Income Inequality and Public Health Status: The Role of Government Expenditures of Pakistan

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Abstract

In developing countries like Pakistan, public health is often perceived as one of the main components of the welfare of society. This study aims to estimate the impact of income inequality on the health sector performance of Pakistan. Health performances are measured with the two leading indicators, life expectancy and infant mortality rate (IMR). The study employs the Autoregressive Distributed Lag (ARDL) model for co-integration analysis from 1980-2020. Furthermore, this study investigates the causality analysis with the help of the Toda Yamamoto Modified Wald test. The empirical result shows that income inequality has an adverse and significant impact on Pakistan's health performance measures. Moreover, the unidirectional relationship is confirmed between income inequality and life expectancy. The findings of the current work suggest that reducing income inequality would be an essential policy option for improving infant mortality conditions, life expectancy, and other poor health outcomes. Policymakers need to focus more on the equal distribution of income through the provision of public health infrastructure, and it may improve health performances over a more extended period.

Keywords: Income Inequality, Life Expectancy, Infant Mortality, Co-integration, Causality.

Introduction

Public health is often perceived as one of the main components of the overall welfare in most developed and developing countries. Various organizations have been formed to evaluate governments' performance regarding their citizens' health status. One such example is the World Health Organization, which was created to analyze the implementation of the health systems and the health status of the citizens of member states. The health system is defined as the institutions and individuals who promote and improve the overall health status of the people (WHO, 2017). Therefore, evaluating the income levels that contribute to promoting or demoting an individual's health is of great concern.

Income and economic resources are well-known contributing factors to the population's overall health status (Sorlie et al., 1995). The debate on the income health relationship is surrounded by two significant hypotheses: the absolute and the relative income hypotheses. The total income hypothesis describes that an individual's health depends on their income regardless of others living

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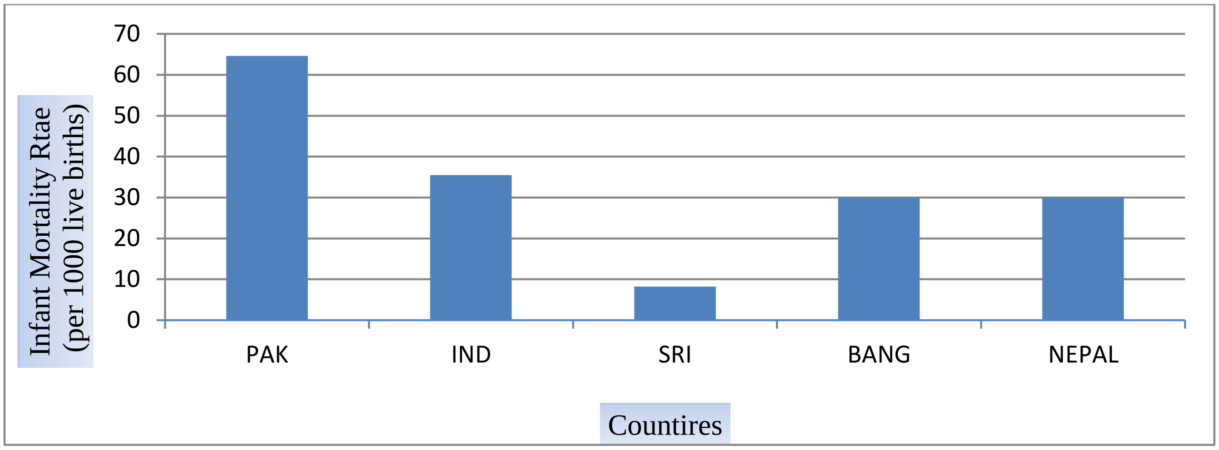
in the same society (Grossman, 1972). The absolute incomes of individuals have increased; they tend to enjoy better living standards, eat better, spend more on health care, and remain healthier (Veenstra, 2003). Wilkinson (1992) gave a new dimension to the income health relationship. He argues that when the absolute income of individuals reaches a particular point, i.e., the threshold level, fundamental living standards become insignificant or less relevant in determining health, and the role of relative income becomes more prominent (Wilkinson, 1994). Many researchers support the negative effect of income inequality on health (Marmot & Bell, 2012; Wilkinson &Pickett, 2006, 2008, 2010).

The relative income hypothesis has supported the countries with high-income inequality, where the relative income distribution is more skewed between rich and poor. Moreover, the relative income hypothesis explains the relationship better when geographic regions are large (Wilkinson & Pickett, 2006). In comparison, when the geographic area is small provinces and counties, the studies do not support the relative income hypothesis, or the results are inconclusive (Franzini et al., 2001; Wilkinson & Pickett, 2006). It's more than ten years since the introduction of the relative income hypothesis, and this issue continues to be debated. However, so many studies and research on income health relationships remain inconclusive. It is generally accepted that social, economic, and demographic conditions play a vital role in shaping the health status of the population (Farag et al., 2013; Sen, 1995, 2002; Woodward & Kawachi, 2000). Hence, policymakers need to formulate policies identifying the factors influencing the population's health.

