



## Population Health from Social Determinants of Health Prospects: A Global Comparison

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### Abstract

Case studies on social determinants of health have been limited to the United States and Western European countries (mostly ECED countries). Most studies concluded that social determinants of health impact more and better than economic factors on health outcomes (infant mortality rate and life expectancy). A lack of similar study for economically underdeveloped countries and/or non-market-oriented countries raise an important research issue whether conclusions derived based on one homogenous economic system can be applied as well to other countries. In addition, most studies use a simple univariate measurement tool which ignores interaction effects among and between policy variables. Policy recommendation may be biased against certain variables leading to unintended implications. This paper attempts to fill the holes of the existing studies in research design. Multivariate statistical analysis on 40 sample countries with heterogenous political and economic system reveals that social determinants universally impact the health outcomes and they are as important as economic variables. Policy implications and limitations of this study are also addressed at the end of the paper.

**Keywords:** Social determinants of health; Health outcomes; Economic variables

### Introduction

Recently discussion of health management has shifted from medical intervention to comprehensive population health concept. Such a shift is a result from less than satisfactory health outcomes based on medical intervention in this country. In spite of spending a huge amount of investment in the nation's health, the outcomes are not on par with investment spent on healthcare sectors especially compared with other similar countries.

Researchers in healthcare are beginning to pay attention to alternative care delivery systems that improve the nation's health. Rather than looking at individual as investigative targets, researchers are increasingly looking into what factors contribute most to the nation's overall health. Such a shift is not unexpected considering the health outcomes that this country has been experiencing over the last several decades.

One of the new approaches that have been discussed in the academic as well as policy arena is an introduction of

population health concept as a possible avenue to address health inequity that disproportionately impacts certain segments of the society (population). Population health stipulates that unless the population in every sector of the society is improved, the overall nation's health is not improved [1]. Population health also seeks to complement the classic efforts of public health agencies by addressing a broader range of factors shown to impact the health of different segments of the population.

Social Determinants of Health (SDOH) play an important role in defining the population health. World Health Organization defines SDOH as "the conditions in which people are born, grow, live, work and age" and "the fundamental drivers of these conditions" [2]. Accordingly, SDOH implicitly includes the concept of health equity. Health equity refers to a socially just state wherein all members of a population have access to the best available opportunities for health [3]. Health inequity, therefore, refers to unfair and avoidable differences in health between population groups that reflect inequitable access to those opportunities [4]. Therefore, it is possible that social inequity leads to health inequity [5]. The fundamental drivers in SDOH precede any medical intervention. The purpose of medical intervention

is to cure the illnesses that have already occurred while social intervention through SDOH prevents such health issues from occurring. Accordingly, researchers in SDOH argue that if and when an adequate investment in social environments is made that affect people's health, there will be less need for medical intervention. Health care leaders and clinicians strongly support incorporating social determinants of health in care delivery, according to an NEJM Catalyst Insights Council survey [6].

The World Health Organization's Commission on Social Determinants of Health reported in 2008 that the SDOH factors were responsible for the bulk of diseases and injuries and these were the major causes of health inequities in all countries. In the US, SDOH was estimated to account for 70% of avoidable mortality [7]. The same study even argues that medical care was responsible for only 10% to 15% of preventable mortality in the U.S. Marmot and Allen (2014) [5], quoted a Canadian study that shows health care accounts for only 25% of health, while socio-economic factors account for 50% of health. Artiga and Heiman (2015) [8], presented that individual behavior and social and environmental factors account for 60% of a person's health. These studies seem to echo a similar argument advanced by Bradley and Taylor (2011) [9], that "to fix health, help the poor." A study by Kwon, Kim and Martin (2017) [10], also shows social determinants play much broader impact on nation's health than economic factors. The merits of SDOH in improving the nation's health has been strongly reaffirmed and supported by health care leaders and clinicians in their recent study [6].

