Income Inequality and Population Health in Sub-Saharan Africa: A Test of Income Inequality-Health Hypothesis

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Abstract

Existing studies have shown that income inequality remains a core determinant of population health. These findings are in line with the Income Inequality-Health Hypothesis (IIHH). However, this assertion remains unclear for Sub-Saharan Africa (SSA), despite the rising trend of income disparity in the region and the vastness of the studies that tested the validity of the IIHH. This inferential study, therefore, examines the effect of income inequality on health for 31 Sub-Saharan African countries from 1995 to 2015 using life expectancy at birth, infant mortality rate, and under-five mortality rate as indicators of population health, as well as the Gini index as a measurement of income inequality. The study employed the Generalized Method of Moments (GMM). We infer that income inequality contributes significantly to poor population health in Sub-Saharan Africa, thereby affirming the validity of the Income Inequality-Health Hypothesis for the region.

Keywords

Africa; economic growth; health; income inequality; panel models

Introduction

Many countries in Sub-Saharan Africa exhibit features of a non-egalitarian society. The region ranks as the second—after Latin America—for most unequal income distribution, globally, despite a decline of 3.4 percentage points in average unweighted Gini index between 1991 and 2011 (UNDP, 2017). Gini index for countries like Central African Republic, Zambia, and 11 other SSA countries range between 0.53 and 0.60 while the 27 other countries (including Nigeria, Swaziland, Kenya, Cote d'Ivoire, and Zimbabwe) have Gini index in the range of 0.40 to 0.529. Despite recording accelerated growth in the gross domestic product (GDP) after nearly 25 years of stagnation (UNDP, 2017), health outcomes are still poorer in Sub-Saharan African countries than in other regions of the world. Life expectancy at birth has been consistently low, while both infant mortality and under-five mortality rates are still high compared to other areas of the world. The top ten countries (i.e., Swaziland, Lesotho, Central African Republic, Sierra Leone, Cote d'Ivoire, Chad, Nigeria, Angola, Guinea Bissau, and Mozambique) with the lowest life expectancy globally between 2010 and 2015 are all in the SSA region. Swaziland, Lesotho, Chad, and Nigeria have a life expectancy at birth of 49.2, 49.5, 51.1, and 52.3, respectively, while Japan, Italy, Canada, and New Zealand have a life expectancy of 83.3, 82.8, 81.8, and 81.6, respectively (United Nations, 2017a).

Likewise, all ten countries (i.e., Angola, Chad, Guinea-Bissau, Central African Republic, Sierra Leone, Somalia, Burundi, Mali, South Sudan, and Nigeria) with the highest under-five mortality rates between 2010 to 2015 are in the SSA region. Out of these countries, Angola has the highest under-five mortality rate of 155.7, while Nigeria has the lowest under-five mortality rate of 122.2 per 1,000 live births. Meanwhile, during the same period, industrialized nations like Luxembourg, Singapore, Hong Kong, and Sweden have under-five mortality rates of 2.0, 2.3, 2.6, and 3.3 per 1,000 live births, respectively. In terms of the infant mortality rate, Africa has the highest at 59 per 1,000 live births. However, Asia, Latin America and the Caribbean, Oceania, Northern America, and Europe recorded infant mortality rates of 31, 20, 20, 6, and 5 per 1,000 live births, respectively, during the same period (United Nations, 2017a).

Income inequality affects the consumption of nutritious food and preventive and curative healthcare due to the disproportionate income accruing in poor households (Birdsall et al., 1995). Income inequality tends to reduce life expectancy even beyond the absolute, and it denotes the psychosocial consequences of social comparison. Income inequality potentially affects the health status of both the poor and the rich through the neo-material, psychosocial, structural, or social capital pathway (Kawachi & Kennedy, 1999; Mellor & Milyo, 2002; Ribeiro et al., 2017; Rözer & Volker, 2015; Subramanian & Kawachi, 2004; Torre & Myrskylä, 2011).