Income inequality can be an important determinant of poor health in developing countries. Few recent studies have explored the association between income inequality and health outcomes and established a significant impact on health (Kabir, 2008; Shahbaz et al., 2016; Sede & Ohemeng, 2015). However, only a few studies took annual time series data for countries like Pakistan to explain the concerned relationship. Moreover, these studies have only considered one proxy variable (i.e., life expectancy) for health. Hence, this study intends to make the following contributions: first, it has used national-level proxies for health and income inequality. Second, this study used various dimensions of health, i.e., infant mortality rate per 1000 live births and total life expectancy. Third, the study investigates some appropriate econometric models of robust results on the association between income and diverse health performance measures.

Increasing income inequality has brought an alarming situation for public health in Pakistan. The problem is very challenging in Pakistan's case as few existing studies on the influence of income inequality on health. In other words, socioeconomic status and income differences can be significant determinants of poor health in low-income countries like Pakistan. Differences in income and socioeconomic status are associated with low life expectancy for both females and males and increased stress among individuals having lower socioeconomic status (Abbas & Sarwar, 2018; Maselko et al., 2018). The income inequality hypothesis has neither been tested at the regional nor the national level, such as case studies like Pakistan. It presented a unique research opportunity for this issue. Moreover, the differences in income distribution and socioeconomic status are the leading causes of poor health in developing countries like Pakistan (Wilkinson 1992).

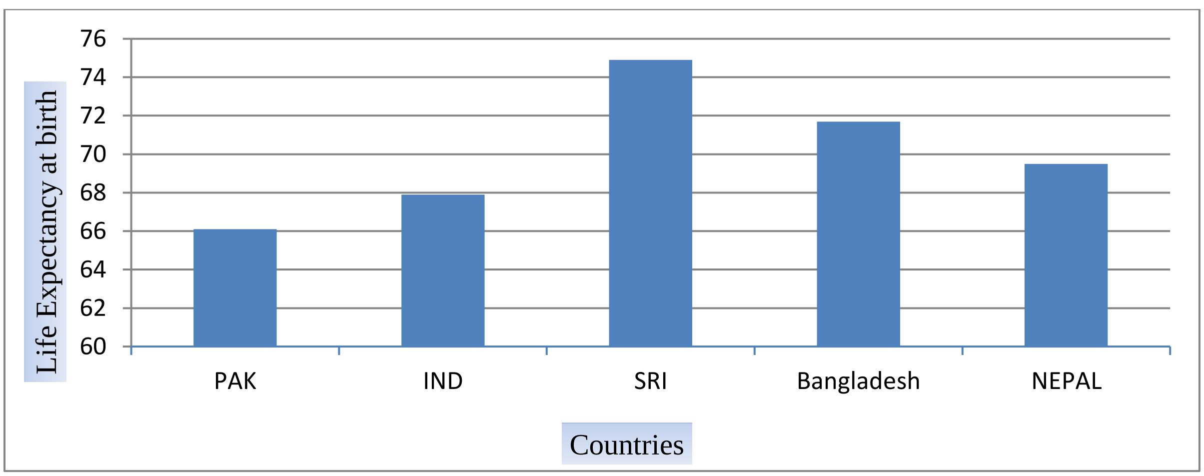
Figure 1: Infant Mortality Rate (South Asian Countries)



Source: World Development Indicators (2020)

Developing countries are more prone to negative impact of income inequality on health. Figure-1 depicts the infant mortality rates in South Asian countries. There are no significant improvements in infant mortality rates. Despite many efforts to reduce income differences and improve health status, Pakistan is still struggling with high level of infant mortality rate, low levels of public health spending and lower life expectancies.

Figure 2: Life Expectancy (South Asia Countries)



Source: World Development Indicators (2020)

Figure 2 provides a picture of life expectancy for some South Asian countries. Pakistan's life expectancy rate is meager compared to other countries. In Pakistan, rural-urban disparities are widespread. Living in a rural area means a higher risk of illness and mortality. Similarly, being a woman in Pakistan means being sick because women are generally not allowed to go to the doctor for their checkups. Social determinants of health in Pakistan include income level, socioeconomic status, gender, education, and poverty (Khan, 2006). Evidence shows a strong impact of wealth status on population health. There was an excess of 25 neo-natal deaths, 34 infant deaths, and 41 under-five deaths in the poorest quintile as compared to the rich that shows people at a lower level of socioeconomic status or people who belong to low-income groups suffer most from differences in wealth status (Alam et al., 2010: Ahmad & Senturk, 2021). Income inequality can be a significant determinant of poor health in developing countries. Few recent studies have found a significant association between income inequality and health outcomes. However, there are minimal studies that took annual time series data for countries like Pakistan to explain the said relationship. This study used various dimensions of health, i.e., infant mortality rate per 1000 live births and total life expectancy. To our knowledge, the income inequality hypothesis has yet to be tested at the regional and national levels for Pakistan. It presented a unique research opportunity for current studies. The rest of the document is arranged: Section II includes the theoretical framework and literature review; Section III contains models, variables, and methods; Section IV explains the empirical results and discussion; Section V includes conclusions and policy formulations.

