



# Understanding multidimensional poverty in Pakistan: implications for regional and demographic-specific policies

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Received: 18 December 2022 / Accepted: 28 May 2023  
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## Abstract

This study enriches the limited literature on multidimensional poverty by focusing on household demographic characteristics as determinants of household-specific living arrangements in Pakistan. The study employs the Alkire and Foster methodology to measure the multidimensional poverty index (MPI) using data drawn from the latest available nationally representative Household Integrated Economic Survey (HIES 2018-19). The analysis investigates multidimensional poverty levels among households in Pakistan according to various criteria (such as access to education and healthcare, basic living standards, and monetary status) and how they differ across Pakistan's regions and provinces. The results indicate that 22% of Pakistanis are multidimensionally poor in terms of health, education, basic living standards, and monetary status; and that multidimensional poverty is more common in rural areas and Balochistan. Furthermore, the logistic regression results show that households with more working-age people, employed women, and employed young people are less likely to be poor, whereas households with more dependents and children are more likely to be poor. This study recommends policies for addressing poverty that consider the needs of multidimensionally poor Pakistani households in various regions and with various demographic characteristics.

**Keywords** Multidimensional poverty · Alkire and Foster (AF) methodology · Household demographic characteristic · Logistic regression · Pakistan

## Introduction

Poverty is defined as the inability to obtain sufficient resources or income to meet basic human needs, such as food, shelter, and health care (Callan and Nolan 1991). Poverty is one of the top threats to global development. Eradicating poverty worldwide in all its dimensions is the first

United Nations Sustainable Development Goal (SDG-1) and the prime objective of national and international development organizations (Alkire and Kanagaratnam 2021; World Bank 2017). Despite global poverty-reduction efforts, approximately 1.3 billion people worldwide are multidimensionally poor, and most are in developing countries. Of those 1.3 billion people, nearly 1 billion are unable to afford secure housing, adequate sanitation, or solid fuels for cooking, and 568 million lack access to adequate drinking water (OPHI 2021). Health deprivation is a common problem in developing countries. Energy deprivation, which significantly affects the living standards of the poor, is also a key obstacle to development goals (Chishti et al. 2023b). The magnitude and intensity of poverty remain severe in many regions, particularly in the developing countries of Asia and Sub-Saharan Africa, which are hotspots of poverty (Sharma 2019). The youth “bulge,” gender inequalities, poor reproductive health, lower employment levels, and high fertility rates pose challenges for the development process in these regions.

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Responsible Editor: Arshian Sharif

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Pakistan, the seventh-poorest country in South Asia, is attempting to cope with the multiple dimensions of poverty through numerous initiatives. Since 2001, Pakistan has moved approximately 32 million people out of monetary poverty, and the poverty headcount rate (measured by consumption-based poverty estimates) dropped from 64.3% in 2001 to 24.3% in 2015 (Sharma 2019). However, the poverty rate in Pakistan remains significantly high, and a large portion of the population is vulnerable, living at or close to the minimum poverty line. Pakistan faces an energy shortage that is impacting the living standards of households. Almost 55% of households are energy-deprived in Pakistan (Quratul-Ann and Mirza 2021).

In 2015, the government of Pakistan announced its long-term growth strategy, “Vision 2025,” designed to overcome economic, social, governance, and security challenges and provide citizens with the ability to improve their choices and standards of living. Vision 2025 stresses a more comprehensive definition of poverty that includes education, health, and other dimensions, together with monetary indicators. Acknowledging the importance of addressing multiple dimensions of poverty for achieving SDG-1, the Pakistani government launched the first national multidimensional poverty index (MPI) in 2016. According to the National MPI (2016), almost 39% of Pakistanis are multidimensionally poor. Hence, the measurement and identification of poverty are key areas of interest to researchers and policymakers. A close look at the available empirical literature on poverty in Pakistan leads to several broad conclusions: most empirical studies focus on the measurement, identification, and determinants of monetary poverty (Ahmad and Faridi 2020; Cheema and Nadeem 2020; Chishti et al. 2022; Sadiq 2010) few empirical studies have examined multidimensional poverty (Debela and Tamiru 2016; Khan et al. 2014; Padda and Hameed 2018; Saboor et al. 2015; Saleem et al. 2021; Saleem and Bilal Khan 2018); and few studies have measured poverty by combining both approaches.

Understanding the determinants of poverty is a crucial step toward effective poverty eradication. While recognizing and estimating poverty dimensions are essential, identifying the factors that contribute to poverty at the household level is equally important (Alkire et al. 2017; Cappellari and Jenkins 2002). A significant body of research has focused on understanding poverty at individual and household levels, with a growing body of literature investigating its determinants. The literature has extensively explored how traditional factors such as household head characteristics (age, education, marital status, health, employment status, gender, occupation), region of residence, remittances received by households, and ownership of land and livestock have shaped household poverty (Alkire et al. 2017; Chen et al. 2019; Lekobane 2021; Meng et al. 2007). The typical household structure and family setup in Pakistan (i.e., joint family

system, large household size, large share of dependents, and lower engagement of females in income-generation activities) are crucial factors in determining household deprivation according to the multiple dimensions of poverty. Therefore, this study seeks to clarify the relationship between household demographic characteristics and multiple dimensions of poverty. The study analyzes household-level data from a large-scale survey to investigate how changes in household demographic characteristics impact multidimensional poverty levels. Specifically, the study examines the effects of dependency ratio, family type, changes in family size, employment, and age composition on poverty while controlling for other traditional factors that have been explored in the literature. Policymakers require a comprehensive understanding of these factors to develop effective poverty-reduction strategies, and the findings of this study provide new insights into the complex interplay between household demographic characteristics and poverty dynamics.