The Income Inequality-Health Hypothesis (IIHH) captures these harmful effects of income inequality on health. The hypothesis posits that income inequality is largely correlated with poorer health status (Hill & Jorgenson, 2018; Ribeiro et al., 2017).

Several studies, including Flegg (1982), Hill and Jorgenson (2018), Judge (1995), Li and Zhu (2006), Odusanya and Agboola (2017), Pampel and Pillai (1986), Qi (2012), Ram (2005), Rodgers (1979), Vilda et al. (2019), and Wilkinson and Pickett (2006) have attempted to confirm the nature of the relationship between income inequality and health, or test the income inequality-health hypothesis (IIHH). However, the income inequality-health nexus in the SSA region has received little or no attention in the available literature despite the rising income inequality and extremely poor health outcomes in the region. Therefore, it is vital to examine how rising income inequality affects health outcomes in Sub-Saharan Africa. More so, SSA is still far from achieving the Sustainable Development Goals (SDG) targets, especially in reducing child mortality (United Nations, 2017b).

Our study provides evidence of the detrimental effects of income inequality on population health in Sub-Saharan Africa. This study confirms the validity of the IIHH using three different measures of population health: life expectancy at birth, infant mortality rate, and under-five mortality rate. The rest of the paper is divided into four sections: the review of the relevant literature is in section two; section three focuses on the methodology; section four contains the results and discussion, and the last section concludes the paper.

Literature review

Several studies exist on the hypothesized detrimental effects of income inequality on population health, based on the income inequality-health hypothesis, for many advanced economies and few low- and medium-income countries. The empirical literature on the effects of income inequality on health has remained large and continues to grow. Findings from these studies have been mixed, with some reporting the adverse impact of income inequality on health, thereby affirming the income inequality-health hypothesis. Some of these studies have found no correlation between income inequality and health or show little support for IIHH. Few studies reported an inverted-U relationship between income inequality and health, with some reporting a mixed relationship (see Table 1).

From Table 1, it is quite evident that most of the studies find income inequality to be responsible for undermining population health, thus confirming the validity of the Income Inequality-Health Hypothesis. The harmful effects of income inequality on health cut across countries irrespective of the level of economic development and the measurement of income inequality and indicators of health outcomes. The effects are even much pronounced in the developed economies.

Table 1: Empirical Studies on the Effect of Income Inequality on Health Outcomes/Test of Income Inequality-Health Hypothesis (IIHH)

S/N	Authors/Year	Sample	Estimation method	Measurement(s) of Income Inequality	Measurement(s) of Health Outcomes	Main Findings	Support for IIHH
1.	Rodgers (1979)	56 countries (developed & developing)	Multiple Regression	Gini coefficient and other measures	LE and IMR	Higher income inequality strongly associated with lower life expectancy	Yes
2.	Flegg (1979)	60 non-industrialized countries	OLS	Atkinson index	Fertility Rate	10% reduction in the Atkinson index reduces birth rates by 2.2%	Yes
3.	Flegg (1982)	46 LDCs and 13 DCs	OLS; 2SLS	Gini index	IMR	Inequality increases IMR	Yes
4.	Pampel and Pillai (1986)	18 industrialized countries	OLS	Gini index	IMR	Higher income inequality unrelated to IMR	No
5.	Wilkinson (1992)	Nine industrialized countries	Multiple Regression	The proportion of income to those below the 7th decile	LE	Higher income inequality strongly correlated with lower life expectancy	Yes
6.	Wennemo (1993)	11 industrialized countries	Multiple Regression	Gini index	IMR	Higher income inequality associated with higher IMR	Yes
7.	Judge (1995)	13 industrialized countries	Multiple Regression	Gini index; income shares	LE	No association between income inequality and LE	No
8.	Kawachi et al. (1997)	39 US states	OLS	Robin Hood index; Income decile	AAMR	Higher income inequality correlated with higher AAMR	Yes
9.	Chiang (1999)	Taiwan	OLS	Gini index; 50% income share	AAMR, UMR	UMR associated with higher income inequality but weak association between income inequality and AAMR	Yes
10.	Judge et al. (1998)	16 Industrialized countries	OLS	Income shares; Gini index	LE, IMR	No association between income inequality and LE; No relationship between change in inequality and change in LE and IMR	No

