Research Square

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Assessing Neo-natal mortality trends in Pakistan: An insight using Equity Lens

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Research

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Abstract

Background

Almost 2.5 million children died in the first year of life in the year 2017. These account for almost half of the total deaths of children under the age of five years. Overall, child mortality has declined over the past two decades. Comparatively, the pace of decline in neonatal mortality has remained much slow. Significant inequalities in health across a number of dimensions – including wealth, ethnicity, and geography – continue to exist both between and within countries, and these contribute to neonatal mortality. This study aims to quantify the magnitude of inequalities in neonatal mortality trends by wealth quintile and place of residence with province wise segregation.

Methods

The study was done using raw data from the last three Pakistan Demographic & Health Surveys (20017-18, 2012-13 and 2006-7). The concentration curves were drawn in Microsoft Excel 365 using scatter plot as graph type while the frequencies were calculated using SPSS 24.

Results

The situation of inequity across provinces and in rural vs urban areas has slightly declined, however, gross inequities continue to exist.

Conclusions

Presentation of outcomes data, such as neonatal mortality in various wealth quintiles is an effective way to highlight the inequities amongst income groups as it highlights the vulnerable and at-risk groups. In other countries, rural-urban distribution, or ethnic groups may also reflect similar differences and help in identifying high-risk groups.

Key Messages

1. Mortality is inequitably distributed across geographic regions and wealth quintiles, the poor and the rural residents
2. Marginalized and vulnerable groups need to be cared for on priority to have an impact on neonatal mortality

Introduction

It was estimated that over 141 million newborns will be added to the world population in the year 2019, the number rising with every year. On the other hand, almost 2.5 million died in the first 28 days of life in the year 2017 [1]. These 2.5 million deaths account for 47% of the total deaths in children under the age of five years, increasing from 40% in 1990 [2]. Although the overall under-5 child mortality has declined

over the past decade or so, the decline in the neonatal mortality has not been at the same pace, according to the UNIGME [2]. This rise in the proportion of neonatal deaths was expected, as predicted in earlier studies which mentioned that the infant mortality rates are expected to decline due to widespread implementation of known and cost-effective interventions like vaccines for preventable diseases, and oral rehydration therapy for diarrhea [3].

Almost 75% of the newborn deaths happen during the first seven days of life, while over 25% happen before completion of the first 24-hours of life, highlighting the fact that the probability of surviving increases with every passing day for the newborn [4].

There is increasing evidence that significant inequalities in health across a number of dimensions – including wealth, ethnicity, and geography – continue to exist both between and within countries [5] [6]. Indeed, it has been suggested that inequalities may have widened in recent times [7] [8]. WHO defines health inequities as “Health inequities are differences in health status or in the distribution of health resources between different population groups, arising from the social conditions in which people are born, grow, live, work and age. Health inequities are unfair and could be reduced by the right mix of government policies” [9].

Over 65% of the total neonatal deaths occurring globally belong to just 10 countries. Most of these countries are from Asia. Pakistan ranks third among these ten. It is estimated that almost 300,000 newborns die annually in the country, the latest reported neonatal mortality rate being 42 per thousand live births, accounting for around 7% of neonatal deaths happening globally[10][11][12][13] [14]. Pakistan is also a signatory to the Alma Ata Agreement [15], which stipulates that health is affected by social position and the underlying inequality in a society.

Equity in health is a basic and core principle of the “Primary Health Care approach” [16]. It is, henceforth, implicitly or explicitly mentioned in the health policies of a majority of the countries [17]. It is widely recognized that people’s equitable access to health care services is vital to sustaining good health which depends primarily on income levels and the cost and availability of quality health services. There is an established correlation between social and health inequality. While inequalities are ubiquitous and a reality of life, the concept of inequity refers to the degree of unfairness and injustice in societies which often result from pervasive inequalities [18].

The SDGs make up a set of targets developed in a holistic manner to guide future development projects. Health is at the center of the third SDG, to “Ensure healthy lives and promote well-being for all at all ages” [19]. This goal also focuses on the integration of equity, human rights, gender and social determinants into policies. These programs and institutional mechanisms all over the world that would be vital for empowering women and men, and reducing inequities between and among populations and promoting everyone’s human rights. Goal 10 also calls for a reduction in inequality within and among countries to empower and promote the inclusion of all [20]. New-born health has also been taken seriously in the SDGs as the target for NMR for each country has been set at 12 per 1,000 live births [19].