Literature Review

In the past, many studies analyzed the nexus between income inequality and health with different methodologies and techniques at the country and panel levels. The outcomes of these studies are different. We here discuss a few of the studies categorized literature in theoretical and empirical for both developed and developing countries.

Theoretical literature

The prior literature presents numerous contributions to the nexus between income inequality and income (Kuznets, 1955). At first, the literature developed on the significance of the individual income hypothesis, which describes that health status grows as personal income rises to a certain level. After reaching that level, any extra increase in revenue does not improve health; hence, there are diminishing returns to health improvement. The critical point in the literature is the concavity link between income inequality and health, which implies that each additional dollar of income increases an individual's health but at a decreasing rate (Preston, 1975).

The relationship between income inequality and health is known as the income inequality hypothesis in health. The foundation of the income inequality hypothesis is that income is the social determinant of health within the country rather than between industrialized countries. The income inequality hypothesis describes that an individual's health is influenced by their absolute income and the level of inequality in the area where they live (Wilkinson, 1997). Underinvestment in human capital, physical health, and social infrastructure is the basis for the negative nexus between income inequality and health (Smith, 1996; Lynch & Kaplan, 1997). In other words, there is a striking association between income inequality and investment in human capital (Kaplan et al., 1996). Income inequality is linked to mortality; reduction in social trust and disinvestment in human capital have been significant causes of mortality (Kawachi et al., 1997).

However, there is a political context attached to the theory. The nexus between income inequality and investment in human capital can be positive or negative. Increased income inequality is often associated with low social spending as people experiencing poverty lack political influence and hence do not bother to vote; thus, they do not support redistributive policies that favor them the most; this behavior promotes the negative relation (Mayer & Sarin, 2002). On the positive side, increased income inequality may be associated with increased government spending through great demands of redistributive policies and support for progressive taxation by the selfish median voter (the middle class) who benefits the most from redistributive policies.

Income inequality may affect health through a lack of social cohesion in a society. Supporters of this theory argue that nations with unequal income distribution yield negative emotions among individuals. These negative emotions are then translated into poor health through anti-social behaviors, less public participation, and reduced social cohesion (Wilkinson & Marmot, 2001). In other words, differences in relative income create enormous negative emotions reflected in an individual's interaction with others. For example, when an individual feels a sense of relative deprivation and awareness of their low social position, they feel embarrassed, and their self-esteem is damaged, ultimately resulting in increased stress and poor health (Wilkinson, 1996). Living in low socioeconomic status can affect health through stressful social comparisons in all stages of life, from birth to death and even before birth. The resources we have at our disposal in the form of family income, education, and quality of life significantly impact health, and the consequences are cumulative rather than transitory. The longer people live in a lower socioeconomic hierarchy, the worse their physical and mental health. Resources shape health before and throughout life (Adler, 2009).

At birth, even before children are born, the resources their families can afford shape their health. Pregnant mothers from low-income groups receive less prenatal care and experience higher stress levels, resulting in pre-birth mortality or low-weight babies. The effects of low birth weight are huge, out of which increased infant death rate is the most common (Case et al. 2005). Even if the problems associated with low birth rates are eliminated, the effects of low status can be seen through childhood in the form of increased chronic diseases (risk of injuries and physical inactivity) and a sense of relative deprivation. Sometimes, the effect of a family's low socioeconomic status may not show up until adulthood. After the body has been overburdened with stress throughout life, the cumulative damage may appear in diseases like high blood pressure, diabetes, cancer, and other conditions that reduce life expectancy (Adler et al., 2007).

Empirical Literature

Economic growth makes available more employment slots, establishes the wage structure, and promotes better living standards for the public, which lessens income inequality. The nexus between economic growth and income inequality is demonstrated by Chen and Fleisher (1996), Panizza (2002), Shin (2012), Malinen (2012), Herzer and Vollmer (2012), Rubin and Segal (2015), and many more. Living status can affect health conditions through stressful social comparisons in all stages of birth to death and even before birth. The family's resources, such as income, education, and quality of life, significantly impact health. The longer people live in a lower level of the socioeconomic hierarchy, the worse is their physical and mental health. Resources shape health before and throughout life (Andersen & Curtis, 2012). At birth, even before children are born, the help their families can afford shape their health. Pregnant mothers in low-income groups receive less prenatal care and experience higher stress levels, resulting in pre-birth mortality or low-weight babies.

