Analyzing the Multidimensional Inequality in Access to Health Care Services in Pakistan

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ARTICLE DETAILS

Health inequality is a global issue since the lack of one or more aspects of the essential health services still exists in 90% of the countries due to changing global economic conditions, political decisions and societal norms. The objective of the current study is to assess the effect of a set of socioeconomic, demographic, severity & non-severity and hospital fixed effects variables on multidimensionality health inequality in Pakistan. We measure multidimensional health inequality by combining eight dimensions of health inequalities and constructing the Multidimensional Health Inequality Index using Principal Component Analysis (PCA). Then multiple regression techniques are applied to empirically assess the impacts of selected variables on the response variable. The results show that social reference (-0.713), no. of doctors available (-0.109), type and severity of disease (-0.85 & -0.163), no. of diagnostic tests completed during the treatment process (-0.093), residential area (-0.097) and gender of the patient (0.170) significantly contribute towards the reduction of inequality among patients. The findings have strong policy recommendations for striviing efforts to reduce health inequality to achieve “Good health and Well-being” the 3rd goal under the United Nations agenda on Sustainable Development.

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1. Introduction

The third sustainable development goal “Good health and Well-being” focuses to ensure healthy lives for all but unfortunately, a lack of one or more aspect of the essential health services still exist in 90% of the countries. Health inequality is rising due to changing global economic conditions, political decisions and societal norms. Unequal distribution of power, wealth and income are closely related to health inequality and poverty. The marginalization of society into different groups has reduced the patient’s well-being by increasing mortality.
and reducing life expectancy (Anser et al. 2020). The Covid-19 pandemic has further amplified health inequality while equality in access to health care services is a top priority on the global policy agenda to ensure a global universal health coverage campaign (Evans & Etien, 2010; UN, 2021).

Extant literature has started now to measure multidimensional health inequality (Abedi et al. 2021; Barbosa & Cookson, 2019; Fleurbaey & Schokkaert, 2011; Moscelli et al. 2019; Norheim and Asada, 2009; Omotoso & Koch, 2020). This research domain has become the area of high research interest globally among policymakers to ensure accurate measurement based on improved information and methods (Costa-Font & Cowell, 2017; Decancq et al. 2017; O. O'Donnell et al. 2008; O. O'Donnell et al. 2013). The research has aimed to measure inequality which emphasizes circumstances that are beyond the control of individuals as well as the effort for which individuals can be held responsible. Equality in health care services has become an important policy concern to promote and protect health without any discrimination. Extant literature claims that low socio-economic status is correlated with poor health outcomes (Wagstaff, 1991, 2002; Deaton, 2003; Goli & Arokiasamy, 2014; Goli et al. 2014; Gopalon et al. 2020; Hosseinpooor et al. 2006; Nikolai et al. 2020; Nedjat et al. 2012; O'Donnell et al. 2008) and vice versa (Deaton, 2003; Evans et al. 1994; Gwatkin, 2000; Kitagawa & Hauser 2013; Wilkinson, 2002; Wilkins & Marmot 2003). Health inequality is heavily concentrated towards low income groups while reducing socio-economic inequality status, regional disparity, improving education and health related infrastructure and accessibility to health care services can be the solution to overcome the multiple health inequalities (Akhter et al. 2020). Reducing inequality in health care services will improve lifespan which is increasingly recognized as health policy objective (Aburto et al. 2018). Health equality and equity will also improve the welfare of the community by ensuring three dimensions; opportunity, process and outcome (Liu & Wong, 2016; Wilson & Soloman, 2020).