This study makes three valuable contributions to the multidimensional poverty literature on Pakistan. First, it constructs an MPI at the national, regional, and provincial levels using the Alkire and Foster (AF) methodology, which combines the non-monetary dimensions of education, health, and living standards with monetary poverty. Few empirical studies have measured acute poverty across the country by combining traditional absolute monetary poverty and non-monetary dimensions in a single index using the latest HIES 2018-19 dataset. By doing so, this study adds to the limited body of literature on multidimensional poverty in Pakistan. Second, the study employs a logit model to shed light on the demographic characteristics that influence multidimensional poverty at the household level, such as family, population, and employment structures, which have received little research attention. Third, the study offers practical implications that can be used in policies for eliminating multidimensional poverty based on empirical research and regional and provincial heterogeneities.

The remainder of this paper is organized as follows. Section 2 provides a detailed account of the relevant literature. Section 3 explains the study’s data and methodology, including the data sources and statistical description, MPI construction, estimation technique, and descriptive details for the explanatory variables. Section 4 presents the estimation of multidimensional poverty, logistic regression findings, empirical results, and robustness checks. Section 5 presents concluding remarks and policy recommendations derived from the findings.

## Literature review

Poverty can be attributed to the scarcity of human well-being. Traditional poverty analysis is limited to a single dimension based on monetary indicators (e.g., income or

consumption expenditure) of well-being (Gamboa et al. 2020; Jolliffe and Prydz 2016). Sen is one of the pioneers who changed this conception of poverty. According to him, well-being is affected by multiple non-monetary dimensions (basic human capabilities), which are essential in determining poverty status (Braybrooke 2008; Sen 1985). Focusing solely on the monetary dimension is thus insufficient (Kim 2019; Najitama et al. 2020; Salam et al. 2020). The concept of “multidimensional poverty” emerged from Sen’s “capability” approach, which inspired the multidimensional measurement of global poverty. Researchers agree that a multidimensional approach is more appropriate than using a single dimension for quantifying poverty (Alkire and Fang 2019; Alkire and Foster 2011; Dutta et al. 2021).

The United Nations Development Program (UNDP) developed the Human Poverty Index (HDI) in 1997 to measure poverty multidimensionality at national and macro levels. The Oxford Poverty and Human Development Initiative (OPHI) and UNDP jointly introduced the global MPI in 2010 (Alkire and Santos 2010, 2014). Since 2010, the MPI has been considered a significant measure of the non-monetary dimensions of poverty, especially in developing countries (Alkire and Kanagaratnam 2021; Alkire and Foster 2011). The global MPI measures multiple dimensions of poverty by using the household as the unit of analysis, which is then aggregated at the national level. The global MPI was revised in 2018 to align with the SDGs (Alkire et al. 2020; Alkire and Jahan 2018; Alkire and Kanagaratnam 2021). This index covers three dimensions of poverty (i.e., education, health, and living standards) with 10 indicators. In 2018, the World Bank officially adopted the multidimensional poverty concept to monitor global poverty. In the last decade, a scholarly consensus has developed that addressing poverty holistically requires that both of its dimensions be considered (Belete 2021; Bersisa and Heshmati 2021; Mothkoo and Badgaiyan 2021; Santos and Villatoro 2018; Wang et al. 2016). Multidimensional poverty is more common than income poverty in poor households, and worsens more quickly (Liu et al. 2023).

Researchers have shifted from measuring monetary poverty to measuring the multidimensional aspects of poverty in order to advance towards sustainable development goals. For instance, most researchers have measured deprivation in the health dimension (Nawaz and Iqbal 2021). The deprivation of energy sources affects households’ living standards. Energy source deprivation has been identified as an aspect of poverty (Al-Tal et al. 2021; Chishti and Dogan 2022), and researchers are trying to identify its determinants at the national (Xia et al. 2022; Chishti et al. 2023a) and international (Murshed and Ozturk 2023; Chishti and Sinha 2022) levels. Furthermore, researchers have highlighted that achieving green development is an important aspect of economic development (Chishti et al. 2023a; Murshed et al.

2023). Technological and financial innovations are crucial for improving environmental quality and achieving development goals (Chishti and Sinha 2022; Dogan et al. 2022; Murshed et al. 2022).

Household demographic characteristics are crucial factors for assessing poverty status (Ahmad and Faridi 2020; Bayudan-Dacuycuy and Lim 2013; Libois and Somville 2018; Munoz Boudet et al. 2018). The nature, intensity, and dynamics of poverty are associated with individual personal characteristics and household composition. Artha and Dartanto (2018) used the education, health, and quality of life dimensions to measure multidimensional poverty in Indonesia by applying the AF approach. They found that around 61% of monetarily non-poor people were multidimensionally poor, and that most had deprivation-level health indicators. They also found that the household head’s education, household size, house ownership, and location were significant determinants of multidimensional poverty. Chen et al. (2019) applied the AF approach to estimate multidimensional poverty in Taiwan. They identified significant correlations between marital status, age, socioeconomic status, household size, and multidimensional poverty in both Taiwan and China. Similarly, Boudet et al. (2021) conducted a comprehensive analysis of household demography using a dataset of 91 countries, finding that the poverty status of households changed along with changes in their demographic composition, and that demographic characteristics such as household type, age, and sex pattern were important determinants of poverty in poor households.