S/N	Authors/Year	Sample	Estimation method	Measurement(s) of Income Inequality	Measurement(s) of Health Outcomes	Main Findings	Support for IIHH
11.	Walberg et al. (1998)	Russia	Probit regression	Robin Hood index	Change in LE	Higher income inequality associated with lower life expectancy	Yes
12.	LeClere and Soobader (2000)	US counties	Logistic regression	Gini	SRH	Higher income inequality correlated with poorer SRH, for only whites aged 18 to 44 and not associated in other age groups	No
13.	Ross et al. (2000)	50 US states and 10 Canadian provinces	Weighted Least square	The income share of poorest 50%	ASMR	Canadian provinces had both lower income inequality and lower mortality than US states	No
14.	Wolfson et al. (1999)	50 US states	Multiple regression	Gini index	Risk of mortality	Weaker association between the level of income inequality and observed mortality in each state.	No
15.	Mellor and Milyo (2002)	50 US states	Probit regression	Gini index	SRH	No association between income inequality and SRH	No
16.	Shibuya et al. (2002)	Japan	Probit regression	Gini index	SRH	Higher income inequality not associated with an increased likelihood of poor health	No
17.	Shi et al. (2003)	US states	cross-sectional Analysis	Gini index	Stroke mortality	Income inequality has a reduced effect on stroke mortality	No
18.	Wen et al. (2003)	US states	The hierarchical ordinal logit model	Gini index	SRH	Income inequality is not a structurally important determinant of SRH	No
19.	Messias (2003)	Brazilian states	Simple and multiple linear regression	Gini index	LE	Income inequality has a negative association with LE	Yes

S/N	Authors/Year	Sample	Estimation method	Measurement(s) of Income Inequality	Measurement(s) of Health Outcomes	Main Findings	Support for IIHH
20.	McLeod et al. (2003)	Canada	Maximum likelihood ordered logit model	The income share of the poorest 50%	SRH	Income inequality not associated with poor health	No
21.	Subramanian and Kawachi (2004)	50 US states	Logit model	Gini index	SRH	The odds ratio of having poor health increased by 1.32% for every 5% increase in income inequality	Yes
22.	Ram (2005)	US states	OLS	Gini index	Death crude rate	Income inequality exerted significantly on mortality	Yes
23.	Ram (2006)	108 countries (cross-sectional)	OLS	Gini index, the income share of the top 10%	IMR	Negative cross-country association between income inequality and health	Yes
24.	Li and Zhu (2006)	Chinese 8 provinces	Probit Regression	Gini index	SRH, physical functions, Activities of daily living (ADL)	Inverted-U association between SRH and income inequality, implying that high inequality poses health threats.	Yes
25.	Wilkinson and Pickett (2006)	Countrywide studies	A meta-analysis of 155 studies			70 percent of the studies found a negative effect of income inequality on health	Yes
26.	Subramanian et al. (2007)	India (1998-1999 cross-sectional National Family Health Survey)	Multi-nominal logistic regression	Gini index	BMI	The risk of under- and over-nutrition at the individual level was significantly associated with income inequality	Yes