About 60% of the world population lives in the Asian region which is representative of having different stages of economic development; passing through a major transitional period in socio-economic and epidemiological dimensions (Kunna et al. 2017). Thus, understanding how a diverse set of variables comprised of socio-economic, demographic, severity & non-severity control variables and hospital fixed effects variables affects health inequality is strongly desired for policy making. The current study is an adoptive version to investigate the multiple inequalities in access to health care coming from multiple unfair means and the factors held responsible for it. To accomplish the study, we select Pakistan as a case study. Pakistan is an interesting case study being the 6th most populous country in the world having over 220 million of population. Pakistan holds the 154th position in terms of the human development index (education, health and income) with a value of 0.557 and stood 2nd lowest in South Asia. Pakistan could improve HDI index by 39 percent in the last 27 years compared to Bangladesh and India had 59 and 52 percent respectively. Pakistan also has Gini coefficient of 33.5 representing medium income inequality (UNDP, 2021). This study is the first kind of attempt to study the multiple inequalities in health care access using Fleurbaey and Schokkaert (2011) multivariate approach in Pakistan. It is a pioneer attempt to quantify the relative contribution of a diverse set of variables to multidimensional health inequality. The second contribution of the study is that we measure eight dimensions of inequality in contrast to the existing literature which usually considers one aspect- waiting time as an indicator of health inequality (Gaughan et al. 2020; Laudicella et al, 2012; Moscilli et al. 2018; Sharma et al. 2013). The remaining paper describes the literature review in section two,
the methodology is discussed in section three, the results and discussion are elaborated in section four and the conclusion & policy recommendation are briefed in the last section.

2. Literature Review
This section discusses the empirical and theoretical literature review on health inequality and its determinants. Waiting time is a core issue in access to the health care system. The factors affecting waiting time as a measure of inequality in access to the health care system are the most commonly used indicator in research domains. The waiting time is the most common inequality in the case of emergency services at the hospital. This inequality is higher in the case when patients are older, hospitals have high bed occupancy conditions and some other demand-supply related infrastructure. There is a growing focus on measuring inequality and its determinants to improve the health system (Gaughan et al. 2020).

Barbosa and Cookson (2019) examine the inequity in the Brazilian health care system. The results claim that area of residence of a patient and having insurance is more important for health-related inequality than income. The researcher suggests focusing on multiple dimensions of health inequality rather than income only by policymakers and research experts. Gaughan et al. (2020) have focused on the waiting time in the emergency department of the National Health Service of the United Kingdom. They aimed to find a way to evaluate the determinants of long waiting time to suggest policies recommendation to reduce the waiting time faced by patients. The results claim that hospital infrastructure is held responsible to a greater extent for long waiting times at the hospital. This needs an urgent improvement of infrastructure to match demand and supply for equality in access to health services. Moscilli et al. (2018) worked on the socioeconomic inequalities in access to health care services. The collected data from the English National Health Service is used for analysis. The key variable of health inequality is the waiting time faced by patients in public hospitals. The results explained that the patients who belonged to less deprived areas were found to face a problem of short waiting times as compared to those who were the residents of the more deprived area of the region.

Achieving health equality by reducing lifespan inequality is recognized as a global health policy objective. A study by Aburto et al. (2018) applied the age decomposition analysis technique to evaluate the life expectancy and life span in Sweden. He concluded that health inequality based on these two variables exists for males and females because habits like smoking and resulted in mortality. Life expectancy and life span inequality should be the focus area of policy makers and health related development projects to reduce health inequality. The traditional method of measuring health inequality is to estimate the concentration of health outcomes using income based criteria. This method lacks reliability as it ignores social status. Thus measuring socio-economic and other categorical based indicators approach is more robust. A regression analysis of determinants of inequality in access to health care is more appropriate to quantify its determinant (Costa-Font & Cowell, 2017). Measurement of multidimensional health inequality is often problematic if the response variable is measured in the categorical method. A regression analysis to examine the self reported health inequality and its determinant is appropriate to evaluate its determinants (Costa-Font & Cowell, 2021).

3. Data and Methodology

3.1. Study area and Data collection
The data for the current study is collected from three tertiary care teaching hospitals; Allied hospital Faisalabad, Nishter Hospital Multan and Mayo Hospital Lahore in the Punjab
Province of Pakistan. A well structured questionnaire is designed from the relevant extant literature. Two days of training of enumerators knowing local dialect are completed at Government College University, Faisalabad Pakistan before the start of data collection. A complete understanding of the designed questionnaire is ensured among enumerators under the supervision of the researcher on the first day of training while a field trip to a nearby hospital is arranged on 2nd day for pre-testing of the questionnaire. After pre-testing, a detailed discussion is arranged to clarify the problems encountered by interviewers to collect unbiased data from the selected population. The information was collected in local languages from respondents. Moreover, data on control variables to capture heterogeneity among sampled hospitals is also collected from focus group discussions from hospital management.