In summary, extensive empirical analyses have been conducted to identify and estimate poverty. Despite their differences in scope and methodology, the studies all found that alleviating poverty in the monetary and non-monetary dimensions always furthers the achievement of sustainable development goals, and that changes in household demographic characteristics affect multidimensional poverty levels. Hence, an in-depth understanding of poverty and its determining factors at the household level is crucial for developing an appropriate framework and strategy for poverty eradication and sustainable development.

## Data and methodology

### Data sources and sampling

This study used the eleventh round of nationally representative HIES data collected by the Pakistan Bureau of Statistics (PBS) of the government of Pakistan in 2018–19. The HIES contains a sample of 24,809 households from all four of Pakistan’s provinces (Khyber Pakhtunkhwa [KPK], Punjab,

Sindh, and Balochistan). It collects nationally representative data on a wide range of social indicators, including information on the sociodemographic profiles of households, health, education, population welfare, housing characteristics, water and sanitation, income, and consumption.

The PBS employs a stratified two-stage sampling framework. The framework is based on the 2017 population and housing census to ensure sufficient provincial and regional representation. The country is divided into enumeration blocks, which were selected as primary sampling units using a probability proportional to the size sampling technique. Households in specific primary sampling units were selected as the secondary sampling units. The detailed sampling procedure and data are presented on the official website of the PBS.<sup>1</sup>

This study selected the HIES 2018-19 dataset for its empirical investigation for two main reasons. First, the PBS revised the survey questionnaire and added innovative modules to monitor the social and economic indicators of the SDGs (Awan et al. 2022). Second, it provides thorough information on both monetary (consumption expenditure) and nonmonetary indicators, such as household health, education, and living standards, to enable a multidimensional measure of poverty in Pakistan. This satisfies the AF methodological requirement that the data for each multidimensional poverty indicator be derived from the same survey and be linked to the household (or individual) level (Alkire and Foster 2011).

## Methodology

### Multidimensional poverty: Construction of MPI

This study employs Alkire and Foster's (Alkire and Foster 2011) method, which is based on Sen's capability approach, to estimate multidimensional poverty. The AF method utilizes a comprehensive set of poverty measures based on the FGT class's poverty measures (Foster et al. 1984) and the counting approach (Atkinson et al. 2002), enabling the consistent measurement of both cardinal and ordinal data.<sup>2</sup> This method is simple and flexible enough to permit a detailed examination of multiple aspects of the multidimensional concept of poverty, which includes monetary poverty as one of several poverty dimensions (Evans et al. 2020).

This methodology constructs the MPI through a dual-cutoff (deprivation and poverty cutoff) approach.<sup>3</sup> In a population with  $n$  persons, the primary information is usually represented by an  $n \times d$  dimensional matrix  $X[x_{ij}]$ , where  $x_{ij}$  denotes the achievement of person  $i$  in dimension  $j$ . The  $d$ -dimensional row vector  $z = (z_1, \dots, z_d)$  is used to produce the deprivation cutoff  $z_j$ . The person  $i$  is considered non-deprived in dimension  $j$  if the person's achievement  $x_{ij} \geq z_j$ . Then, a deprivation matrix  $g^0[g_{ij}^0]$  is obtained from matrix  $X$  and vector  $Z$ , where person  $i$  is considered non-deprived if  $x_{ij} \geq z_j$  and  $g_{ij}^0 = 0$  and is considered deprived if  $x_{ij} < z_j$   $g_{ij}^0 = 1$ . The  $d$ -dimensional weight vector  $w = (w_1, \dots, w_d)$  reflects the relative importance of each dimension ( $\sum_{j=1}^d w_j = 1$ ). The weighted deprivation score of person  $i$  is denoted as  $c_i$ , computed as  $c_i = \left( \sum_{j=1}^d w_j g_{ij}^0 \right)$  and commonly known as the "deprivation score" of person  $i$ . If a person is deprived of all dimensions, then  $c_i = 1$ ; similarly,  $c_i = 0$  when person  $i$  is not deprived of all dimensions.

Furthermore, a poverty cutoff of  $k$  ( $0 < k \leq 1$ ) and an indicator function  $\rho k(x_i, z)$  are used to identify the multidimensional poor. A person is considered poor if  $c_i > k$  and  $\rho k(x_i, z) = 1$ ; otherwise,  $c_i < k$ ,  $\rho k(x_i, z) = 0$ . Thus, the multidimensional poverty headcount ( $H$ ) can be presented as  $H = (q/n)$ , where  $q = \sum_{i=1}^n \rho k(x_i, z)$ , which indicates the proportion of the poor population.  $H$  explains the incidence of multidimensional poverty but does not represent each dimension's contribution to poverty.<sup>4</sup> To address this issue, Alkire and Foster (2011) proposed several other indices. They defined dimension  $j$ 's censored headcount ratio as  $h_i(k) = \frac{1}{n} \sum_{i=1}^n g_{ij}^0(k)$ , where  $g_{ij}^0(k) = g_{ij}^0(k) \times \rho k(x_i, z)$  denotes the censored deprivation matrix. The intensity of poverty ( $A$ ) in the poor population is given by  $A = \sum_{i=1}^q c_i(k) / q = \sum_{i=1}^q \sum_{j=1}^d w_j g_{ij}^0(k)$ , where  $c_i(k) = \sum_{j=1}^d w_j g_{ij}^0(k)$  is the censored deprivation score of person  $i$ . The aggregation phase in the AF methodology employs an adjusted headcount ratio ( $M^0$ ), also known as the MPI. The MPI ( $M^0$ ) combines two types of information: the multidimensional headcount ratio ( $H$ ) and intensity of poverty ( $A$ ):

$$MPI = M^0 = H \times A = \frac{1}{n} \sum_{i=1}^n c_i(k) = \frac{1}{n} \sum_{i=1}^n w_j h_i(k) \quad (1)$$

<sup>1</sup> See <https://www.pbs.gov.pk/content/pslm-hies-2018-19-provincial-level-survey>.