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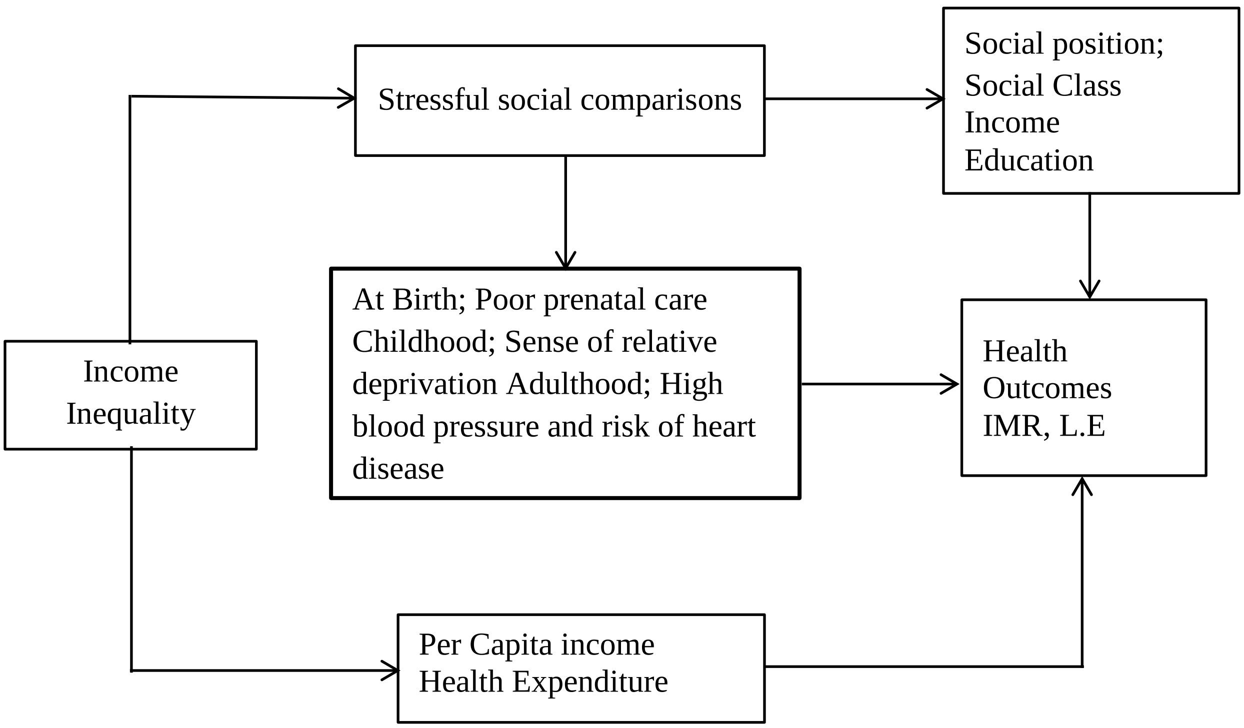
Early reviews in the field suggested different interpretations of the existing income health relationship, most of which support the hypothesis that health is worse in more unequal societies than in egalitarian ones. In an epidemiological causal framework, this review was conducted to see whether more significant income inequalities lead to worse population health and establish the probability of a causal connection between income inequality and population health. The body of literature strongly supports that income inequality harms population health and well-being. The studies based on fixed effects methodology are abundant and established the link between income inequality and outcomes related to life expectancy or mortality risk (Avendano, 2012; Babones, 2008; Modrek & Ahern, 2011; Jamil et al., 2016; Neumayer & Plumper, 2016; Torre and Myrskyla, 2014). A minority of the studies found no associations between income inequality and health because of the following reasons: First, income inequality was calculated at an inappropriate scale. Secondly, the enclosure of many mediating variables as controls. Third, using subjective instead of objective measures of health, and last, the period considered to measure the impact was too small (Mellor & Milyo, 2001; Lorgelly & Lindley, 2008; Pickett & Wilkinson, 2015; Patel et al., 2018).

The most recent literature on the nexus of income inequality and health performance in China was investigated by Luo and Xie (2020). They concluded that China's population has a life loss of about 0.6 years for men and 0.4 years for women due to the sharp increase observed in recent years. Fors (2021) investigated Sweden and concluded that a rise in income inequality has a lower life expectancy in the lower income group compared to the highest income group. Tetzlaff et al. (2022) investigated the correlation between inequality and health performance in Africa and Asia for the last 180 years. They observed that a statistically significant negative correlation for both reigns over time. Ahmad et al. (2023) investigated life expectancy, urbanization, and income inequality in South Asian countries. They concluded that income inequality and urbanization negatively and significantly affect life expectancy for both males and females. Health expenditure has a positive influence on life expectancy. Jørgensen and Hovde (2022) estimated the panel for the municipal level of Norwegian-born males and females during the last thirty years. Overall, an increase in income inequality has no significant association with higher mortality. These results further debate the contradictory effect on developing nations' economic disparities and health performance. Under the above literature review, we have found different studies to investigate the links between income inequalities (with varying measures of inequality with macroeconomics, social development, and environment variables and for development as sound as developed nations with different estimated methods. So, this study tries the most primitive attempt to probe the combined impact of income inequality on the health performance of Pakistan.