3.2. Variables Selection and Justification

We measure health inequality by taking eight variables representing various types of health care related issues (described in table 1) resulting in multidimensional health inequality. The general question “To what extent do you face the problem of inequality in access to health care services” is measured on a five Likert scale; Never- representing that respondent has never faced any issue related to health care access, rarely shows a lower level of inequality. The third option “indifferent” depicts that respondents could not identify such problems while availing of health facilities but “frequently” and “always” show a higher level of health inequality faced by the respondents. The variables used for measuring multidimensionality inequality in access to health care services are considered as best proxies in the existing literature. For example, Gaughan et al. (2020) and Moscilli et al. (2018) used the waiting time as a proxy for measuring inequality and our first two variables on undue delay in check and non-compliance of patient’s turn of ticket issued are in line with these studies. Waiting time is non-pricing mechanism for measuring inequality and is largely used in literature to overcome the possible link relating access to the ability to pay for it (Martin, 1999; Laudicella et al. 2012; Sharma et al. 2013; Siciliani et al. 2013; Manning et al. 1987). Literature such as West et al. 2014 claims that the size of health related workforce (No.of doctors) and their behavior greatly affects the health outcomes and we consider such variables while selecting variables of the interests. Similarly, the lack of availability of free medicine is considered a major issue in access to health care services and this variable is in line with the literature by Eisen et al. (2007). Behavior of staff strongly affects the outcome of Moreover, the disruption in the international supply-chain among countries caused by COVID-19 has affected health care suppliers, health care system and public health (Lenzen et al. 2020; FDA, 2020; Weidmann & Lanzen, 2018; Malik et al. 2018; Planetary Health, 2018; Walker et al. 2020). This pandemic is expected to hard hit people having limited access to healthcare and social safety nets in the South Asian region with low income (World Bank, 2020a). This will result in challenges to medical & supporting staff and health care administrators at local as well as the global level (World Bank, 2020b). We use a combination of variables on socio-economic and geographic aspects; severity & Non-severity controls and hospital fixed effects variables as independent variables to check their impacts on the dependent variable. Tables 1 and 2 briefly describe the variables selected with their measurement methods.

| Variable Name | Variable Description | Measurement Method |
|---------------|----------------------|--------------------|
| HI            | Undue delay in check-up/ proxy for waiting time | To what extent do you face the problem of inequality in access to |
The patient is not checked up on turns as per computerized Ticket No. issue. Lack of access to the senior doctor. An issue in the availability of free medicine. Issue in the free diagnostic test. Issue in admission to hospital. Assertive behavior of hospital staff. Lack of Medicine due to Covid Pandemic.

1-Never
2- Rarely
3-Indifferent
4- Frequently
5-Always

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### Table 2: Description of Independent Variables

| Variable                          | Description and Measurement Method                                      |
|-----------------------------------|------------------------------------------------------------------------|
| Residential Area                  | 1 if the patient belongs to urban areas, 0 otherwise                    |
| Gender                            | 1 if the patient is Male, 0 otherwise                                   |
| Age                               | No.of Years                                                             |
| Education                         | No.of Years                                                             |
| Monthly Income of the Family      | Pak Rupees                                                             |
| Social Reference                  | 1=Yes 0= No                                                             |
| Number of Doctors                 | Numbers of doctors serving in hospital                                  |
| Type of Disease                   | Type/nature of the disease                                             |
| Severity of Disease               | 1=Yes 0= No                                                             |
| No.of Diagnostic Tests before admission to the hospital | Continuous Numbers         |
| No.of patients attended/admitted to hospital | Continuous Numbers         |