In spite of the mounting evidence that social determinants of health play important roles in improving the population health, little research has been done to investigate a comprehensive statistical analysis on a global scale. Furthermore, most studies on social determinants of health treat social determinants of health and medical intervention as if they were two separate agents. Health is a complex issue not independent from each other. Integrating social and medical services can be 10 times more effective than waiting for families to visit health services in reducing mortal in children under-5 years old [11].

This paper proposes that the nation's health can be improved by strengthening (investing) areas/factors related to SDOH which creates a situation that requires less medical intervention. The purpose of this paper is to investigate relationship between these two constructs; SDOH and population health. Multivariate statistical analysis is used to investigate the impact of social and economic determinants on health outcomes (infant mortality rate and life expectancy) using 40 samples (countries). Samples in this study include countries with different economic and political systems.

This paper is organized as follow: Section 2 presents literature review on population health and social determinants

of health. Testable hypothesis will be developed in this section. Section 3 outlines the research methodologies including data sources and variable identifications. Section 4 presents statistical outputs and discussions. Section 5 outlines implications of this study which is followed by limitations of this study in Section 6.

## Literature Review

The United States healthcare system has been used as a starting point to investigate the return on investment in healthcare areas. Economic theory stipulates that the more investment in healthcare systems, the higher the returns measured by typical universal health outcomes/indicators; infant mortality rate and life expectancy. Had the return on investment in healthcare system in the United States followed the economic theory, one would expect better health outcomes. But the common argument and question in healthcare researchers as well as with policy makers is "what is wrong with U.S. healthcare system?" as U.S. infant mortality rate has been higher than other similar countries especially in OECD countries and life expectancy is lower than that in other countries in spite of significantly higher investment in the healthcare system in the United States.

The U.S. healthcare system is the world most costly per capita base. Yet the results are at bottom of the pack among the comparable countries. The United States spent in average \$9,024 per capita in 2015 while other comparative countries in our sample study spent in average a little over \$5,000 per capita. In terms of percentage of health care spending to Gross Domestic Product (GDP), the United States spent 16.6% while comparative group spent in average 11.1%. Yet life expectancy and infant mortality rates of the United States are contrary to what researchers expected with lower life expectancy and higher mortality rates than their counterparts in the study [10]. If the above unfavorable health outcomes are compared with investment on social spending vs. healthcare spending, one must conclude there is a clear relationship between these two constructs health outcomes and spending on social vs. healthcare area. For example, countries in OECD spend \$1.70 on social spending per \$1.00 on healthcare whereas in the U.S. the ratio is \$0.56 vs. \$1.00 [12]. In the United States, only 10% of health outcomes are tied to medical care, while 60% are rooted in social and environmental factors and associated behaviors [13]. In 2015, only 3% of healthcare dollars were spent on preventive services [14].

A significant inference can be drawn from the above relationship without entering causality of these two constructs. Doran, Misa and Shah (2013) [15], even argue that lack of upstream investment in social determinants of health probably contribute to exorbitant downstream spending on medical care in the United States with no apparent favorable outcomes. It is argued that improvements in the nation's health can be achieved only when we have the commitment to moving even further upstream to change

the community behaviors that make people sick [16]. In spite of many challenges collecting proper information and corresponding data supporting the SDOH theory, there is a strong evidence of association between social factors and the population health [17].

The concept of SDOH is not a new policy proposal. It was implied by McKeown, Record, and Turner (1975) [18], in their study of decline of mortality in England and Wales during the 20<sup>th</sup> century. They noticed a dramatic increase in life expectancy since 19<sup>th</sup> century primarily due to improving living conditions (income) including nutrition, sanitation and clean water. Another example of the limits of medical intervention is the widening of mortality disparities between social classes in the United Kingdom in the decades following the inception of the National Health Service in 1948. Martinson (2012) [19], found that disparities in health by income were similar in the United States (which has no universal healthcare system) and England (which has universal healthcare system).

Adequate investment in social services at the state level is reportedly associated with a range of health outcomes [20]. Other studies claim that social, behavior, and environmental factors are estimated to contribute to more than 70% of some types of cancer cases, 80 percent of cases of heart disease, and 90 percent of cases of stroke [21,22]. It is claimed that adequate social determinants could reduce healthcare costs as much as 10% or \$2,443 per year per member [23].