Human welfare and development is a basic right of each individual as highlighted in the Constitution of Pakistan [21]. Access to majority of the curative and preventive health services, and hence, their utilization are not equitable in Pakistan. These inequities are specifically intensified as we move from the richest towards the poorest wealth quintiles, as well as across various geographical regions of the country, especially highlighting the rural and urban divides. A multitude of initiatives have been taken over time to improve maternal and neonatal health indicators across the country. However, the progress so far is sluggish, and the inequities amongst different wealth and income statuses, social statuses, literacy rates and geographies have remained more or less constant [15] [22].

Using national data from Pakistan, this study aimed to:

- observe trends in neonatal mortality in Pakistan with an equity lens; using data from the last three Demographic and Health Surveys
- quantify the magnitude of inequalities in neonatal mortality trends by wealth quintile and place of residence with province wise segregation.

Methodology

The study was done using raw data from the last three Pakistan Demographic & Health Surveys (PDHS) i.e. 2017-18 [10], 2012-13 [23] and 2006-7 [24]. The 2018-18 PDHS is the fourth in the series of Demographic and Health Surveys conducted so far in Pakistan. The earlier three PDHSs were carried out in the years 1990-91, 2006-07 and 2012-13. These surveys are carried out with collaborations of National Institute of Population Studies (NIPS), Islamabad, Pakistan and the DHS Program (of the United States Agency for International Development, USAID). Data files used for the purpose of this study was “Birth Recode”. The variables used for neo-natal mortality was B7: Age at death (months-imputed). This variable was recoded into new variable (deaths at 0 months taken as YES for neo-natal mortality and all others taken as NO for neo-natal mortality). Data was filtered by V208 (births in last 5 years) and the cases weighted by V005 (women’s individual weight) using the same methodology as is used for measurement of neonatal mortality in the PDHS report. Other variables used for the purpose of analysis were V024, V025 and V190 for province, area of residence and wealth quintile respectively.

Measurement of inequities through Concentration Curves

Inequities were observed in neonatal mortalities in different wealth quintiles by geography and type of residence:

- National
- Type of Residence: Rural / Urban population
- Geography: Provinces

Several methods have been in use to date for measurement of inequities. Some have their origin in research on income inequality (e.g. Lorenz curve and the associated Gini coefficient) or from modifications of these (e.g. concentration index). Other methods are based on measures of association (index of dissimilarity, slope index of inequality). We used the concentration index and corresponding concentration curve.

Concentration Curves and Index

The concentration curves and index have their origin in research on income inequality (e.g. Lorenz curve and the associated Gini coefficient) or from modifications of these (e.g. concentration index).

Inequities are represented by concentration curves that are relatively easier to understand compared to the concentration indices. The concentration curve plots the cumulative proportion of the individuals under consideration ranked by wealth against the cumulative proportion of the health/healthcare variable (e.g. antenatal care visits, skilled birth attendant etc.) being measured. If the health indicator under consideration is an undesirable outcome, a concentration curve that lies above the line of equality signifies inequity disfavoring the poor and is bad from the equity point of view. If the indicator being considered is a desirable one (e.g. immunization coverage), a concentration curve that lies above the diagonal (line of equality) shows inequity favoring the poor – a situation that is desirable from the equity point of view. The concentration index (C) is computed in a spreadsheet program using the following formula:

$$C = (p_1 L_2 - p_2 L_1) + (p_2 L_3 - p_3 L_2) + \ldots + (p_{T-1} L_T - p_T L_{T-1}),$$

Where *p* is the cumulative percent of the sample ranked by economic status, *L(p)* is the corresponding concentration curve ordinate and *T* is the number of socioeconomic groups [25].

The concentration curves were drawn in Microsoft Excel 365 using scatter plot as graph type while the frequencies were calculated using SPSS 24.

Sampling

The sample size was 22,610 births (2006-07), 27,320 (2012-13) and 22,378 (2017-18) out of which 1,328, 1,703 and 1,079 neonatal deaths were observed respectively.

- Inclusion Criteria

Births occurring in the last five years preceding the survey

Cases filtered by V208 (births in last five years preceding the survey)

- Exclusion criteria

Cases belonging to areas other than the four provinces because ICT and GB data is not available separately for PDHS 2006-07 while data for GB and FATA is not available separately for PDHS 2017-18.