S/N	Authors/Year	Sample	Estimation method	Measurement(s) of Income Inequality	Measurement(s) of Health Outcomes	Main Findings	Support for IIHH
27	Safaei (2007)	10 Canadian provinces		Income groups	Health utility index; Chronic health condition (CHC); SAIH	Inequality in income caused inequalities in health	Yes
28.	Chen and Meltzer (2008)	Nine Chinese provinces	A multi-level linear probability model	Coefficient of variation	Health risk factors: obesity & hypertension	Increasing community income inequality is positively associated with health risk factors.	Yes
29.	Babones (2008)	126 countries (1970 & 1995)	Polynomial regression	Gini index	LE, IMR, and murder rate	Income inequality is significantly correlated with LE, IMR, and inconsistently with the murder rate	Yes
30.	Kondo et al. (2009)	Canada, Chile, China, Denmark, Finland, Japan, Norway, US, UK, New Zealand	Meta regressions	Gini index	Premature mortality and SRH	Income inequality is associated with a modest excess risk of premature mortality and SRH	Yes
31.	Biggs et al. (2010)	22 Latin American nations (1960-2007)	Fixed effects	Gini index	LE, IMR, and TB	Inequality has no significant direct effect on public health	No
32.	Torre and Myrskylä (2011)	21 rich countries (1975-2006)	Random effects	Gini index	ASMR and LE	Income inequality strongly and positively associated with the mortality rate	Yes
33.	Esmaeili et al. (2011)	24 Islamic countries (1996-2004)	OLS	Gini index; Income share	LE and IMR	Income inequality not a significant determinant of health	No
34.	Karlsdotter et al. (2012)	Spanish life conditions survey for 2007	Multilevel logistic regression	Gini index, Theil & Atkinson indices	SRH and Chronic illness	Measures of income inequality had no significant association with health outcomes	No

S/N	Authors/Year	Sample	Estimation method	Measurement(s) of Income Inequality	Measurement(s) of Health Outcomes	Main Findings	Support for IIHH
35.	Feng et al. (2012)	Longitudinal survey data for 23 Chinese provinces (2008)	Multilevel logistic model	Gini index	SRH	Province level income inequality affects the health of the elderly in China.	Yes
36.	Qi (2012)	World Value Survey (2005) in 57 (OECD & non-OECD) countries	Logistic regression	Gini index	SRH	There is no independent adverse effect of country income inequality on SRH	No
37.	Lau et al. (2012)	Hong Kong (1976-2006)	Negative binomial regression	Gini index	All-cause and cause-specific deaths	Income inequality was positively associated with mortality	Yes
38	Grönqvist et al. (2012)	Swedish population aged 16-65/16-74	OLS; Instrumental variable	Gini index; Coefficient of variation, etc.	Risk of being hospitalized	Income inequality has no significant effect on health	No
39	Sun et al. (2012)	12,449 middle and high schools' students from seven major Chinese cities in 2002	OLS	SPRII	SRH, depression, stress, and cigarette smoking	A positive relationship between SPRII and SRH, but such a relationship does not exist between SPRII and stress	Mixed
40.	Rasella et al. (2013)	Brazil (2000-2009)	Fixed Effects	Gini index /Percentile dispersion ratio	LE	Income inequality was negatively associated with LE	Yes
41.	Baeten et al. (2013)	China (1991-2006)	Probit model	IRHI	SRH	Rising income inequality was related to poor health	Yes

S/N	Authors/Year	Sample	Estimation method	Measurement(s) of Income Inequality	Measurement(s) of Health Outcomes	Main Findings	Support for IIHH
42.	Pop et al. (2013)	140 countries (low, middle, and high income) (1987-2008)	Hybrid Fixed effects model	Net Gini	LE	Rising inequality was associated with lower LE for low- & middle-income countries but insignificant for high-income countries	No
43.	Hamilton and Kawachi (2013)	35,620 US immigrants	Logistic regression	Gini index	SRH	Less income inequality is associated with better health	Yes
44.	Rajan et al. (2013)	2001 Indian Census and 60th Round of Indian National Statistical Survey	Logistic regression	Gini index; 90/10- & 80/20-income ratios	IMR, UMR, and SRH	Income inequality is a strong determinant of health at the individual level but not at the state & district levels	Mixed
45.	Rözer and Volker (2015)	30 developed countries-based World Value Survey (1981 to 2014)	Multi-level regression	Net Gini	SRH	Income inequality impacted negatively on health, but the effect faded away after age 36	No
46.	Vincens and Stafström (2015)	Brazil (2002-2009)	Random effects models	Gini index	Stroke mortality rate	Income inequality was independently associated with stroke mortality rates despite controlling for the gross domestic product (GDP) per capita	Yes
47.	Bakkeli (2016)	China	Fixed effects model	Theil index & Gini index	Blood pressure, WHR, MAMC, and overweight	Income inequality does not have a significant impact on an individual's risk of having health problems	No
48.	Siddiqi et al. (2015)	US states (1990-2007)	Fixed effects & Random effects	Gini	IMR	Income inequality was inversely associated with IMR; But with time, it had increased positive association with IMR	No