<sup>2</sup> A detailed overview of the AF method is available in Alkire and Foster (2011) and Alkire S., Chatterjee M, Conconi A., Seth S. (2015).

<sup>3</sup> The first deprivation cut-off is used to determine the poor in each indicator. This cut-off specifies the least level of attainment required to be judged non-deprived in each MPI indicator. Then, a second poverty cut-off  $\kappa$  is used to determine the multidimensional poor across dimensions.

<sup>4</sup> The headcount ratio ( $H$ ) does not satisfy the property of dimensional monotonicity (Azeem et al. 2016).

where  $H$  represents the percentage of multidimensionally poor individuals in the total population, and  $A$  is the average proportion of indicators in which poor people are deprived. Here, MPI can be defined as the proportion of deprivation experienced by a multidimensionally poor person as a share of the deprivation that would be experienced if the entire population were multidimensionally poor and deprived of all the indicators considered.

## Dimensions and indicators of MPI

The selection of dimensions and indicators for developing an MPI is a normative decision and an initial step in the empirical valuation of poverty (Alkire and Seth 2015; Firdausy and Budisetyowati 2022). With this in mind and following the literature on multidimensional poverty measures (Alkire and Santos 2014; Alkire and Foster 2011) we selected the education, health, living standards, and monetary poverty dimensions to construct our MPI. The living standards, education, and health dimensions are similar to those of the traditional global MPI; however, some indicators have been adjusted to allow for data availability. The global MPI is sufficiently flexible to include additional dimensions, indicators, and changes to the weighting scheme. This allows a detailed analysis of multidimensional poverty, particularly by counting country-specific dimensions and indicators. We included monetary poverty as an additional dimension, assuming that monetary deprivation combined with multidimensional deprivation captures a comprehensive picture of overall deprivation (Evans et al. 2020). The MPI consists of four dimensions and 11 indicators, including two for education and health, six for living standards, and one for monetary poverty.

The education dimension comprises the household members' number of years of schooling and the children's school attendance. These two indicators reflect a household's fundamental educational ability and attainment (Alkire and Santos 2014; Yu 2013). This education dimension is consistent with the global MPI (Alkire and Santos 2010). Education level is a key dimension of multidimensional poverty, and numerous studies have found that education level positively influences poverty reduction (Debebe and Wuletaw 2022; Tran et al. 2020).

This study used child mortality and the availability of health service indicators to measure household deprivation in the health dimension. The association between health status and poverty has been extensively discussed in the empirical literature. Health has been identified as one of the top contributing factors to multidimensional deprivation (Chen et al. 2019) because physical vulnerability may limit a person's freedom and functional scope (Callander et al. 2013). In empirical research, health-related indicators, such as nutrition, child mortality, access to basic health services,

and health insurance, have been extensively employed as health deprivation measures with a major impact on economic welfare (Alkire and Santos 2010; Cheema 2021; Cheema and Nadeem 2020).

This study considered five indicators (availability of safe drinking water, sanitation facilities, housing quality, cooking fuel, electricity, and small asset ownership) to assess household living standards. For the living standards dimension, most studies have used indicators such as electricity, sanitation, drinking water, cooking fuel, flooring, and assets to assess deprivation (Alkire and Jahan 2018; Alkire and Santos 2010). Possession of durable assets (such as televisions, radios, animal carts, telephones, bicycles, motorbikes, and refrigerators) has been used as a poverty indicator in several empirical studies (Alkire and Santos 2014; Pham and Mukhopadhaya 2022).

The fourth dimension comprised information on the deprivation of the households' monetary well-being. The World Bank considers the monetary dimension, a common and robust measure of well-being, a principal measure of poverty. The study considered only one indicator, household per-capita consumption expenditure (the sum of food and non-food expenditures), in this dimension. Household per-capita consumption is a significant indicator of monetary well-being (Bersisa and Heshmati 2021). Based on the internationally defined poverty line for developing economies, households unable to meet a per-capita consumption expenditure equal to \$1.90 per day were considered deprived in the monetary dimension (Jolliffe and Prydz 2016).

## Weights and poverty cut-off

Selecting weights for the dimensions and indicators is another crucial step in the development of the MPI. However, there is no consensus regarding a single standard method. Three weighting methods—frequency-based, expert opinion, and equal weights—are commonly used in the literature; each method has its advantages and disadvantages (Decancq and Lugo 2010; Deyshappriya and Feeny 2021). Most research on multidimensional poverty assigns equal weight to all dimensions and indicators within each dimension (Alkire et al. 2017; Alkire and Santos 2010). In the absence of a justifiable reason for assigning unequal weights to each dimension, it seems logical to use equal weights to measure multidimensional poverty (Atkinson et al. 2002; Chakravarty et al. 2008). We assigned equal weights (0.25) to each dimension given the equal importance of all dimensions and following the AF (2011) approach. The same method was followed for indicators within the dimensions. The definitions, weights, and descriptive statistics of the dimensions and indicators are presented in Table 1.