Population health is total well-being of population that includes mental as well as physical health. SDOH plays an important role impacting population health. SDOH broadly covers three areas; housing, food security, and transportation [24-27]. Evidence indicates that we cannot improve nation's health without addressing social determinants. There is a growing body of literature indicating that risk factors such as food insecurity [28], lack of transportation, and poor housing in community [29-31], result in poor downstream health condition and tend to deplete community health resources [32]. People with lack of social supports cited above usually end up in emergency department [33]. Recognizing the value of SDOH, insurance companies and other payers start to pay attention beyond the hospital or clinic and stepping into the community to give patients help where it is needed [34].

Within the healthcare system, a house is not just a shelter. Access to clean, safe and affordable housing has been identified as one of the most basic and important social determinants for good health [12]. Clean houses form a healthy community where information exchange takes place that will reduce stress and anxiety among residents [27]. A lack of active and informed community creates disconnected communication network among residents in the community. One survey reveals that many people missed appointments with healthcare providers due to “forgetting”

(35.5%), and “miscommunication” (31.5%) [35]. A healthy and functional community fosters communication flow among the community members. A large-scale survey on healthcare providers reveals a similar finding. Housing and transportation are high on the agenda that improves the community health [36]. The Drake and Eisenson study (2019) [32], reveals that more than 61% of physician surveyed cited isolated community as a major cause of stress and anxiety of patients. A study in Massachusetts of the Community Support Program for People Experiencing Chronic Homelessness shows that every dollar spent on housing in this program yields \$2.43 healthcare saving [37]. A lack of a healthy community seems to also create also a dysfunctional neighborhood togetherness and fosters alcoholism among the young [38], and gun violence [39].

A lack of transportation, on the other hand, has been main source of missing appointments with healthcare providers. No-show rates are higher in clinics caring for underserved population and may contribute to poorer health outcomes in the group [35]. Those who missed appointments regularly usually end up in an emergency room for chronic treatments that could be avoided had they kept their appointments on a regular basis [40]. Sixty-six (66) percent of physicians seem to agree that availability of transportation for low income group would help patient's overall health [23].

Food insecurity, a condition in which households lack access to adequate food because of limited money or other resources, is a leading health and nutrition issue in the United States [41]. In 2013, almost fifty million Americans (14.3 percent) were experiencing food insecurity [42]. The Gundersen and Ziliak's study further reports that food insecurity is associated with increased risks of some birth defects, anemia, lower nutrient intakes, cognitive problems, and aggression and anxiety. It is also associated with higher risks of being hospitalized and poorer general health and with having asthma, behavioral problems, depression, suicide ideation, and worse oral health. Compared to children in food-secure households, children in food-insecure households had 2.0~3.0 times higher odds of having anemia, 2.0 times higher odds of being in fair or poor health, and 1.4-2.6 times higher odds of having asthma, depending on the age of the child. Gurvey, et al. (2013) [43], tested a pioneering study in the Philadelphia metropolitan area on adequate nutrition in chronically ill patients. Their study reveals that for those who enrolled in their study, the mean monthly numbers of ER visits decreased for three consecutive months compared with the control group (0.2. vs. 0.4) and the total monthly costs also decrease (\$28,268 vs. \$40,906).

A lack of a healthy community fosters an environment where other social determinants of health come into play such as gun violence, alcohol abuse and suicide that affect life expectancy and infant mortality [17]. Exposure to violence can perpetrate gun violence [44], and availability of alcohol in poor communities can

influence its young people to be more dependent on alcohol than their peers in other communities [38]. Some authors argue that the low life expectancy from drug over does was as big as the low life expectancy from Alzheimer’s disease, suicide, chronic liver disease and septicemia combined [45]. The same study also reports that during the period 1999 to 2017, the age-adjusted suicide rate increased 33% from 10.5 per 100,000 in 1999 to 14.0 in 2017. On average, 115 people in the U.S. die each day from an opioid overdose, and six Americans die per day from alcohol abuse [46]. The same report also highlights a rise of the suicide rate by 24% between 1999 and 2014.