Data and Methodology

The potential relationship between the variables should be explained accordingly; the implications of the concavity of the income-health relationship are clear as they can be described with two different approaches. First, Wilkinson (1992) presented that income inequality affects health directly regardless of one's position in the income distribution scale. He explained that societies that experience higher levels of income inequality suffer more from worse health status. The link between income inequality and health is known as the income inequality hypothesis in health. The foundation of the income inequality hypothesis is that income is the social determinant of health within the country but not between industrialized countries. The income inequality hypothesis states that an individual's health is affected by their absolute income and the level of inequality in the area where they live (Wilkinson, 1996). The present study estimates this argument

Figure 3: Circular Flow of Income and Health



Living in a low socioeconomic status can affect health through stressful social comparisons in all stages of life, from birth to death and even before birth. The resources we have at our disposal in the form of family income, education, and quality of life significantly impact health, and the consequences are cumulative rather than transitory. The longer people live in a lower socioeconomic hierarchy, the worse their physical and mental health. Based on the social comparison (as explained in Figure 3), the second approach gives rise to a sense of relative deprivation among people due to their differences in available resources. Differences in resources like income determine the socioeconomic status at the individual or household level. This difference in socioeconomic status (SES) gives rise to social comparisons. Socioeconomic status has a positive impact on health. In short, the better the position in the social hierarchy, the better the health. SES affects the health of individuals living in extreme poverty and those not poor. Hence, individual's mortality and morbidity differ at all levels of SES (Smith et al. 1996; Marmot & Bell 2012). The mortality rate falls as one's socioeconomic status is improved (Adler et al., 1993). Living in a low socioeconomic status can affect health through stressful social comparisons in all stages of life, from birth to death and even before birth. The resources we have at our disposal in the form of family income, education, and quality of life significantly impact health, and the consequences are cumulative rather than transitory. The longer people live in the lower socioeconomic hierarchy, the worse their physical and mental health. After reviewing the theoretical and empirical work elucidated in prior studies, we have formulized following models to examine the relationship among income inequality and life expectancy and income inequality and infant mortality rate. As suggested by (Wilkinson, 2015; Jørgensen & Hovde, 2022; Ahmad et al., 2021).

$$IMR_t = \beta_o + \beta_1 GDP_t + \beta_2 IIQ_t + \beta_3 H.E_t + \varepsilon_t \quad (1)$$

$$L.E_t = \gamma_o + \gamma_1 GDP_t + \gamma_2 IIQ_t + \gamma_3 H.E_t + \varepsilon_t \quad (2)$$

Where ε_t is the disturbance term, IIQ represents income inequality proxies by GINI coefficient, GDP is the GDP per capita and H.E is the public health expenditure. Yearly data have been utilized from 1980 to 2020. As mentioned earlier that the data source are world development indicator (WDI) and PSE. The scheme of the variable is given below; Dependent Variables $L.E_t$ = Life Expectancy at birth and IMRt = Infant mortality rate per 1000 births; Independent Variables are Gini coefficient for income inequality, GDP per capita income, HE Health expenditure as percentage of GDP. GDP per capita is used as a proxy for economic growth. Economic growth plays a vital role in prediction of income inequality in most developing countries. The possible relationship between two variables is often analyzed by a following simple two variables equation:

$$Y = f(X)$$

Where, Y is the dependent variable, X is the vector of independent variable and *f* represents some function. The ARDL method introduced by Pesaran et al., (2001) captures the relationship *f(X).* In this section we will start by unfolding a simple ARDL model with one variable i.e., ARDL (p, q) and then we will move forward to apply this model to our selected variables. Following the ARDL model presented by Pesaran and Shin, (1999) and Pesaran et al., (2001) we have specified one variable ARDL model in the following equation:

$$\Delta Y_t = \beta_o + \alpha_o + \sum_{i=1}^{q} \delta i \Delta Y_{t-i} + \sum_{j=0}^{p} \vartheta j \Delta X_{t-j} + \gamma_1 Y_{t-1} + \gamma_2 X_{t-1} + \varepsilon_t \quad (3)$$

Where, β_0 and α_0 are the drift and trend coefficients respectively. The variables with $\sum$ sign represent the short-run dynamics (δ_i, ϑ_j are the short run coefficients) and γ_1 and γ_2 correspond to long-run relationship. Given the above specifications (3) we have developed following two ARDL models for estimation to investigate the impact of income inequality on Infant mortality rate and life expectancy for model 1 and 2 respectively.

$$\Delta IMR_t = \beta_0 + \sum_{i=1}^{p} \beta_{1i} \Delta IMR_{t-i} + \sum_{i=1}^{p} \beta_{2i} \Delta GDP_{t-i} + \sum_{i=1}^{p} \beta_{3i} \Delta IIQ_{t-i} + \sum_{i=1}^{p} \beta_{4i} \Delta H.E_{t-i} + \gamma_1 IMR_{t-i} + \gamma_2 GDP_{t-i} + \gamma_3 IIQ_{t-i} + \gamma_4 H.E_{t-i} + \mu_t \quad (4)$$

Where, β_0 is the constant and μ_t is the error term. The summation signs denote the coefficients of error correction dynamics and the γ's are the long run coefficients. Similarly, the following ARDL model is formulated to estimate of the long run relationship between income inequality and life expectancy.