Results

The data analysis revealed that out of the total births observed in the sample for 2006-07 PDHS, 54% were from Punjab, 25% from Sindh, 16% from Khyber Pakhtunkhwa (KP) and 5% from Balochistan. Similar proportions were observed in the sample for PDHS 2012-13 and 2017-18 (Table 1). However, as far as the proportion of neo-natal deaths was concerned, 59% were from Punjab, 25% from Sindh, 13% from KP and 5% from Balochishtan in 2006-07 while 62% from Punjab, 22% from Sindh, 11% from KP and 5% from Balochistan. Thus, the share from Punjab and Balochistan increased while that from Sindh and KP decreased (Table 1).

Table 1
Number of births and neo-natal deaths observed in PDHS 2006-07 and 2012-13

Variable	Region	PDHS 2006-07	PDHS 2012-13	PDHS 2017-18
Births	Pakistan	22,610	27,639 *	23150*
			27,320	22,378
	Punjab	12,258 (54%)	15,233 (55%)	11,156 (50%)
	Sindh	5,699 (25%)	6,405 (23%)	5,544 (21%)
	KP	3,569 (16%)	4,180 (15%)	4,100 (18%)
	Balochistan	1084 (5%)	1,502 (5%)	1,578 (7%)
Neo-natal deaths	Pakistan	1,328	1,716 *	1,079*
			1,703	1,061
	Punjab	787 (59%)	1,059 (62%)	607 (57%)
	Sindh	328 (25%)	376 (22%)	218 (21%)
	KP	167 (13%)	185 (11%)	183 (17%)
	Balochistan	46 (3%)	83 (5%)	53 (5%)

** Total figure for Pakistan, also includes GB, ICT and FATA which have not been included in the study as matching data is not available uniformly for the three surveys.*

When we compare the concentration index for neo-natal deaths by wealth quintile for Pakistan (Fig. 1), there was an overall decrease from − 0.2472 to -0.12759 from 2006-07 to 2012-13 reflecting an improvement in terms of equity as the gap between the number of deaths among the richest and poorest quintiles narrowed down. Same was observed in the provinces of Punjab, Sindh and KP where the concentration index decreased from − 0.19847 to -0.03841; -0.35748 to -0.22176 and − 0.21621 to -0.19529 respectively. However, very minor decrease was observed in Balochistan i.e. from − 0.40744 to -0.4062. Thus, the lowest level of inequity was observed in Punjab followed by KP, Sindh and Balochistan during the 2012-13 PDHS (Table 2, Figs. 2 and 4).

Table 2
Concentration index for neo-natal mortality by wealth quintiles

Area	2006-07	2012-13	2017-18
Pakistan	**-0.2472**	**-0.12759**	**-0.17531**
Punjab	-0.19847	-0.03841	-0.07374
Sindh	-0.35748	-0.22176	-0.38869
KP	-0.21621	-0.19529	-0.16307
Balochistan	-0.40744	-0.4062	-0.43876

When we compare the concentration index for neo-natal deaths by wealth quintile for Pakistan, there was an overall increase from to -0.12759 to -0.17531 from 2012-13 to 2017-18 (Figs. 1 and 5) reflecting a decline in terms of equity as the gap between the number of deaths among the richest and poorest quintiles widened. However, if we compare 2017-18 with 2006-7 (Figs. 2,3,4 and 5), the gap has narrowed. In case of the provinces, Punjab and Sindh showed a rise compared to 2012-13 while KP showed a continuing declining trend and Balochistan a rising trend (Table 2).

Discussion

Disparities among the developed and under-developed or developing countries are gross, and the gap is gradually being widened in some areas; as is the case inter-country as well as intra-country. Children belonging to the poor quintiles are more vulnerable compared to their counterpart children belonging to richer quintiles, due to multiple challenges like malnutrition leading to weaker immunity, more exposure to risky and hazardous environments, and lesser or no access to both preventive and curative health. Efforts to improve the health outcomes through provision of subsidy for health services also usually doesn't reach the vulnerable, and those not in need frequently benefit from such subsidies [26].

A study shows a significant variation in coverage and inequalities across various regions of Afghanistan. These results are quite the expected ones, and highlight the fact that comparative availability and accessibility of health services is better in urban areas [18]. According to WHO, the disparity among high and low income countries for neonatal death is fairly large and it continues to increase. Another study states that's while there is little doubt that, lower income is one of the major factors underlying inequitable access to services. However, the overall situation is quite complicated, as multiple factors like geography, economy and ethnicity exist as determinants of inequity, and their simultaneous presence in certain cases makes the situation complex. Further to this, the importance of one or the other determinant in relation to the other determinants may vary with the passage of time [27].