The poverty cut-off  $k$  reflects the lowest level of deprivation that needs to be identified for a household to be considered

**Table 1** Definitions, weights, and descriptive statistics of MPI components

Dimension/Indicator	Deprivation cut-off (deprived if...)	Weight	Mean	SD
<b>Education</b>				
Year of schooling	No household member older than age 10 completed 6 years or more than 6 years of education	0.125	0.39	0.48
School attendance	Any child between ages 6 and 11 years is not attending school	0.125	0.17	0.37
<b>Health</b>				
Basic health facilities	No visit by a health worker during the last 30 days	0.125	0.55	0.49
Child mortality	Any child less than age 5 ever died in the family	0.125	0.09	0.28
<b>Living Standards</b>				
Drinking water	The drinking-water source of the household is not safe, or is a 30-minute walk from home for a round trip <sup>a</sup>	0.041	0.26	0.44
Sanitation	The household has no sanitation facility, or it is shared with other households	0.041	0.23	0.42
Housing quality	The roof of the house is made of wood or bamboo	0.041	0.28	0.45
Fuel for cooking	The household cooks with dung, charcoal, wood, or coal	0.041	0.55	0.49
Electricity	The household has no electricity facility	0.041	0.11	0.31
Asset ownership	The household does not own more than one of these assets: TV, radio, animal cart, telephone, bicycle, motorbike, refrigerator, and car	0.041	0.34	0.45
<b>Monetary poverty</b>				
Per-capita consumption expenditures	Per-capita consumption expenditure of household is less than \$1.90 per day <sup>b</sup>	0.25	0.50	0.49

<sup>a</sup>Safe water sources include public taps, hand/motor pumps, closed wells, filtration plants, protected springs, and piped water

<sup>b</sup>Per-capita consumption expenditure in Pakistani rupee converted into US dollar using purchasing power parity (PPP). In 2019, the PPP exchange rate was US\$1 = PKR 150.036. See <https://data.worldbank.org/indicator/PA.NUS.FCRF?locations=PK>.

multidimensionally poor in a particular situation. Two extreme methods are used to identify poverty in the literature: the intersection method (where the household is considered multidimensionally poor if it is deprived in all indicators) and the union method (where the household is considered multidimensionally poor if it is deprived in at least one indicator) (Atkinson et al. 2002). However, the AF dual-cutoff method offers an intermediate choice between the intersection and union methods. This implies an intermediary poverty cutoff (i.e., 0.33) for global MPI (Ambros and Saxena 2018; Alkire and Kanagaratnam 2021). For the AF, the 0.25 poverty cut-off value ranges from 0 to 1, where 0 indicates non-poor households and 1 indicates completely poor households. This was used in this study to identify multidimensionally deprived households. Households were considered multidimensionally poor if they were deprived of 0.25 of weighted indicators within a dimension or across dimensions. This is qualitatively equivalent to a 0.33 global MPI poverty cut-off. At a 0.25 poverty cut-off point, the MPI value identifies poor households in the monetary poverty dimension, in terms of global MPI dimensions, or in both (Evans et al. 2020).

### Household demographic characteristics

The key explanatory variables in this study were household demographic characteristics, operationalized as household family, household population, and household employment characteristics. Household demographic characteristics are crucial for assessing households' poverty status (Ahmad and

Faridi 2020; Bayudan-Dacuycuy and Lim 2013; Libois and Somville 2018; Munoz Boudet et al. 2018), which changes along with changes in demographic characteristics (Boudet et al. 2021). Key family characteristics include family size and type (whether the house is separate or joint). Dependency and child ratios are key household population characteristics. The youth employment ratio, female employment ratio, and labor force ratio were used as household employment characteristics.

### Specification of econometric model

This study applied logistic regression to analyze the impact of household demographic characteristics on the multidimensional poverty status of households. The poverty status of the household ( $POV_i$ ) is a dichotomous variable indicating that a household is poor if the multidimensional deprivation score  $c_i \geq$  the selected  $k$ , as shown in Equation 2:

$$POV_i = \begin{cases} = 1, & \text{if } c_i \geq 0.25 & \text{household is poor} \\ = 0, & \text{if } c_i < 0.25 & \text{household is non - poor} \end{cases} \quad (2)$$

Logistic estimation is the best method for dichotomous dependent variables (Ambros and Saxena 2018; Greene 2003; Sperandei 2014). Hence, this study used the following logistic regression model to analyze the empirical relationship between household demographic characteristics and multidimensional poverty in Pakistan:

