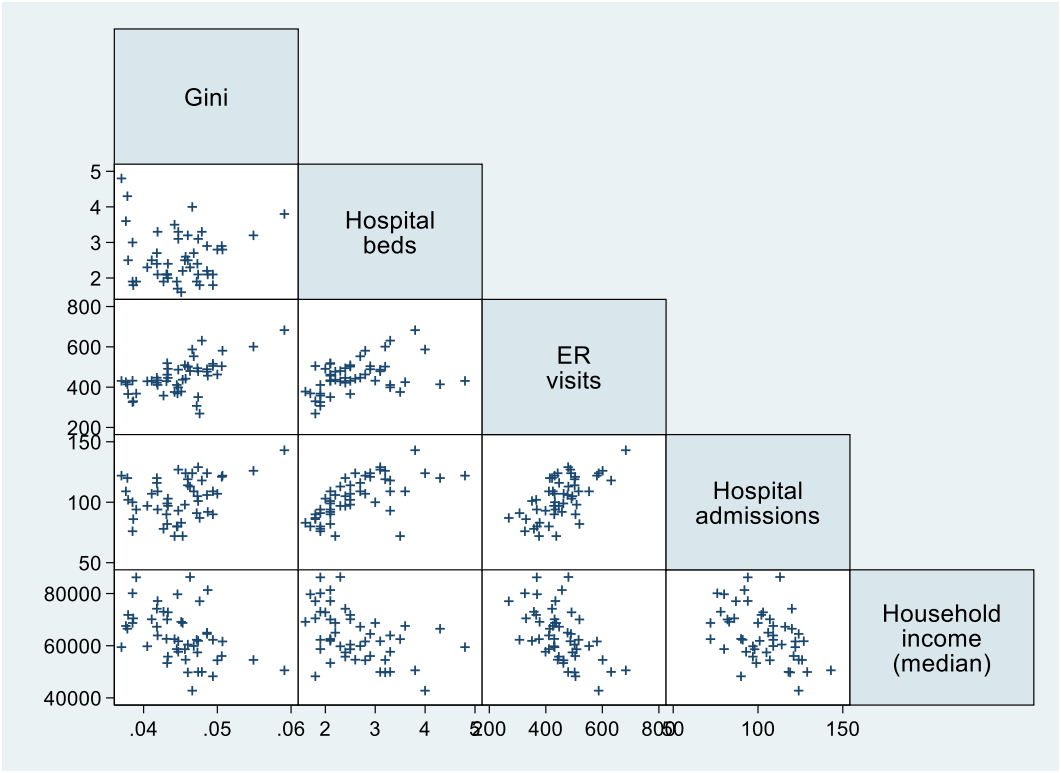
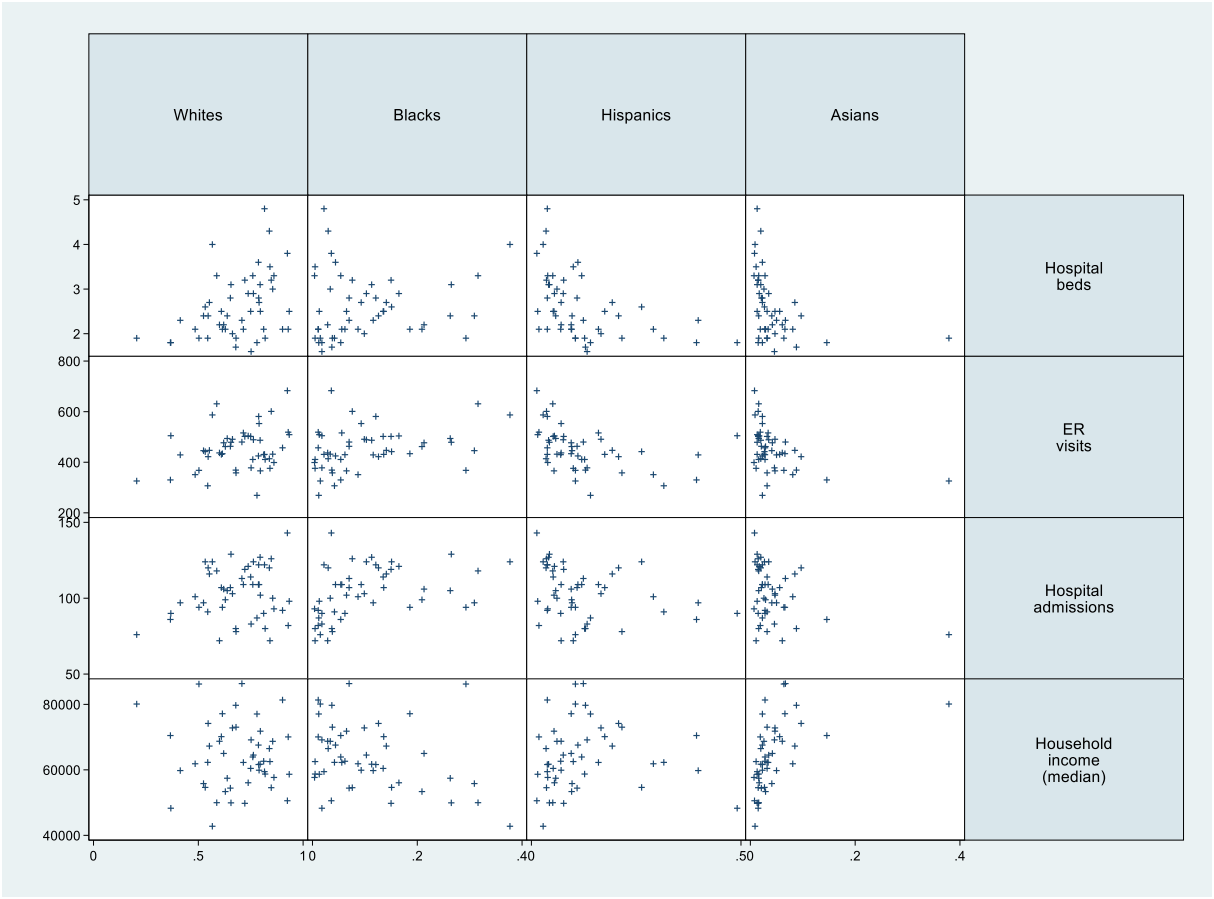
APPENDICES

Appendix A; Correlation scatterplots

Gini, household income and health care



Race/Ethnicity, household income and health care



Appendix B; List of abbreviations

CI: Confidence Interval

DW: Disability Weights

ER: Emergency Room

GBD: Global Burden of Disease

HIV: Human Immunodeficiency Virus

IHME: Institute for Health Metrics and Evaluation

KFF: Kaiser Family Foundation

Max.: Maximum

Min.: Minimum

R2: Squared sum of residuals

SD: Standard Deviation

S.E.: Standard Error

U.S.: United States

U.S.A.: United States of America

WHO: World Health Organization

YLD: Years Lived with Disability