$$\Delta L.E_t = \alpha_o + \sum_{i=1}^{p} \alpha_{1i} \Delta L.E_{t-i} + \sum_{i=1}^{p} \alpha_{2i} \Delta GDP_{t-i} + \sum_{i=1}^{p} \alpha_{3i} \Delta IIQ_{t-i} + \sum_{i=1}^{p} \alpha_{4i} \Delta H.E_{t-i} + \delta_1 L.E_{t-1} + \delta_2 GDP_{t-1} + \delta_3 IIQ_{t-1} + \delta_4 H.E_{t-1} + \mu_t \quad (5)$$

The optimum lag length for the models and each series is identified using Schwarz Information Criteria (SIC). For this purpose, we will first estimate the *F*-statistic value using the appropriate ARDL model and secondly, we will conduct Wald test, by putting restrictions on γ_1, γ_2, γ_3 and γ_4 and δ_1, δ_2, δ_3 and δ_4 in models 4 and 5 respectively, to estimate the long run nexus between the variables. We reject the H_0 of no co-integration if the calculated *F*-statistics exceeds the upper critical bound. The results are inconclusive if the *F*-statistics value falls between upper and lower critical bound and lastly the H_0 is accepted if the value is below the lower critical bound.

If a significant long run relationship is found between infant mortality and income inequality then the long run coefficients will be estimated using the following model:

$$IMR_t = \gamma_o + \sum_{i=1}^{p} \gamma_{1i} IMR_{t-i} + \sum_{i=1}^{p} \gamma_{2i} GDP_{t-i} + \sum_{i=1}^{p} \gamma_{3i} IIQ_{t-i} + \sum_{i=1}^{p} \gamma_{4i} H.E_{t-i} + \mu_t \quad (6)$$

Similarly, if long run relationship between income inequality and life expectancy is confirmed, the long run coefficients will be estimated using the following model:

$$L.E_t = \delta_o + \sum_{i=1}^{p} \delta_{1i} L.E_{t-i} + \sum_{i=1}^{p} \delta_{2i} GDP_{t-i} + \sum_{i=1}^{p} \delta_{3i} IIQ_{t-i} + \sum_{i=1}^{p} \delta_{4i} H.E_{t-i} + \mu_t \quad (7)$$

If we find significant evidence of the long-run relationship in our both models then we will estimate short-run coefficients by utilizing ECM models given below:

$$\Delta IMR_t = \vartheta_o + \sum_{i=1}^{p} \vartheta_{1i} \Delta\, IMR_{t-i} + \sum_{i=1}^{p} \vartheta_{2i} \Delta\, GDP_{t-i} + \sum_{i=1}^{p} \vartheta_{3i} \Delta\, IIQ_{t-i} + \sum_{i=1}^{p} \vartheta_{4i} \Delta\, H.E_{t-i} + nECT_{t-1} + \mu_t \quad (8)$$

$$\Delta L.E_t = \delta_o + \sum_{i=1}^{p} \delta_{1i} \Delta\, L.E_{t-i} + \sum_{i=1}^{p} \delta_{2i} \Delta\, GDP_{t-i} + \sum_{i=1}^{p} \delta_{3i} \Delta\, IIQ_{t-i} + \sum_{i=1}^{p} \delta_{4i} \Delta\, H.E_{t-i} + \theta ECT_{t-1} + \mu_t \quad (9)$$

The error correction terms n and θ show the speed of adjustment required to achieve the long-run equilibrium succeeding a short-run shock. ARDL method can be employed even when the variables are integrated of mixed order, i.e., *I(0)* and *I(1)* (Duasa, 2007; Adom et al., 2012). However, ARDL does not operate when the order of integration of variables is *I(2)*. Second, the ARDL method can integrate the short-run impact of a given variable with long-run equilibrium simultaneously without losing the long-run information. Third, the ARDL process is relatively more flexible because it allows to take different lags for each variable. Last, ARDL provides robust and consistent results with small samples compared to other techniques sensitive to sample size (Pesaran & Shin, 1998; Pesaran et al., 2001; Adom et al., 2012).

There are certain limitations attached to the General Granger causality test. First, the test is sensitive to model specification and several selected lags. Second, time series data are often non-stationary and cause spurious estimation. Moreover, when variables are integrated, the *F*-test procedure is invalid as it does not follow standard distribution (Gujrati, 2006). We have applied the Toda Yamamoto test for causality to overcome these limitations and obtain robust and reliable results. Toda Yamamoto causality test is a modified Wald test presented by Toda and Yamamoto (1995). The test guarantees the asymptotic distribution of the Wald test (an asymptotic $\chi 2$ - distribution) and is better for the integration and co-integration properties of the procedure.

Empirical Results and Discussions

We utilize Augmented Dickey-Fuller (ADF) unit root tests to examine the non-stationarity of the variables. Table 1 reports the results of ADF for Gini, IMR, L.E, H.E, and GDP per capita income, respectively, first at levels and then at first difference. All the variables are stationary at levels except the GINI coefficient, IMR, and L.E, which are fixed at first difference.

Table 1: Results of ADF Test for Stationarity

Variables	Test-statistic I(0)	Prob.	T-statistic I(1)	Prob.
GNI	-2.640	(0.0945)	-5.1018*	(0.002)*
IMR	-2.212	(0.2052)	-5.866*	(0.000)*
LF	0.2693	(0.9730)	-6.4671*	(0.000)*
HE	-5.537*	(0.0088)*	-6.3079*	(0.000)*
GPC	-5.765*	(0.000)*	-4.956*	(0.000)*

Note: ***, **, * display p<0.1, p<0.05, p<0.01, respectively.