S/N	Authors/Year	Sample	Estimation method	Measurement(s) of Income Inequality	Measurement(s) of Health Outcomes	Main Findings	Support for IIHH
49.	Undurraga et al. (2016)	Bolivian Amazon	Negative binomial model, ordered logit, OLS, and logistic regression	The income share of the poorest 20%	SRH, WHZ, blood pressure, and body fat	Income transfers to rural households increased perceived stress of the better off and reduced the perceived health-related stress of the poorest	Yes
50.	Elgar et al. (2016)	40 Industrialized countries (1994-2014)	Hybrid FE model	Net Gini	Psychological and physical symptoms	Early life income inequality has adverse effects on the health and well-being of adolescent girls.	Yes
51.	Ribeiro et al. (2017)	A meta-analysis of 27 studies	Meta-regression	Gini index, Theil index, Atkinson index	Mental illness-related morbidity	Income inequality is associated with mental health problems, with a small overall effect	Yes
52.	Pasqualini et al. (2017)	12 European countries (1920-1956)	OLS regression	Gini index	SRH, BMI, chronic diseases	Country income inequalities are negatively associated with health conditions	Yes
53.	Moeller et al. (2017)	US	Chi-square tests	Gini index	Oral health	Income inequality affects both functional and social dimensions of oral health.	Yes
54.	Odusanya and Agboola (2017)	Nigeria	ARDL	Gini index	IMR	Income inequality exerts negatively and significantly on health	Yes
55.	Hill and Jorgenson (2018)	50 US states	Fixed Effects	Gini index; the percentage of the income share	LE	Income inequality has an inverse association with the life expectancy of people	Yes
56	Matthew and Broderson (2018)	50 US states	Probit regression	State-level Gini Index	Behavioral, physical, and mental health	Income Inequality has a significant relationship with behavioral, physical, and mental health outcomes	Yes

S/N	Authors/Year	Sample	Estimation method	Measurement(s) of Income Inequality	Measurement(s) of Health Outcomes	Main Findings	Support for IIHH
57	Vilda et al. (2019)	US Census American Community Survey	Poisson Regression	Gini coefficient	Pregnancy-related mortality	Income inequality is associated with pregnancy-related mortality.	Yes

Note: *IRHI ⇒ Income - Related Health Inequality; MAMC ⇒ Middle-upper arm muscle circumference; WHR ⇒ waist-to-hip, ratio; UMR ⇒ under-5 mortality rate; SRH ⇒ Self-Rated Health; BMI ⇒ Body Mass Index; TB ⇒ Tuberculosis; WHZ ⇒ Weight for height - Z-score LE ⇒ Life Expectancy; IMR ⇒ Infant mortality rate; AAMR ⇒ Age-Adjusted mortality rate; CSMR ⇒ Cause-specific mortality rate*
No ⇒ Partly or not supportive of IIHH; Yes ⇒ Wholly supportive of IIHH

Methodology

Following Bakkeli (2016), Flegg (1982), Ram (2006), and Torre and Myrskylä (2011), we express indicators of health outcomes as a function of income inequality and a set of control variables.

$$HE_{i,t} = \alpha_0 + \beta INEQ_{i,t} + \theta y_{i,t} + \gamma X_{i,t} + \varepsilon_{i,t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(i)$$

HE represents indicators of population health (i.e., life expectancy at birth, infant mortality rate, and under-five mortality rate), β is the coefficient of income inequality, while X is the vector of control variables that also determine health status in the SSA region. The set of control variables are healthcare expenditure (HCE), access to an improved water source (WAT), access to improved sanitation (SAN), and income (y), measured as per capita GDP.