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### 3.3. Econometric Model

We devised an econometric model following Moscilli et al., (2018) and develop the following simple regression model to quantify the relationship between dependent and independent variables,

\[
\text{Multidimensional Health inequality index}_i (\text{HII}) = \beta_0 + \beta_1 \text{Residential Area} + \beta_2 \text{Gender} + \beta_3 \text{Education} \times \beta_5 \text{Income} + \beta_6 \text{Social Reference} + \beta_7 \text{No. of Doctors} + \beta_8 \text{Type of Disease} + \beta_9 \text{Severity of Disease} + \beta_{10} \text{No. of Diagnostic Tests} + \beta_{11} \text{No. of Patients attended/admitted} + \varepsilon_i
\]

Where HII is a multidimensional health inequality index constructed from Principal Component Analysis (PCA) technique. Whereas all the independent variables are briefly described in Tables 1 & 2 above.

### 4. Results and Discussion

#### 4.1. Principal Component Analysis

We applied Principal Component Analysis (PCA) to construct a health inequality index to capture multidimensional health inequalities. PCA efficiently converts large no’s of mostly correlated variables into a fewer uncorrelated variable. The new variables are named principal
components (PC’s) which are linearly developed from original variables and have maximum explanation power, preserving variation in original data and reducing the dimensionality of the data set for robust analysis. We use PCA in its standardized form—the correlation matrix to calculate eigenvalues and their corresponding eigenvectors (weights) associated with each variable of multidimensional health inequality (Dunteman, 1989; Jolliffe, 2002). The documented advantages of developing indices in this manner are by reducing the clutter of too much information and it also helps to communicate information more precisely. Although the PCA is limited for ex-post analysis of a situation and is not appropriate for prospective investigations still it can provide fertile inquiry for the development of aggregate indices (Chatfield & Collins 1980; Jollands et al. 2004; Yu et al. 1998). Table 3 describes summary statistics on selected variables while results of PCA analysis are reported in table 4 in the appendix.

### Table 3: Descriptive Statistics

| Variable                  | Mean  | Std. Dev. | Min | Max |
|---------------------------|-------|-----------|-----|-----|
| Residential Area          | 1.526 | 0.931     | 0   | 1   |
| Gender                    | .488  | 0.5       | 0   | 1   |
| No years of Education     | 6.293 | 5.165     | 0   | 18  |
| FamilyIncome              | 38.15 | 33.705    | 15000 | 200000 |
| Social Reference          | 2.002 | 0.818     | 0   | 1   |
| No.of Doctors             | 19.101| 3.226     | 14  | 25  |
| Type of Disease           | 2.328 | 1.108     | 1   | 4   |
| Severity of Disease       | 2.809 | 1.62      | 1   | 5   |
| No. of Diagnostic Tests   | 2.376 | 1.212     | 1   | 5   |
| No. of Patients attended/admitted | 51.567 | 4.022 | 45  | 58  |