**Table 2** Description of variables and statistical summary

Variable	Description	Mean	SD
<b>Dependent variable</b>			
Multidimensional Poverty	The household’s deprivation score (the weighted sum of the deprivation score across all dimensions). The household is considered poor if the weighted deprivation score is equal to or more than the 0.25% poverty cut-off point (poor = 1, non-poor = 0)	0.35	0.23
<b>Independent variable</b>			
<b>Demographic characteristics</b>			
Size of family	Total number of household members living together in the household	6.44	3.22
Type of family	Family lives in separate/independent house = 1, joint = 0	0.76	0.42
Dependency ratio	Total number of household members (below age 15 and above age 64) to the working-age members of the household (between ages 15 and 64)	1.00	0.94
Child ratio	Total number of children in the household (below age 15) to total members of the household	0.36	0.23
Youth employment ratio	Total number of employed young household members (between age 15 to 29) to the labor force	0.27	0.23
Female employment ratio	Total number of employed female household members (between ages 15 and 64) to the labor force	0.11	0.26
Labor force ratio	Working-age members of the household (between ages 15 and 65) to total household members	0.58	0.23
<b>Control Variable</b>			
Age	Age of household head in years	45.81	13.6
Gender	Gender of household head; male = 1, female = 0	0.45	0.49
Marital status	Marital status of household head; married =1, otherwise = 0	0.90	0.29
Education	Education status of household head in years	4.93	5.11
Health status	Household head was ill during last 3 months: yes = 1, no = 0	0.41	0.49
Ownership of property (log value)	Monetary value of commercial and residential buildings owned by household members	11.68	4.98
Remittances (log value)	Monetary value of remittances received by the household	1.26	3.65
Region	Region of household; urban =1, rural =0	0.35	0.47
KPK	Province of residence of household KPK = 1, otherwise = 0	0.18	0.38
Punjab	Province of residence of household Punjab = 1, otherwise = 0	0.47	0.49
Sindh	Province of residence of household Sindh = 1, otherwise = 0	0.25	0.43
Balochistan	Province of residence of household Balochistan = 1, otherwise = 0	0.09	0.29

$$\begin{aligned}
 POV_i = \ln\left(\frac{P_i}{1 - P_i}\right) &= \beta_0 + \beta_1 Hs_i + \beta_2 Ft_i \\
 &+ \beta_3 Dr_i + \beta_4 Cr_i + \beta_5 Ye_i + \beta_6 Fe_i + \beta_7 Lf_i \\
 &+ \beta_8 X_i + U_i
 \end{aligned}
 \tag{3}$$

where  $POV_i$  denotes the natural log of the odds ratio. A household is identified as multidimensionally poor if  $P_i=1$  and non-poor if  $P_i=0$ . Seven variables related to family, household population, and household employment characteristics were used to capture household demographic characteristics. Family characteristics were assessed by considering family size  $Hs_i$  and family type  $Ft_i$  (whether the house is separate or joint). The household’s population characteristics were assessed via the dependency ratio  $Ft_i$  of the family to-child ratio  $Cr_i$ . Household employment characteristics were assessed by considering the youth employment ratio  $Ye_i$ , female employment ratio  $Fe_i$ , and labor force ratio  $Lf_i$ .  $X_i$  denotes the vector of control variables that are potentially correlated with the household poverty status. We controlled for household head characteristics (i.e., age, gender, marital status, education, employment status), ownership of

property by household, remittances received by the household, and region and province of residence.  $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8$  are the parameters, and  $U_i$  is the error term. The detailed description and summary statistics of variables are presented in Table 2.

Furthermore, the study investigated the impact of household demographic characteristics on multidimensional poverty independently for urban and rural regions and each province in Pakistan using Equation 3.

## Empirical results and discussion

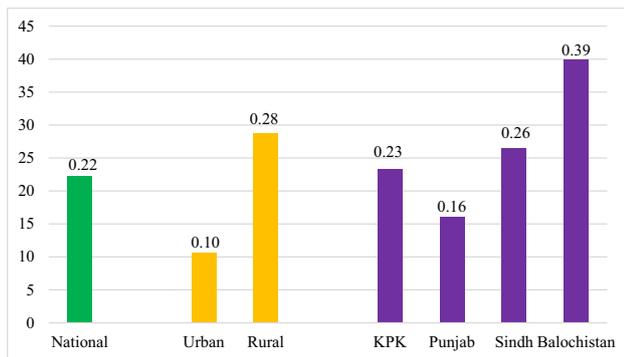
### Multidimensional poverty estimation and decomposition

The MPI is equal to the mean  $ci(k)$ . It satisfies the axioms of weak monotonicity, dimensional monotonicity, population subgroup decomposability, and ordinality (Alkire et al. 2015). Population subgroup decomposition implies that the MPI,  $H$ ,  $A$ , and each dimension/indicator can be disaggregated by any group for which the data represent subgroup

**Table 3** MPI estimates at national, provincial, and regional levels

	H (SE)	A (SE)	MPI (H*A) (SE)
National	48.8 (0.003) ***	45.6 (0.001) ***	0.22 (0.003) ***
Urban	27.1 (0.001) ***	39.2 (0.001) ***	0.10 (0.001) ***
Rural	60.3 (0.001) ***	47.2 (0.001) ***	0.28 (0.001) ***
KPK	52.5 (0.001) ***	44.3 (0.001) ***	0.23 (0.001) ***
Punjab	39.0 (0.001) ***	41.3 (0.001) ***	0.16 (0.001) ***
Sindh	54.8 (0.001) ***	48.4 (0.001) ***	0.26 (0.001) ***
Balochistan	75.2 (0.001) ***	53.0 (0.001) ***	0.39 (0.001) ***

Values in parentheses are standard errors

**Fig. 1** National, regional, and provincial multidimensional poverty in Pakistan

poverty levels. The MPI was used to estimate multidimensional poverty in Pakistan and further decompose it according to region, province, and dimension to investigate its contribution to overall poverty.

Table 3 and Fig. 1 present the multidimensional poverty estimates. The MPI value is 0.22 at the national level, indicating that 22% of Pakistani households are multidimensionally deprived in 25% of the selected dimensions (see Fig. 1).<sup>5</sup> The national headcount ratio (H) is 48.8%, and the intensity of poverty (A) is 45.6% (see Table 4). A close look at Fig. 1 reveals a significant variation in regional multidimensional poverty, as the MPI value is 0.28 in rural regions and 0.10 in urban regions. Furthermore, the provincial results highlight heterogeneities in the MPI values. For example, Punjab is the least multidimensionally poor province, with a 0.16 MPI

value. The proportion of multidimensional poverty is highest in Baluchistan, followed by Sindh and KPK, with MPI values of 0.39, 0.26, and 0.23, respectively.