The panel data models were estimated using the Blundell-Bond estimator (Blundell & Bond, 1998), a system generalized method of moments (GMM) estimator. In line with the recommendation of Roodman (2009), the appropriateness of this method is based on the peculiarity of our panel data set (1995-2015), which comprises of cross-section of 31 countries for a period of 21 years. The sample size is restricted to 2015 due to data available on the Gini index, our measurement of income inequality. We opted for the system GMM other than the fixed effects and the random effects estimators due to the inherent reverse causality between income inequality and economic growth (as measured by the per capita GDP). The GMM estimators are also more efficient in handling this issue than the other instrumental variable approaches like the two-stage least squares (2SLS), and the three-stage least squares (3SLS). The system GMM also has better finite sample properties than the difference GMM estimator of Arellano and Bond (1991). It allows for the use of more instruments because it uses lagged variables as internal instruments for endogenous regressors (Gründler & Scheuermeyer, 2018). To avoid a large set of instruments that could likely overfit the instrumented variables, we relied on the Hansen test statistics of over-identifying restriction. In order to test for autocorrelation, which could make some of the lags invalid when used as instruments, the probability values of the Arellano-Bond test for autocorrelation were relied on. The null hypothesis of this test is 'no autocorrelation.' Hence, the probability value AR (2) should not be significant. The probability values of both the AR (1) and AR (2) were generated by default with the aid of the *Xtabond2* command in Stata. If the p-value of AR (2) is significant, then the null hypothesis of no autocorrelation is rejected.

Sources of data

The study is inferential, and it employs secondary data sourced online. With the nature and sources of the data, the study is retrospective. Further details on data and relevant variables are in Table 2.

Table 2: Sources of Data, Description, and Measurement of Variables

Variable	Description	Measurement	Source of Data
INEQ	Market Gini	Gini index of inequality in equivalized household (pre-tax and pre-transfer) income	Standardized World Income Inequality Database (SWIID) https://dataverse.harvard.edu/dataset.xhtml?
Y	GDP per capita	The income per head for individuals in the population obtained as the GDP divided by the total population	World Development Indicators (WDI) https://databank.worldbank.org/source/world-development-indicators
HCE	Health Care Expenditure	General government expenditure on health per capita in constant (2005) dollars	World Health Organization (WHO) Global Health Observatory Data Repository https://apps.who.int/gho/data/node.country
WAT	Access to improved Water Source	Percentage of population with access to an improved water source	United Nations (UN) Millennium Development Goals (MDGs) Indicators database http://mdgs.un.org/unsd/mdg/Data.aspx
SAN	Access to improved Sanitation	Percentage of population with access to improved sanitation	United Nations (UN) Millennium Development Goals (MDGs) Indicators database http://mdgs.un.org/unsd/mdg/Data.aspx
LE	Life Expectancy	Life expectancy at birth	World Development Indicators (WDI) https://databank.worldbank.org/source/world-development-indicators
IMR	Infant Mortality Rate	This is expressed per 1,000 live birth	World Development Indicators (WDI) https://databank.worldbank.org/source/world-development-indicators
UMR	Under-five Mortality Rate	This is expressed per 1,000 live birth	World Development Indicators (WDI) https://databank.worldbank.org/source/world-development-indicators

Note: All sources within this table were accessed in February 2020.

The study covers 31 Sub-Saharan African countries from 1995-2015:

- West Africa: Burkina Faso, Cape Verde, Cote d'Ivoire, Ghana, Guinea, Guinea Bissau, Mali, Mauritania, Niger, Nigeria, Senegal, and Sierra Leone.
- East Africa: Burundi, Ethiopia, Kenya, Mauritius, Rwanda, Seychelles, Tanzania, Uganda, Zambia, Malawi, and Madagascar;
- Central Africa: Angola, Central African Republic, and Cameroon;
- Southern Africa: Botswana, Lesotho, Namibia, South Africa, and Swaziland.

The scope of the study is primarily predicated on the availability of data on income inequality for the above countries.