Results of the regression model are reported in table 5. It is found that the place of residence of patients significantly affects health inequality. The negative and significant coefficient of the place of residence (-0.097) indicates that an urban resident patient face less inequality compared to a rural patient. Rural people faced more exploitation in access to health care services as compared the urban people. In the field of health, the health policymakers were focusing on the areas while formulating their targets (French et al. 2005). Pirani and Silvana (2015) found that health inequality existed more in the highly developed areas as compared to less developed areas. In contrast to that Barbosa & Cooksan (2019) evaluated that people residing in urban areas had less likelihood to face unfair inequality. Thus our results can be considered in line with previous studies. The negative and significant value of the gender coefficient (-0.170) shows that being a male patient, health inequality decrease compared to female. A study by Zhang et al. (2015) found the same results and described that females were exploited from getting access to health care services. A mixed result on gender discrimination in health care access also exists in the literature in England it was found that females had less access to health care services and have to face more inequality compared to males (Pell et al. 2000). In some developed nations all genders were treated equally in hospitals while getting access to health care services (Coyte et al. 1994). The literature claims that higher education reduces inequality because of having more awareness as compared to the less educated people (Smirthwaite et al. 2016; Martin & Scilliani, 2020; Paradhan, 2010. Income is a proxy for economic status and results show that it reduces inequality significantly by a coefficient value of -0.003 similar to previous literature (Sharma et al. 2013; Barbosa & Cookson, 2019). It confirms that the rich people are considered the most advantageous people in case of health utilization (Donnell et al. 2007) while the poor are found to be the
most neglected people in getting access to health care services (Hecker and Stani Street, 2004; Fujita et al. (2016). In developing countries, social relation is considered an important tool to reduce inequality. Our results also confirm this hypothesis significantly (-0.713) while previous studies like Szynkaruk et al. 2014 and Brydsten et al. 2018 also concluded that the social relation had a negative impact on health inequality. The hospital fixed effects variables like No.of doctors significantly reduces inequality having a highly significant coefficient (-0.109). Previous literature confirms the robustness of our results (Martin, 2002; West et al. 2014; Moscilli et al. 2018. Nature or type of diseases such as more chronic and life threatening diseases, the severity of disease and no. of diagnostic tests or procedures or primary diagnosis completed already significantly reduces inequality (0.085; -0.162; -0.093). These factors are highly correlated to each other and collectively reduce inequality. Our findings are consistent with previous studies (Moscilli et al. 2018; Sharma et al. 2013). Since developing countries are passing through a rapid transition, a careful health policy is strongly desired by policymakers (Kunna et al. 2017).

| Name of Variables         | Coefficients | p-Value |
|---------------------------|--------------|---------|
| Residential Area          | -0.097*      | 0.056   |
|                           | (0.051)      |         |
| Gender                    | -0.170*      | 0.073   |
|                           | (0.094)      |         |
| Education                 | 0.002        | 0.849   |
|                           | (0.009)      |         |
| Family Income             | -0.003**     | 0.022   |
|                           | (0.001)      |         |
| Social Reference          | -0.713***    | 0.000   |
|                           | (0.101)      |         |
| No.of Doctors             | -0.109***    | 0.000   |
|                           | (0.023)      |         |
| Name/Type of disease      | -0.085*      | 0.072   |
|                           | (0.047)      |         |
| Severity of Disease       | -0.162***    | 0.000   |
|                           | (0.030)      |         |
| No.of Diagnostic Tests    | -0.093**     | 0.025   |
|                           | (0.041)      |         |
| No.of Patients            | 0.001        | 0.923   |
|                           | (0.014)      |         |
| Observations              | 601          |         |
| R-squared                 | 0.178        |         |
| Adj R-squared             | 0.1641       |         |

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5. Conclusions and Policy Recommendation

Health inequality has become a global issue due to changing economic conditions, political decisions and societal norms. Unequal distributions of power, wealth and income have resulted in health inequality and poverty and have affected the patient’s well-being by
increasing mortality and reducing life expectancy (Anser et al. 2020). The Covid-19 pandemic has further amplified health inequality while equality in access to health care services is the top priority on the global policy agenda to ensure a global universal health coverage campaign (Evans & Etien, 2010; UN, 2021).

The main objective of the current study is to evaluate the multidimensional inequality in access to health care services and the factors held responsible for this issue. This is the first kind of attempt to study the multiple inequalities in health care access using Fleurbaey and Schokkaert (2011) multivariate approach in Pakistan. It is a pioneer attempt to quantify the relative contribution of a diverse set of variables to multidimensional health inequality. The second contribution of the study is that we measure eight dimensions of inequality in contrast to the existing literature which usually considers one aspect- waiting time as an indicator of health inequality (Gaughan et al. 2020; Laudicella et al, 2012; Moscilli et al. 2018; Sharma et al. 2013). We applied the Principal Component Analysis technique to capture the eight dimensions of health inequality and inequity. Using this technique, we developed a multidimensional health inequality index for Pakistan. To check the impacts of various selected variables, we applied multiple regression econometric tools. The main findings of the study are briefly described here. The socio-economic variables such as residential area, gender, education, income and social relation strongly affect the health inequality of the respondents. Similarly, severity and non-severity control variables such as no. of diagnostic tests or procedure competed; no. of patients admitted/attended, nature and type of disease, and severity of disease also significantly affect the variable of interest. Variables related to hospital fixed effects like no. of doctors and related infrastructure are also important to undermine the health inequality.