Table 1 predicts that variables are integrated in mixed order, i.e., I(0) and I(1). To obtain the long-run associations between the variables, we used the ARDL co-integration procedure. It allows for retrieving the lost information about the long-run relationships between variables by integrating short-run dynamics with long-run equilibrium, as suggested by (2016). In other words, the ARDL Co-integration technique estimates long-run relationships between mixed integrated variables and re-parameterizing the relationship through ECM to obtain short-run dynamic relationships.

Before running the ARDL method to estimate long-run relationships, it is essential to determine the order of optimal lag length. We have used SIC criteria for the selection of optimal lag length. The minimum value of SIC shows the selected lag for each model. As shown in Table 2, the number of lags chosen with SIC is 2. The second step is to run the ARDL estimation technique of bound testing to check for co-integration. The H0 for the set test indicates that there is no long-run relationship or no co-integration among variables. The *H*0 of no co-integration is rejected if the computed *F*-statistics value is greater than the upper critical bound in favor of *H*1, indicating a valid long-run relationship among variables. The results of the bound test for the IMR and IIQ model are shown in Table 2. The computed *F*-statistic to check the long-run co-integration between IMR and IIQ is 20.48646, more significant than the upper critical bound at a one percent significance level, so we reject the *H*0. Likewise, we estimate long-run co-integration between life expectancy and income inequality. As shown in Table 2, the calculated *F*-test value 15.06955 is greater than the upper critical bound, so we reject the *H*0 and conclude that a valid long-run association exists between life expectancy and income inequality.

Table 2: Lag length Selection and Bound Test

Models	Lag order	AIC	SBC	F- Statistics
Model-1 IMR	1	20.41478	21.30355	**20.4865*** **
	2	18.433***	20.033***	
Model-1 LF	1	14.14098	15.74077	**15.0695*** **
	2	11.337***	13.648***	

Note: ***, **, * display p<0.1, p<0.05, p<0.01, respectively.

Table 3: The Long-run and Short-run Analysis

	Model-1 IMR Dependent Variable		Model-2 LE Dependent Variable	
Variable	**Coefficient**	**Prob**	**Coefficient**	**Prob**
GINI	3.39669 (0.7789)	0.0003**	-0.25060 (0.07971)	0.0044**
H E	-2.97057 (4.9075)	0.1201**	-0.92628 (1.01444)	0.3703
GDPPC	-0.0172 (0.0006)	0.0000**	0.02238 (0.0002)	0.0000**
Constant	-1.5321 (0.0015)	0.5945	2.56588 (1.67691)	0.03456**
Short Run				
DIMR(-1)/ D(LE(-1))	0.364231	0.0085**	1.801735	0.0000**
DIMR(-2)/ D(LE(-2)	(0.125357)	0.0121**	(0.045444)	0.0000**
D(GINI(-1))	-0.047428	0.0637***	-0.001250	0.0790***
D(GINI(-2))	(0.024223)	0.0057**	(0.000681)	0.0109**
D(HE)	-0.0267748 (0.099787)	0.0139**	0.09672 (0.00515)	0.0726***
D(GDPPC)	0.0312 (0.000001)	0.1994	0.03321 (0.0000)	0.0000**
ECM_{t-1}	-0.020126 (0.002267)	0.0000**	-0.007395 (0.00139)	0.0000**
Diagnostics				
Adj. R square	.79		.77	
ARCH test	0.8369	0.5023	0.4721	0.4611
LM	0.3651	0.8312	0.164	0.8499

Note: ***, **, * display p<0.1, p<0.05, p<0.01, respectively.

Table 3 explains the long and short-run results of both models. The upper portion of the Table corresponds to the long-run coefficients of the model. We interpret each variable individually and test its significance. The P-value of 0.0003 shows that the Gini coefficient, i.e., income inequality, positively affects the infant mortality rate. Our results coincide with Avendano, 2012; Babones, 2008. Keeping other things constant, the coefficient of 3.3967 implies that a one percent increase in the Gini coefficient would increase the infant mortality rate by 3.3967 percent. Income has a statistically significant and negative impact on the infant mortality rate per capita. These results coincide with Ahern, (2011); Neumayer and Plümper, (2016). Other things being constant, a one percent increase in per capita income would lessen the infant mortality rate by 0.0172 units. The signs of the Gini coefficient and per capita income are the same as expected; however, the coefficient of health expenditure, i.e., -2.9705, shows an insignificant but negative impact on the infant mortality rate. The lower part of the table represents the coefficient of error correction model with the speed of adjustment of -0.020126 in the long run from a short-run shock. The ECM coefficient -0.020126 indicates that 2 percent of the disequilibria in IMR of the previous year's surprise were adjusted in the present year. Moreover, the p-value of ECM 0.000 < 0.01 indicates a significant relationship between income inequality and IMR. All other diagnostic tests also show satisfactory outcomes.