In spite of mounting evidence that social determinants are effective approach to improving the population health [10,47], policy makers have been reluctant to make investments in these areas. If nation’s health is public goods and social determinants play important roles in improving nation’s health, public investments are needed to manage the population health [48]. Nevertheless, it appears that governments especially the federal government wants to leave this area of health improvement to local governments and the local governments, in turn, tend to push this assignment to charitable organizations. But there is a limit how much charitable organizations can invest their resources in social services.

Another issue related to SDOH is how and who finances this task. Multiple stakeholders benefit from the upstream intervention; patients, payers, health and social service providers and ultimately taxpayers [48]. Health is public goods (e.g., COVID-19) and therefore it is assumed that governments should invest its resources into this area. However, policy makers especially at the federal level have been reluctant in committing a huge sum of the investment in this area since the benefits for SDOH is not visible in the short term. The policy makers especially in Congress usually entertain investments in short-term projects where the outcomes become visible in time for their constituency especially in the election years (every 2 years in this country). Under such political environment, a long-term investment is not “politically wise” agenda for many elected officials. As a result, the public funding/investment in SDOH take a back seat for many years and our health outcomes fall behind other countries who invest regularly in the SDOH areas where health impacts become evident in the long-run. So much so that the 2017 National Academy of Medicine proclaims that “integrating arrangement, financing, and delivery of nonmedical social services with medical services is important to improve outcomes, yield savings, and enhance equity” [49].

Although the concept of social determinants of health is convincing, implementing this concept is challenging. One survey on 640 healthcare leaders in this country reveals that the top two challenges in people’s health management include influencing people’s behavior (63%), such as preventive health, nutrition, smoking, etc. and addressing and convincing importance of social determinants such as food insecurity, housing, and transportation

(57%) [50].

### Hypothesis Development

Literature on social determinants of health indicates that the nation’s health is shaped more by people’s social backgrounds (where one is born, raised and aged) than economic variables. As the population ages, per capita healthcare spending increases; it costs \$3,552 per capita healthcare for ages 18 and under while it costs \$32,411 for the population 85 and older [51]. The way one is born and raised plays an important role shaping our health in the early stages of our lives. Such health formation advances into our adulthood benefiting from healthy social and economic environments. Medical intervention is needed to correct and improve the areas where positive social determinants are either lacking or absent. Imbalance between physical and mental developments due to poor social determinants eventually shifts the burden to medical intervention. Cost of total healthcare mounts while the outcome of population health is a painfully slow, long, and costly process. Based on literature survey especially with Doran, Misa, and Shah (2013) [15], study, improvement of population health can be described in the Figure 1.

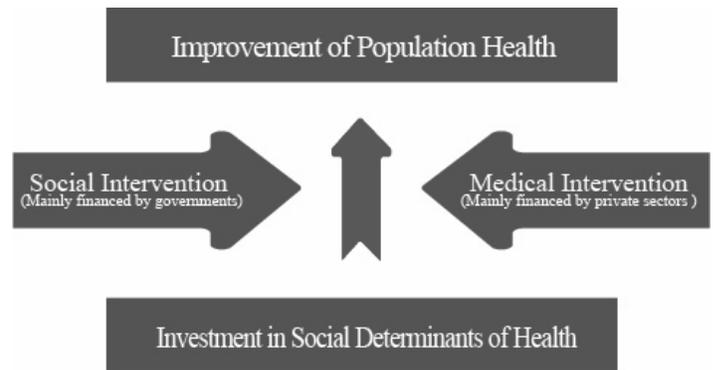


Figure 1: Formation of Population Health.