The contributions of the poverty dimensions to the national, regional, and provincial MPIs are shown in Fig. 3. The education dimension contributes 28% to national multidimensional poverty, followed by living standards (25%), monetary poverty (23%), and health (22%). The highest share of the education dimension in the MPI is observed at the regional and provincial levels, as shown in Fig. 2. The contributions of education, living standards, and monetary dimensions differ between urban and rural regions and across provinces. For instance, the contribution of the monetary dimension to the MPI is lowest in KPK province, while the share of the health dimension is lowest in Sindh province. Likewise, the living standards dimension was the second-highest contributor to the rural MPI but the lowest contributor to the urban MPI. Interestingly, the dimension contribution patterns are similar between the most-deprived (rural and Balochistan) and least-deprived (urban and Punjab) regions and provinces.

Figure 3 shows the percentages of Pakistani households deprived of each of the 11 indicators. Most of the households are deprived of basic health facilities (56.06%), followed by cooking fuel (55.09%), years of schooling (39.51%), and asset ownership (34.91). Cooking with dung, charcoal, wood, or coal produces considerable volumes of indoor air pollution, resulting in health problems, particularly for rural females. The deprivation percentages of households in terms of child mortality (9.13%) and access to electricity (11.04%) were quite low, indicating that Pakistan has improved significantly in terms of child health and the power sector. The percentages of deprived households in urban and rural regions and provinces are presented in Appendix Table 6.

## Demographic characteristics of multidimensional poverty: Logistic regression results

Table 4 presents the regression results for the national sample, urban and rural regions, and the four provinces. The logistic regression coefficients in the estimated models in Table 4 are the natural logarithms of the odds ratios. All the variables presented in Column 1 are statistically significant. The log-likelihood ratio indicates the statistical significance of the model at the 1% level. Household demographic characteristics have a significant impact on defining multidimensional poverty status. The signs of all the predicted coefficients are consistent with traditional economic concepts.

## Family characteristics

The estimated results shown in Column 1 indicate that family characteristics are inextricably linked to a household's multidimensional poverty level. The household likelihood of being

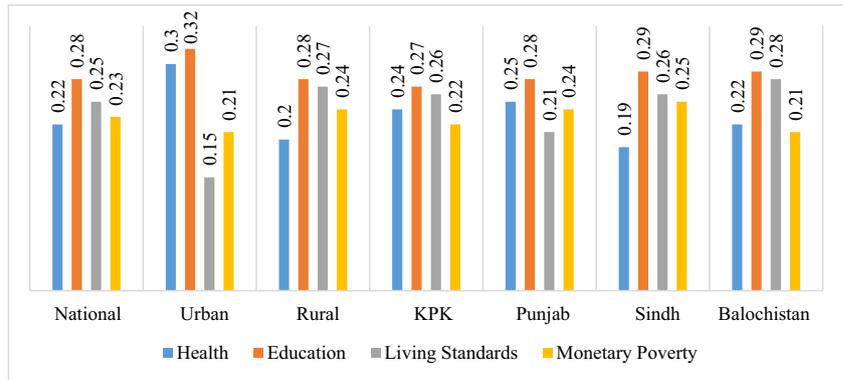
<sup>5</sup> We computed the MPI estimates in STATA using the “*mipi*” command introduced by Pacifico and Poege (2017).

**Table 4** Impact of household demographic characteristics on multidimensional poverty at national, regional, and provincial levels (logistic regression results)