In an Ethiopian study, it was noted that geography over-rides the economic factors as the health facilities are at a distance from the population, making access difficult even for those who do not have economic issues. Thus, the risk of child (or newborn) mortality does not correlate with the income groups; and

rather correlates with the type of residence i.e. rural versus urban [28]. Studies in India also showed that the underprivileged groups like the financially weak, poorly literate, or living in rural areas, had limited access to healthcare services, thus leading to poorer outcomes for health [29] [30]. Similar findings were observed in the case of Pakistan and for the provinces except for Balochistan where the inequities continue to prevail in the same ratio during throughout the last decade.

A comparative study of 14 countries that had undertaken at least two Demographic and Health Surveys during the 1980s and 1990s was done by Minujin and Delamonica. These countries had shown progress in child survival and decline in mortality. Out of the 14 countries, broadening of gap in child mortality amongst the richest versus poorest income / wealth quintiles was observed in eight [31]. PDHS for Pakistan shows that the gap between the richest and poor wealth quintiles has increased from 2012-13 to 2017-18; and the overall neonatal mortality has declined from 58 to 42 per 100,000 live births nationally during the same interval. This could be an alarming indicator for quality of services being provided even in the urban areas.

Geographic and ethnic disadvantages also result in lack of access to healthcare services; as much as the economic disadvantages. Therefore, health systems should consider these three determinants to provide preventive services like integrated management of newborn and childhood illnesses (IMNCI), vaccinations, and other interventions for newborn care through an equity-focused approach [6].

Inequities between the populations at the lower and higher end of the risk spectrum are further aggravated due to limited availability of effective interventions for the most marginalized children, as highlighted by Tugwell et al [32]. Systematic reviews of demographic and health surveys show consistent inequities in child health across multiple countries [33] [34]. The study conducted in Afghanistan discussed that unfair inequities and inequalities in service provision, access to services, and product availability to different segments of the population lead to societal inequities [18].

Kruk et al. concluded that “redistributive health policies that promote pro-poor distribution of health services may reduce the gap in under-5 mortalities between rich and poor in low-income and middle-income countries”. They highlighted the importance of targeting of newborn and child health services to the poor strata of the population, enabling the poor to gain from global efforts to attain the Millennium Development Goals (and now Sustainable Development Goals) [35].

Despite the fact that the inequities and inequalities are declining, the ongoing trend of service coverage for the disadvantaged groups are not at a sufficient pace to accelerate progress towards achieving the goals of universal health coverage (UHC) by 2030, as evidenced by Amouzou et al., and this calls for an urgent need for more robust and effective strategies for equitable access and coverage across all population segments, if the goals for UHC are to be achieved [36].

Conclusion

Presentation of outcomes data, such as neonatal mortality in various wealth quintiles is an effective way to highlight the inequities amongst income groups as it highlights the vulnerable and at-risk groups. In other countries, rural-urban distribution, or ethnic groups may also reflect similar differences and help in identifying high-risk groups.

Declarations

Ethics approval and consent to participate

NOT APPLICABLE (This study involved secondary analysis of data collected during the Pakistan Demographic & Health Surveys (PDHS). The PDHS team took the required consents. For the purpose of this study, the authors have taken permission from the DHS for use of the raw data for secondary analysis.)

Consent for publication

NOT APPLICABLE

Availability of data and material

Raw data of PDHS is available publicly on the DHS website. The same was used for the purpose of this study. The analysis sheets can be shared if required.

Competing interests

The authors declare that they have no competing interests

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None

Authors' contributions

Both the authors have contributed equally in the analysis, literature review, and writing of the manuscript. Both authors prepared, reviewed and approved the final manuscript.