The main hypothesis of this study is that social determinants have as much impact as economic variables on population health measured by infant mortality rate and life expectancy. This study uses a cross sectional comparative analysis of selected variables among 40 economically and politically diverse countries. Countries in the study include Australia, Austria, Belgium, Brazil, Canada, Chile, China, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, India, Ireland, Israel, Italy, Japan, Korea, Latvia, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Russian Federation, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Thailand, Turkey, United Kingdom, and United States. Information on selected variables came from the United Nation, World Health Organizations and other sources that publish pertinent health related statistics on a regular basis. Selection of variables especially social determinants of health that impact a nation’s

health is rather challenging and limited. For example, information uniquely relevant to the United States such as income disparity by races may not be so pertinent or relevant to other countries in our sample. In addition, information gathering processes are different by countries and some instances, certain countries may not collect information important to this study. For example, there is no information on Gini Index for China, India, Japan, Russia and Thailand. Also, Thailand does not collect information on gun homicide.

Multivariate statistical model was used to measure the relationship between health outcomes (life expectancy and infant mortality rate) and economic and social variables. However, we believe that there is/are strong interaction among economic and social variables that impact the health outcome. For instance, people with higher income group would have better chance to access to more and better social and healthcare networks where a variety of supporting services are available. Alcohol abusers tend to use gun violence to keep their drug habits. Multicollinearity among independent variables, therefore, must be measured and to minimize their impacts on outcome variables. We are hoping that multivariate regression approach would address some of these issues. Variable selection, therefore, follows the existing literature on health outcomes and social determinants and economic variables. The following variables were selected in this study.

#### **A. Resources for Health Care**

1.  $\text{Log}_{10}$  per capita healthcare spending as a % of GDP indication of investment in health care system (Source: OECD Health Statistics, 2016)
2. Percent (%) of spending on health care to gross domestic product; normalized indicator of investment in health care system (Source: OECD Health Statistics, 2016)

#### **B. Health Outcomes**

1. Infant mortality rate per 1000 live births (Source: UN Population Division, 2017)
2. Life expectancy (years) (Source: UN Population Division, 2017)

#### **C. Social determinant variables impacting health outcomes**

1. Income disparity (Gini index). It is a measurement of the income disparity of a country's residents. This variable ranges between 0 and 1(or 0 to 100%) with 0 representing perfect

income equality and 1 representing perfect income inequality. (Source: World Fact Book, 2015)

2. Insurance coverage (%), percent of people in a country covered by some types of health insurance (Source: OECD Health Statistics, 2016).
3. Drug overdose deaths per 100,000, indicator of personal health behavior [38], (Source: [www.worldlifeexpectancy.com/cause-of-death/drug-use/by-country](http://www.worldlifeexpectancy.com/cause-of-death/drug-use/by-country), 2015)
4. Gun ownership per 100 residents, another indicator of personal health behavior (Source: Wikipedia 2017, estimated number of civilian guns per capita by country)
5. Gun homicide per 100,000 (Source: Wikipedia 2017, Firearm-related death rate per 100,000 populations)

### **Statistical Results**

#### **Bivariate statistical analysis**

In order to highlight differences of outcome variables, economic variables, and social determinants between the United States and the rest of the sample countries as well as the United States and OECD countries, a simple bivariate statistical analysis was conducted. The results are shown in Table 1. Life expectancy for the U.S. is lower than that of the entire sample countries. However, such difference is not statistically significant, perhaps due to much lower life expectancy for some of the underdeveloped countries. However, when the U.S. life expectancy is compared with that of economically advanced countries (mostly in OECD countries), there is a statistically significant difference between these two groups in the sample (78.88 years for U.S. vs. 81.5 years for advanced countries,  $p < 0.05$ ). The infant mortality rate for U.S. is the highest (5.6 per 100,000 live birth vs. 5.05 for the entire sample and 2.95 for the economically advanced countries ( $p < 0.05$ ). The U.S. healthcare system spent in average of \$9,892 per capita as opposed to \$3,348 for the entire sample countries and \$4,924 for advanced countries. Yet the life expectancy for the U.S. is the lower than study group. On income distribution, the Gini index indicates that the U.S. has the highest income disparity (45.01 for U.S. vs. 33.2 for the rest,  $p < 0.05$ ). The death rate from drug overdose per 100,000 for U.S. is recorded as 6.96 vs. 1.99 for the sample and 2.09 for the advanced countries ( $p < 0.05$ ). Table 1 also reveals that of all social determinant variables except gun related homicide, U.S. has the worst record ( $p < 0.05$ ).