The findings have strong policy recommendations at policy making level. Pakistan is a developing country like others is phasing through a transition period on socio-economic, demographic and health related issues under climate change. In the light of the United Nations, 2030 agenda on sustainable development goals, to achieve the 3rd SDGs “Good health and Well-being” to ensure healthy lives for all at all levels of ages, need striving efforts to reduce health inequality and inequity. The policymakers should enhance the health care programs in rural areas, and overcome gender and social biases in access to healthcare services. Moreover, health related workforce and patient ratio, the infrastructure of health providing hospitals and training should be arranged to avoid any inequality. This will achieve a higher human development index and improve the overall well-being of society. Following may be the specific policy recommendation,

Health awareness programs should be enhanced to achieve universal health coverage.

- Proper information and communication of the health system should be ensured by providing help-desk services at hospitals to reduce health inequality.
- Centralized computer based data on patients should be maintained covering the details on the name of patients, date of visit, date of admission at the hospital, type of disease, name of diagnostic tests recommended and availed from the hospital, medicine provided to patients, waiting time between visit and check-up, undue delay in admission to hospital, provision of medical diagnostic tests, etc to reduce inequality among patients.

This study is based on three selected hospitals due to the lack of financial resources and time limit for the student. A more detailed study should be designed by including more districts.
and types of disease to evaluate the proper functioning, lapses and improvement in the health care system in the case of Pakistan so that the finding may be used for policy making for any developing country like Pakistan.

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### Appendix

#### Table 4: PCA Results- Eigen values and Eigenvectors

| Component | Eigenvalues | Difference | Proportion | Cumulative |
|-----------|-------------|------------|------------|------------|
| Comp1     | 1.524       | 0.126      | 0.191      | 0.191      |
| Comp2     | 1.398       | 0.210      | 0.175      | 0.365      |
| Comp3     | 1.188       | 0.156      | 0.148      | 0.514      |
| Comp4     | 1.032       | 0.184      | 0.129      | 0.643      |
| Comp5     | 0.848       | 0.083      | 0.106      | 0.749      |
| Comp6     | 0.764       | 0.115      | 0.096      | 0.844      |
| Comp7     | 0.649       | 0.051      | 0.081      | 0.925      |
| Comp8     | 0.598       | .          | 0.075      | 1.000      |

#### Principal components (eigenvectors)

| Variable | Comp1 | Comp2 | Comp3 | Comp4 | Comp5 | Comp6 | Comp7 | Comp8 |
|----------|-------|-------|-------|-------|-------|-------|-------|-------|
| Waiting  | 0.327 | 0.383 | 0.363 | -0.362| 0.350 | 0.252 | 0.446 | -0.314|

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|                     | Ticken No.s | 0.065 | 0.133 | 0.714 | 0.376 | 0.065 | 0.223 | -0.491 | 0.178 |
|---------------------|------------|-------|-------|-------|-------|-------|-------|--------|-------|
| Access to senior doctors |            | 0.469 | -0.006 | -0.268 | 0.300 | -0.445 | 0.631 | 0.143 | 0.040 |
| Access to free medicines |           | 0.349 | -0.028 | -0.225 | 0.597 | 0.607 | -0.255 | 0.168 | 0.094 |
| Access to free diagnostic tests |        | -0.212 | 0.527 | 0.042 | 0.445 | -0.374 | -0.301 | 0.161 | -0.471 |
| Problems in admission to hospital |       | 0.167 | 0.512 | -0.449 | -0.199 | 0.185 | 0.070 | -0.640 | -0.140 |
| Behavior of Staff |             | 0.525 | 0.234 | 0.124 | -0.205 | -0.347 | -0.522 | 0.042 | 0.466 |
| Disruption in supply |           | -0.445 | 0.490 | -0.129 | 0.045 | 0.112 | 0.236 | 0.272 | 0.633 |