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Figures

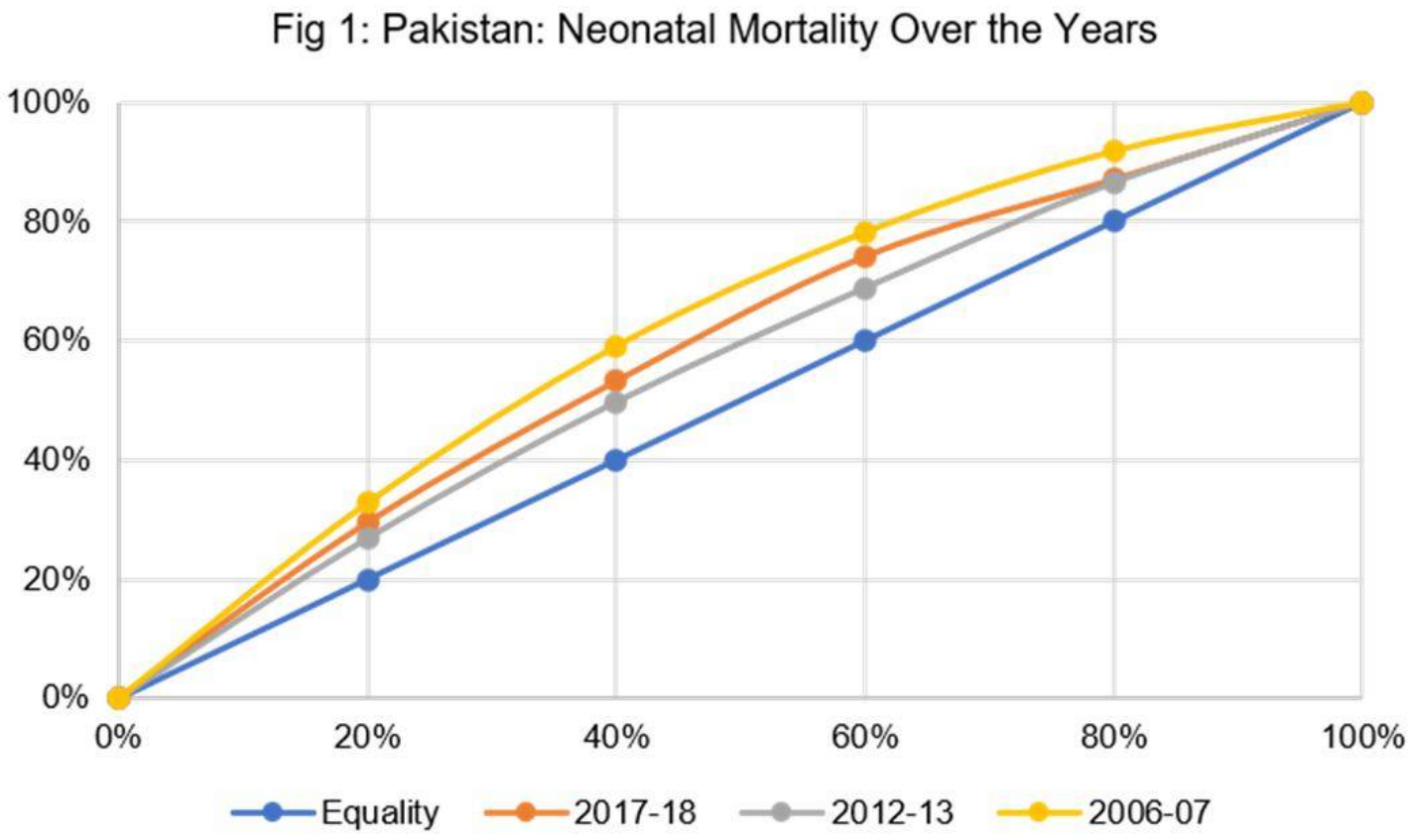


Figure 1

Pakistan: Neonatal Mortality Over the Years