Variables/Determinants	U.S.	Sample countries	Advanced countries
Life Expectancy (Years)	78.88	79.1 (0.42)	81.5 (-14.66)***
Infant Mortality (per 100,000 live birth)	5.6	5.05 (-0.607)	2.95 (-16.57)***
Per capita healthcare spending (\$)	9,892	3,348.71 (-18.33)***	4,924.02 (-17.63)***
Healthcare spending As % to GDP (%)	17.21	8.37 (-22.14)***	9.74 (-25.42)***
Income distribution (Gini Index, %)	45.01	33.2 (-9.19)***	30.0 (-16.87)***
Insurance Coverage (%)	90.9	98.1 (11.30)***	99.7 (40.11)***
Drug Overdose Death (per 100,000)	6.96	1.99 (-15.1)***	2.09 (-17.66)***
Variables/Determinants	U.S.	Sample countries	Advanced countries
Gun Ownership (per 100 households)	101.1	15.0 (-54.20)***	18.3 (-4.36)***
Gun Homicide (per 100,000)	3.6	2.2 (-1.26)	1.86 (-1.04)
Suicide Rate (per 100,000)	13.7	11.2 (-3.54)**	11.1 (-3.78)**
() = t-values; **p < 0.05, ***p < 0.01			

**Table 1:** Bivariate Statistical Result.

### Multivariate regression outcomes

**Life Expectancy:** Table 2 illustrates the relationship between the life expectancy and independent variables. Variation inflation factors (VIF < 5) were examined and no serious multicollinearity issues were detected. Adjusted R<sup>2</sup> is respectable (0.696) and overall model is reliable (F = 10.677, p < 0.0+). All signs point to the right relationship except Gini index. We expect an inverse relationship between these two variables; higher the index, higher the income inequality leaving less for other activities related to a healthy life style. A positive relationship between these two variables is unexpected. However, such relationship is not statistically significant. There is a weak relationship (p < 0.1) between life expectancy and drug related death and suicide rate.

Variable	Regression Coefficient	Beta Coefficient	t-value
Constant	35.85		
Per capita healthcare spending	8.841	0.908	5.971***
Gini Index	0.054	0.161	1.218
Insurance Coverage	0.134	0.204	2.321**
Drug Overdose Death (per 100,000)	-0.93	-0.179	-1.922*
Gun Ownership (per 100 households)	-0.36	-0.126	-1.813*
Suicide Rate (per 100,000)	-0.98	-0.138	-2.191**
R <sup>2</sup> = 0.696, F = 10.677***, *p-value < 0.1, **p-value < 0.05, ***p-value < 0.01.			

**Table 2:** Life Expectancy.

**Infant Mortality Rate:** Table 3 shows the relationship between infant mortality rate and income and social determinants variables. The model is respectful with adjusted  $R^2 = 0.656$  and the overall model seems to be reliable ( $F = 8.581$ ,  $p < 0.01$ ). Per capita spending on health has the highest reliability supporting Blumenthal, Collins and Fowler’s study (2020) [52]. To our surprise, health insurance coverage shows not only statistically insignificant relationship with the mortality rate, but the direction is contrary to what a conventional theory indicates. Multicollinearity reveals no serious issues. Although unexpected directional relationship, the relationship is statistically not significant ( $P > 0.1$ ). Another surprising finding from Table 3 is the strength of Gini index on infant mortality rate. We indeed expect a positive relationship between these two variables; the higher the income concentration into few groups in a society, less money is left for other needs including healthcare. The infant mortality bounds to rise as shown in this study.