Data on income inequality

In order to handle the problems of quality and non-comparability, which are peculiar to data on income inequality, we employed data from the Standardized World Income Inequality Database (SWIID). Data from this source are commonly used in many contemporary studies and have greater preference over the World Income Inequality Database (WIID), the Luxemburg Income Study (LIS), and other similar sources. SWIID provides data from a broader and large number of sources across countries and regions comprising cross-national inequality databases (including WIID and LIS), and national statistical offices (Gründler & Scheurmeyer, 2018; Solt, 2016). This source offers data on the market and net Gini inequality for 192 countries from 1960 and provides 5119 country-year observations.

Results and discussion

Regressing Gini index on life expectancy returns a negative coefficient (Column 1 of Table 3). The coefficient of the Gini index is statistically significant at 5 percent (β= -0.07, $p < 0.05$). The coefficient indicates that a one percentage point increase in the Gini index brought about a decline in life expectancy by about 0.07 years. That is, income inequality is associated with lower life expectancy. This implies that income inequality has an adverse effect on life expectancy. This is consistent with Babones (2008), Hill and Jorgenson (2018), Messias (2003), Rasella et al. (2013), Rodgers (1979), Torre & Myrskylä (2011), and Wilkinson (1992). Our findings reveal that income inequality contributes to a shorter life span in SSA. We also considered the effect of other core determinants of population health—access to potable water, health care expenditure, access to improved sanitation, and per capita GDP. The results indicate positive coefficients for healthcare expenditure, access to potable water, and access to improved sanitation. Both healthcare expenditure and access to improved sanitation are statistically significant in determining life expectancy. These results are entirely plausible as improved preventive and curative healthcare expenditures should naturally prolong longevity and good health status.

Table 3: System GMM Estimation of the Effect of Income Inequality on Health Outcomes

Dependent Variable	Life Expectancy	Infant Mortality Rate	Under-five Mortality Rate
Lagged Life Expectancy	0.9301* (0.1119)		
Lagged Infant Mortality Rate		0.9544* (0.0533)	
Lagged Under-five Mortality Rate			0.9778* (0.0221)
Gini Index	-0.0675** (0.0269)	0.1096** (0.0480)	0.1346*** (0.0794)
Health Care Expenditure	0.0099* (0.0031)	-0.0273** (0.0122)	-0.0405* (0.0154)

Dependent Variable	Life Expectancy	Infant Mortality Rate	Under-five Mortality Rate
Access to Improved Water Source	0.0004*	-0.0639	-0.0879
	(0.0351)	(0.1425)	(0.0913)
Access to Improved Sanitation	0.0932*	-0.2257**	-0.2266**
	(0.0339)	(0.1082)	(0.1360)
GDP per capita	-0.0019*	0.0050**	0.0069*
	(0.0006)	(0.0015)	(0.0018)
Constant	5.1429	5.0129	1.8285
	(7.7447)	(12.3009)	(8.4063)
Cross-sections	31	31	31
Instruments	15	21	23
AR (1)	0.298	0.095	0.253
AR (2)	0.329	0.880	0.316
Hansen test	0.838	0.438	0.163

*Note: The values in parentheses are the standard error (SE). The AR (1), AR (2), and the Hansen test are p-values. *, **, *** denote 1%, 5% & 10% level of significance.*

There is still a larger proportion of the populace that does not have unfettered access to safe drinking water. This is probably a core condition that contributes to the preponderance of water-borne diseases (e.g., cholera, typhoid, amebic dysentery, and hepatitis A) in the region, especially in the rural areas. Contrary to expectations, the coefficient of per capita GDP (a measure of economic growth) is negative and significant, suggesting that economic growth does not ordinarily translate into better health status. This indicates that economic growth in the region is not offsetting the harmful effect of income inequality on population health. Earlier studies (Bloom & Bowser, 2008; Pritchett & Summers, 1996; Odusanya & Atanda, 2018), which established a positive effect of income on population health, failed to control for the impact of income inequality in the income-health nexus.