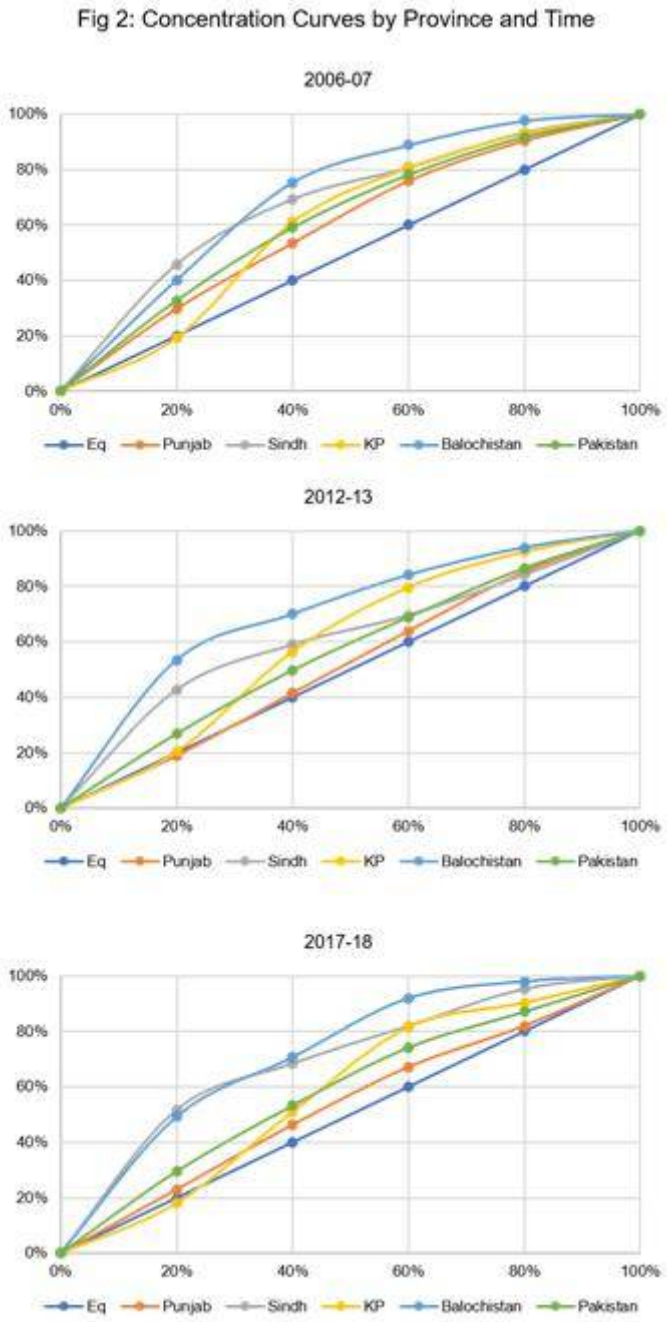


Figure 2

Concentration Curves by Province and Time

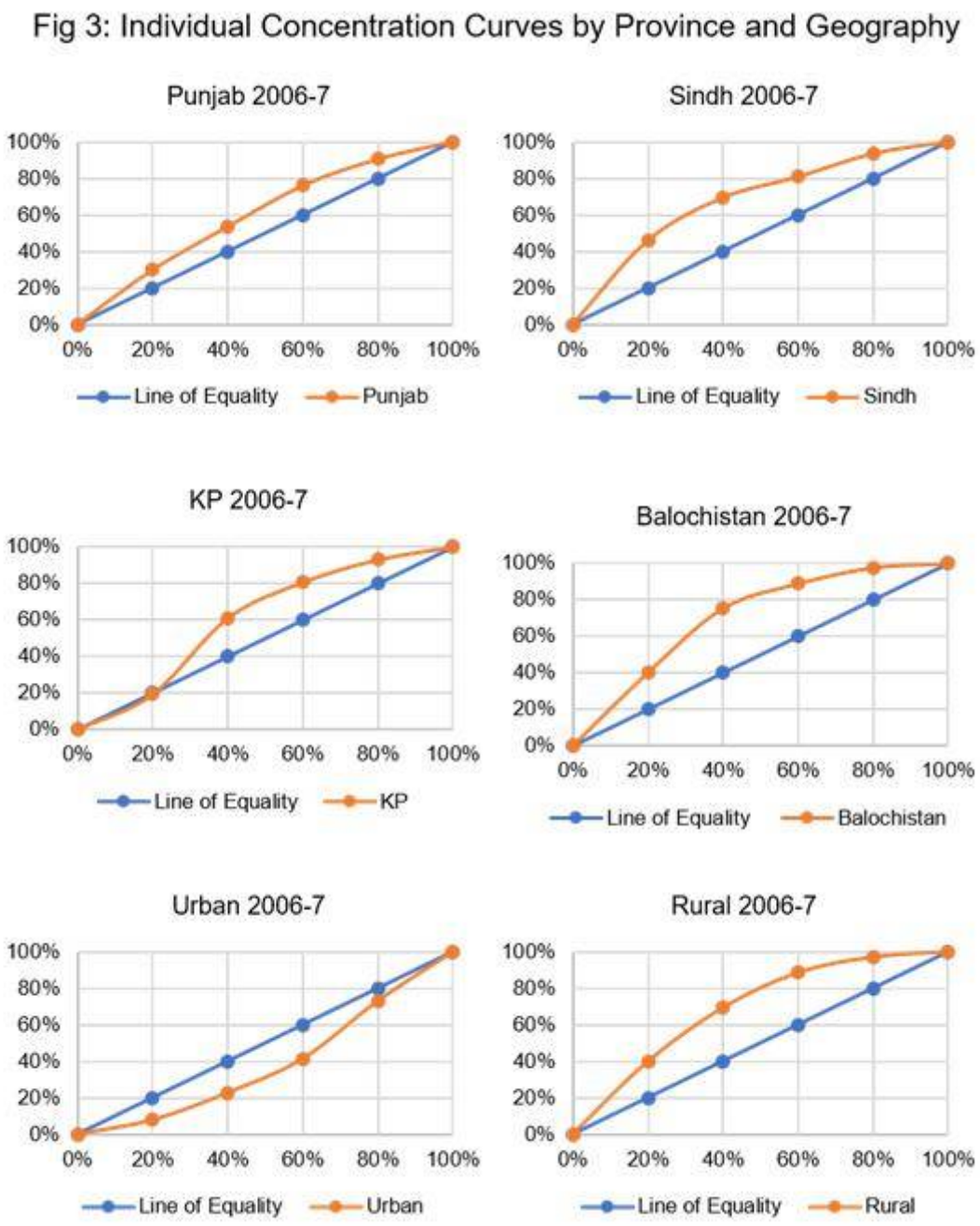