The upper part of Table 3 shows the long-run coefficients of model 2. The probability value of the Gini coefficient -0.25 shows that the Gini coefficient is statistically significant at a 1% significance level and negatively impacts life expectancy, i.e., a 1% increase in the Gini coefficient would decrease life expectancy by 0.25 percent. Health expenditure shows an insignificant result as the p-values exceed 10%. Furthermore, the impact of health expenditure is negative. GDP per capita is significant and positive, i.e., a one percent decrease in GDP per capita would decrease life expectancy by 0.0228 percent. GDP and life expectancy have a positive association, as suggested already by Chen and Fleisher (1996), Panizza (2002), Shin (2012), Malinen (2012), Herzer and Vollmer (2012), Rubin and Segal (2015) and many others. The above Table represented long-run and short-estimation results for our second model when life expectancy was the dependent variable. Similar to model 1, in this case, the coefficient of ECM is negative (-0.007) and significant at a 1% level, implying a valid long-run relationship between income inequality and life expectancy. The value -0.007395 shows that 0.7 percent of the disequilibria in Life expectancy of the previous year's shock were adjusted in the existing year. Table 3 represents the co-integration and long-run results for model 1 when the infant mortality rate was kept as a dependent variable. The upper part of the Table represents the coefficient of error correction model with the speed of adjustment of -0.020126 in the long run from a short-run shock.

Table 4: Results of Toda Yamamoto modified Wald Test (Model 1)

Dependent variable	Modified Wald Statistics			
	IMR	GINI	H.E	GDPPC
IMR	-	12.84892 (0.0455)**	12.35297 (0.0545)***	10.69979 (0.0981)***
GINI	3.570443 (0.7346)	-	27.90802 (0.0001)*	10.77836 (0.0955)***
H.E	25.13663 (0.0003)*	7.208798 (0.3020)	-	28.07281 (0.0001)*
GDPPC	27.85913 (0.0001)*	40.36785 (0.0000)*	38.81921 (0.000)*	-

Source: Author's Calculation.

Note: The values in parenthesis are the p-values. '*', '**' and '***' represents 1, 5 and 10 percent level of significance respectively. Lag length selected using SBC.

Table 5: Results of Toda Yamamoto modified Wald Test (Model 2)

Dependent variable	Modified Wald Statistics			
	L.E	GINI	H.E	GDPPC
L.E	-	23.12274 (0.0008)**	49.01416 (0.000)**	38.85185 (0.000)**
GINI	18.40759 (0.0053)**	-	52.27204 (0.000)**	40.37600 (0.000)**

H.E	104.1550 (0.000)**	54.67049 (0.000)*	-	48.88780 (0.000)**
GDPPC	12.86585 (0.0452)**	11.08490 (0.0858)***	22.03996 (0.0012)**	-

Source: Author's Calculation.
Note: The values in parenthesis are the p-values. '*', '**' and '***' represents 1, 5 and 10 percent level of significance respectively. Lag length selected using SBC.

To perform causality analysis, we have used three different techniques. First, we applied the Toda Yamamoto Modified Wald test using simple, unrestricted VAR to check the direction and strength of causality between our variables in both models. The Toda Yamamoto modified Wald test results are reported in Tables 4 and 5. Table 4 reports the results of the Toda Yamamoto Test for model 1. As shown in Tables, a unidirectional causal relationship was found between infant mortality rate and Gini that runs from Gini to IMR. Furthermore, a bidirectional causal relationship between life expectancy and the Gini coefficient is found. The Toda Yamamoto Wald test results confirm a causal relationship between IMR and income inequality and life expectancy and income inequality.

Conclusions and Policy Implications

The study explored the effect of income inequality on two different health measures, infant mortality rate and life expectancy, in Pakistan using data from 1980 to 2020. A valid long-run relationship is established and confirmed between income inequality and IMR and between L.E and income inequality through the ARDL Bound testing method of co-integration. Results from the model with IMR as a dependent variable suggest a significant long-run impact of income inequality on IMR. Similarly, a significant long-run effect of income inequality on life expectancy was established. The results for the second model show a substantial negative influence of income inequality on life expectancy. The most surprising result of government expenditure shows an insignificant impact on the health performance of Pakistan. Moreover, the unidirectional relationship between income inequality IMR and between income inequality and life expectancy in Pakistan is confirmed, which runs from income inequality to IMR in the first model and from income inequality to life expectancy in the second model, for this, we utilized Toda Yamamoto Modified Wald test.

The current study's findings suggest that reducing income inequality and improving income distribution would be an essential policy option for improving infant mortality, life expectancy, and other poor health outcomes in Pakistan. There is a need for policies that focus more on equal distribution of income, allocation of resources, equitable access to healthcare, and comprehensive healthcare policies are equally important in achieving this goal. Also, public health expenditure can be vital in improving poor health outcomes; the poor benefit more by increasing the share of public spending, especially on health facilities. Moreover, Public expenditure can help in generating more employment. Similarly, targeted subsidies may also help in reducing income inequalities.

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