The results in column 2 of Table 3 provide evidence on the effects of income inequality, healthcare expenditure, access to safe water, improved sanitation, and per capita GDP on another indicator of population health, infant mortality rates. The regression of Gini index on infant mortality rate yielded a significant positive coefficient (β= 0.11, $p < 0.05$). A one percentage point increase in the Gini coefficient brought about an increase in infants' death by 0.11 per 1,000 live births in the region. This finding is consistent with Babones (2008), Flegg (1982), Odusanya and Agboola (2017), Ram (2006), and Wennemo (1993), suggesting that income inequality contributes markedly to the mortality figure of children less than age 1 in the region. The result indicates income inequality as a significant predictor of infant mortality rate in Sub-Saharan Africa. The coefficients of healthcare expenditure, access to safe water, and access to improved sanitation are correctly signed, as they are negative, with all of them (except access to potable water) exerting significantly on infant mortality rate. Our results from the infant mortality rate model also indicate good hygiene or sanitation as a strong driver of healthy living. Adequate sanitation and access to potable water are vital for children, especially infants. Findings based on the regression results for the under-five mortality rate are similar to that of the infant mortality rate. The coefficient of the Gini index remains positive and statistically significant (β= 0.15, $p < 0.05$). A one percentage point increase in Gini coefficient (on average) brought about an increase in the death of children under age 5 by 0.15 per 1,000 live births in the region. This implies that the higher the income distribution inequality in SSA, the higher the under-five mortality rates. This confirms the adverse effect of income inequality on population health. This finding justifies the ranking of many Sub-Saharan African countries among those with very high under-five mortality rates globally. Healthcare expenditure and access to improved sanitation are also significant determinants of the under-five mortality rates.

Generally, our analysis indicates that income inequality is significantly associated with lower life expectancy, higher infant mortality rates, and higher under-five mortality rates in SSA. We, therefore, confirm the validity of the income inequality health-hypothesis. This hypothesis submits that higher income inequality is associated with worsened health conditions. Hence, findings from our study are consistent with Babones (2008), Baeten et al. (2013), Chiang (1999), Elgar et al. (2016), Feng et al., (2012), Figueiredo & Adami (2018), Flegg (1979, 1982), Hill and Jorgenson (2018), Messias (2003), Moeller et al. (2017), Pasqualini et al. (2017), Ram (2005), Rasella et al. (2013), Rodgers (1979), Shi et al. (2003), Subramanian and Kawachi (2004), Torre and Myrskylä (2011), Undurraga et al. (2016), Vilda et al. (2019), Vincens and Stafström (2015), Wennemo (1993), Wilkinson (1992), and Wilkinson and Pickett (2006), among others. These studies affirmed the validity of the IIHH for countries in other regions.

Conclusion

The critical research questions in this paper are: How does income inequality affect population health in SSA? Or how rational is the income inequality health-hypothesis for the SSA region? Relying on the appropriate analytical procedures and relevant data from 1995 to 2015, this study has revealed the detrimental effect of income inequality on population health, and has established the validity of IIHH for the SSA region. Thus, our study fills this research gap for the region.

Findings from our study indicate that income inequality is a significant predictor of poor health conditions in Sub-Saharan Africa. We also find that higher healthcare expenditure and access to improved sanitation are vital for promoting better population health. One important implication of these findings is that any policy addressing income inequality or income redistribution in SSA should go together with higher healthcare spending and an acceptable sanitation policy for practical impact on SSA population health.

Given the high incidence of poverty in the SSA region, subsequent studies must investigate whether poverty is more significant than economic growth (i.e., economic output expansion) in determining the effect of income inequality on health. It seems clear that recorded spurts of economic growth in the region, particularly between 2001 and 2011, did not reduce the adverse effects of income inequality on health outcomes. Without any doubt, our study contributes substantially to the empirical literature on IIHH. However, it is still necessary to explore the relationship between income inequality and health, using household-level data for better policy formulation and implementation. Furthermore, future research should identify channels or pathways through which inequality in income distribution affects the population in Sub-Saharan Africa. Likewise, country-level studies on the effect of income inequality on health will be necessary to formulate the appropriate policies for the affected countries. Such policies will capture the inherent peculiarities of each economy and engender a better decision-making process.

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