Figure 3

Individual Concentration Curves by Province and Geography

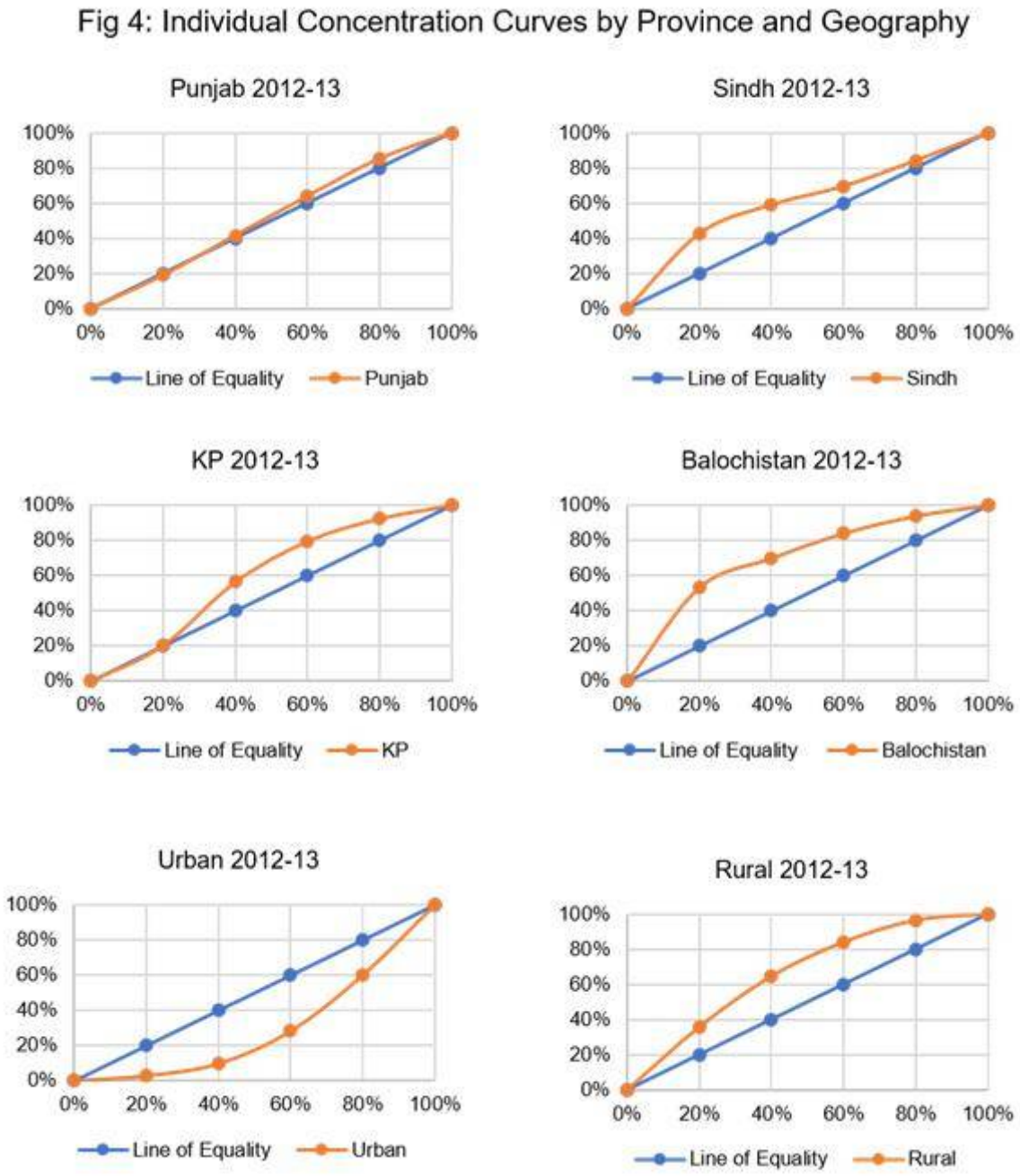


Figure 4