Variable	Regression Coefficient	Beta Coefficient	t-value
Constant	16.096		
Per capita healthcare spending	-6.285	-0.616	-3.624***
Gini Index	0.134	0.308	2.890***
Insurance Coverage	0.05	0.093	0.663
Gun Ownership (per 100 households)	0.04	0.306	2.028**
Gun Homicide (per 100,000)	0.073	0.2	1.713*
Suicide Rate (per 100,000)	-0.083	-0.02	-0.318
$R^2 = 0.656$ , $F = 8.581$ ***, *p-value < 0.1, **p-value < 0.05, ***p-value < 0.01			

**Table 3:** Infant Mortality Rate (per 100,000 Live Births).

## Discussion

In spite of a large investment in healthcare areas, the U.S. falls significantly behind other similar countries in two health indicators, infant mortality rate and life expectancy. Implication from this study suggests that medical intervention alone cannot improve the population health. The U.S. spent \$1,220 per capita on pharmaceutical products in 2018 with life expectancy of 78.74 year and infant mortality rate of 5.6 per 100,000 live births. Korea (South), for example, spent \$660 per capita with life expectancy of 82.2 years and infant mortality rate of 2.9 [53]. America is the giant “medicated” and over “medicalized” nation in the world [10,54]. Yet the health outcomes failed to reflect the investment the U.S has made.

Statistical evidence across the different economic and political spectrum seems to confirm that social determinants indeed influence the nation’s health much more than the medical intervention supporting various studies in this area [5,8-10]. Our findings appear to support such hypothesis at a global scale regardless of political and economic systems.

Social determinants are grouped broadly into three areas; housing, food security and transportation. Per capita income and rate of insurance covered are strongly related to health outcomes supporting economic theory of health; higher the income, higher the spending on social determinant areas such as a better housing, easy access to transportation and better nutrition. Health outcomes

accordingly improve. Social determinant variables collectively display a close relationship with health outcomes. Income disparity measured by Gini Index strongly related to the infant mortality rate supporting previous findings by Kwon, Kim and Martin (2017) [10]. Other social determinant variables such as drug overdose deaths and suicide rate appear to influence life expectancy whereas income disparity, gun ownership and gun related homicide seem to impact mortality rate supporting studies by Preidt (2016) [39], and Braveman and Gottlieb (2014) [17].

This study reaffirms the importance of social determinants of health as a means of improving the population health. Then perhaps the important question is “Why does the United States see a consistent lack of investment into social variables such as housing, food security, and easy accessibility to transportation? Unfortunately, the short answer is “politics.” Return on investment from social determinant variables is a long-term process; sometime it would take a decade or generation to see the returns (improvement of health indicators). But politicians cannot wait for that long to see the results. Election comes every two years and politicians have to demonstrate their achievements to the voters in election years. Investment in social variables, accordingly and always, takes a back seat.

## Limitations and Contribution of Study

This study has limitations in two important areas. Firstly, lack of standards of data collection in social determinants of health

restricts broader applicability of findings from this study. Certain important variable such as race is not available for many countries. In addition, a lack of uniform definitions of food insecurity, healthy housing, and availability of transportation hamper data collection on country basis. Accordingly, certain published information, for example, ratio of social spending to healthcare spending, may not reflect actual intent across the countries.

Secondly, this study used only 40 countries as samples. In addition, this study heavily sampled in favor of economically advanced countries. Accordingly, we cannot claim the findings and conclusions derived from this study are applicable universally. Outcomes may be different had we include all countries in the model.

Nevertheless, this study has two important contributions to the body of knowledge in population health. This study confirms that the social determinants of health are important factors in improving the nation's health across the countries. Although few studies deal with international comparison of social determinants on health [10], most studies use only one homogenous group of countries (OCED) and as such global interpretations of the outcomes may be biased. Secondly, this study used a multivariate statistical model to reflect a possible interaction effect among and between independent variables. Multivariate statistical analysis/model allows investigators to measure the extent of interaction effects among the independent/policy variables. For example, if availability of transportation tends to reduce ER utilizations [23,35], it follows that easy access to transportation would keep people healthy by maintaining regularly scheduled appointments with healthcare providers.

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