Individual Concentration Curves by Province and Geography

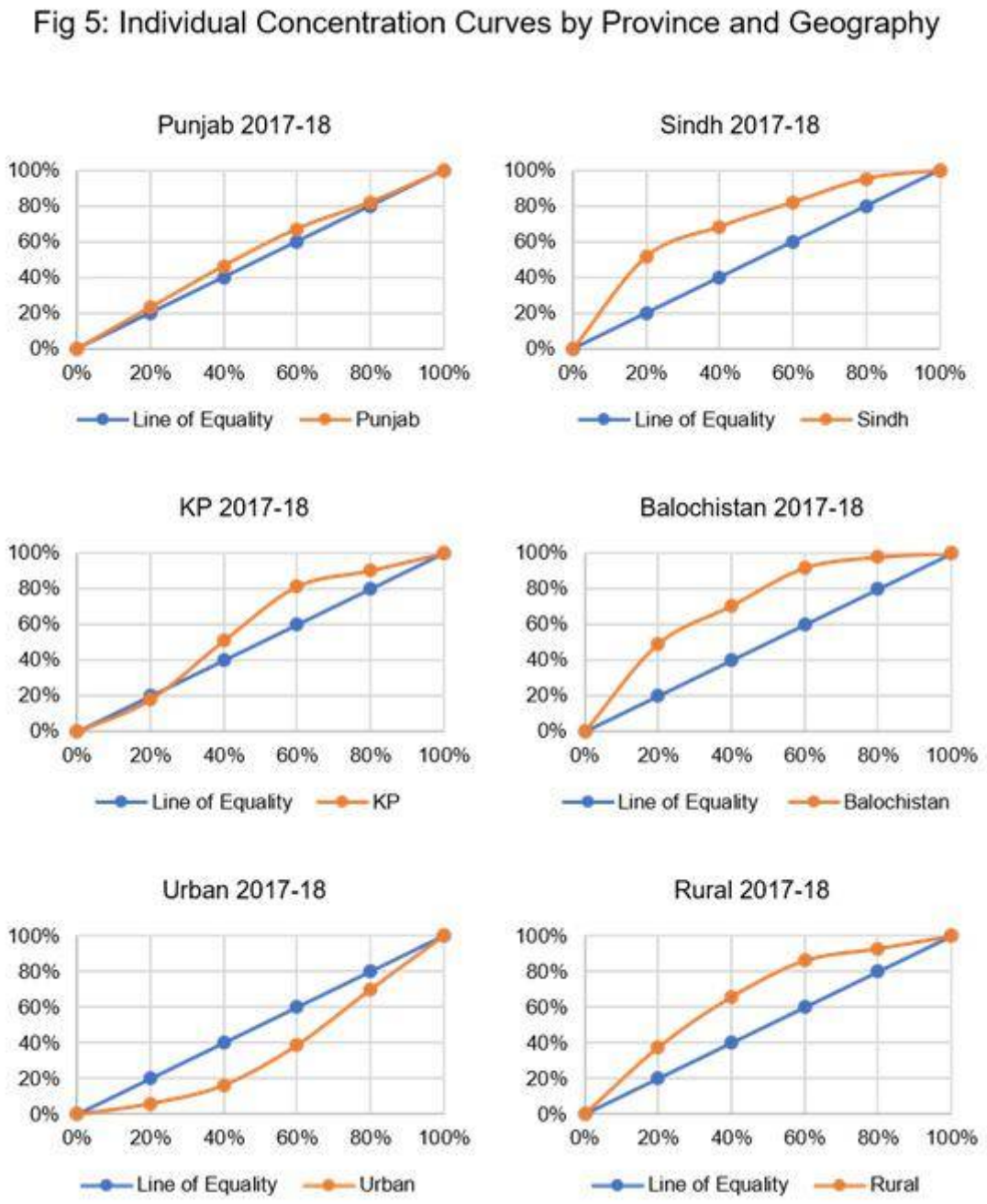


Figure 5

Individual Concentration Curves by Province and Geography