	National (1)	Regional		Provincial			
		Urban (2)	Rural (3)	KPK (4)	Punjab (5)	Sindh (6)	Balochistan (7)
<b>Family Characteristic</b>							
Family size	0.177*** (0.013)	0.162*** (0.020)	0.192*** (0.018)	0.154*** (0.026)	0.211*** (0.020)	0.154*** (0.028)	0.153** (0.062)
Family type (separate = 1)	-0.246*** (0.039)	-0.087 (0.072)	-0.245*** (0.049)	-0.199** (0.091)	-0.105* (0.057)	-0.613*** (0.078)	-0.495* (0.281)
<b>Population characteristic</b>							
Dependency ratio	0.293*** (0.036)	0.284*** (0.067)	0.282*** (0.043)	0.249*** (0.074)	0.244*** (0.046)	0.505*** (0.101)	0.550*** (0.184)
Child ratio	0.176*** (0.034)	0.217*** (0.059)	0.168*** (0.043)	0.197*** (0.071)	0.178*** (0.046)	0.213** (0.093)	0.360** (0.181)
<b>Employment characteristic</b>							
Youth employment	-0.395*** (0.093)	-0.615*** (0.138)	-0.275*** (0.101)	-0.565*** (0.156)	-0.401*** (0.122)	-0.562*** (0.142)	-0.368 (0.270)
Female employment	-0.126* (0.012)	-0.379*** (0.144)	-0.102*** (0.068)	-0.119 (0.159)	-0.418** (0.116)	-0.409** (0.175)	-0.290* (0.221)
Labor force	-0.421*** (0.066)	-1.801*** (0.285)	-1.663*** (0.171)	-1.631*** (0.338)	-1.775*** (0.191)	-0.745* (0.380)	-0.889 (0.752)
<b>Control variable</b>							
Age	-0.019*** (0.001)	-0.015*** (0.003)	-0.019*** (0.001)	-0.019*** (0.003)	-0.018*** (0.002)	-0.019*** (0.003)	-0.0217*** (0.006)
Gender (male = 1)	-0.046 (0.039)	-0.167** (0.066)	0.011 (0.048)	0.047 (0.084)	-0.057 (0.055)	-0.146* (0.087)	-0.076 (0.148)
Marital status (married = 1)	0.012 (0.060)	0.050 (0.107)	-0.007 (0.074)	0.131 (0.150)	-0.036 (0.076)	0.141 (0.148)	0.362 (0.274)
Education	-0.216*** (0.003)	-0.210*** (0.006)	-0.218*** (0.004)	-0.182*** (0.007)	-0.230*** (0.005)	-0.228*** (0.007)	-0.217*** (0.012)
Health status (ill = 1)	0.086** (0.040)	0.058 (0.0613)	0.129** (0.0543)	0.064 (0.100)	0.107* (0.055)	0.167** (0.083)	0.339* (0.184)
Property ownership	-0.035*** (0.003)	-0.025*** (0.004)	-0.058*** (0.006)	-0.044*** (0.007)	-0.042*** (0.004)	-0.021*** (0.007)	-0.041*** (0.014)
Remittances	-0.013*** (0.004)	-0.003 (0.010)	-0.011** (0.005)	-0.013 (0.008)	-0.008 (0.005)	-0.019 (0.026)	0.021 (0.057)
Region (urban = 1)	-1.620*** (0.037)			-1.305*** (0.082)	-1.423*** (0.054)	-2.051*** (0.075)	-1.636*** (0.128)
KPK (Balochistan reference category)	-1.022*** (0.074)	-0.779*** (0.113)	-1.115*** (0.099)				
Punjab	-1.586*** (0.067)	-1.361*** (0.102)	-1.664*** (0.092)				
Sindh	-0.618*** (0.070)	-0.811*** (0.102)	-0.384*** (0.101)				
Constant	2.953*** (0.174)	0.705** (0.300)	3.327*** (0.225)	1.334*** (0.357)	1.580*** (0.219)	2.363*** (0.371)	1.528** (0.697)
Pseudo R2	0.322	0.255	0.254	0.249	0.275	0.401	0.332
Log likelihood	-11097.60	-3960.31	-7591.71	-2296.26	-5843.27	-2529.46	-830.77
Chi-squared	6210.28	1878.95	3457.02	990.81	2850.50	1764.73	547.63
Degrees of freedom	18	17	17	15	15	15	15
Observations	24809	8873	15936	4485	11781	6216	2327

Values in parentheses are robust standard errors; \*\*\*, \*\*, and \* indicate significance at  $p < 0.01$ ,  $p < 0.05$ , and  $p < 0.1$ , respectively.

**Fig. 2** Percentage contribution of dimensions to national, regional, and provincial MPIs



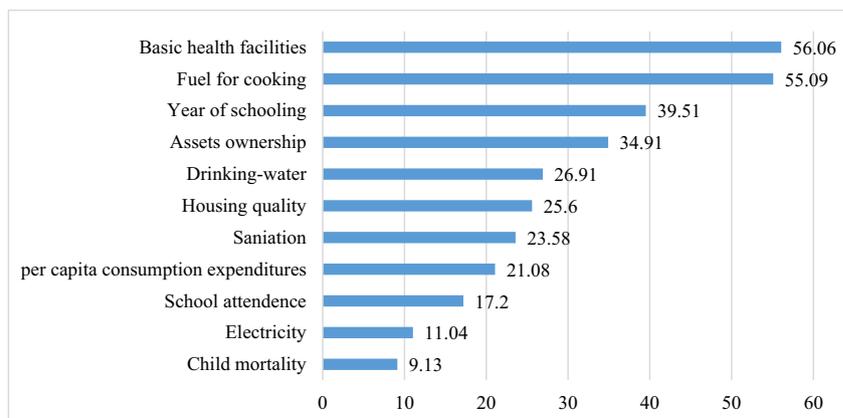
poor increases by 0.17% with a unit increase in household size. These findings can be explained in the context of household liabilities, which tend to increase along with the number of household members. These results are consistent with those of previous studies (Chen et al. 2019; Libois and Somville 2018). The dwellings in which people live play a vital role in determining their lives and well-being. The nuclear or separate dwelling setting negatively affects multidimensional poverty; households living in separate dwellings are 0.24% less likely to be poor than coupled/joint households. A joint family system is prevalent in Pakistani culture, with multiple families living together and often sharing their livelihoods. These shared households tend to be overcrowded and have fewer earners, resulting in financial strain and reduced living space. Consequently, the household members often lack access to adequate living facilities. On the other hand, independent householders have better access to basic amenities, such as electricity, sanitation, water, and healthcare, making them less likely to experience multidimensional poverty. These results support the findings of Mahmood et al. (2019).

**Population characteristics**

The indicators of household population characteristics—the household dependency and child ratios—contribute

positively to multidimensional household poverty, consistent with theoretical forecasts. The probability of being multidimensionally poor increases by 0.29% with additional dependents. Having a sizable unproductive population increases a household’s burden, which increases the likelihood of multidimensional poverty. This finding aligns with the results of Salam et al. (2020) and Najitama et al. (2020), who found that the household dependency ratio was a traditional factor in multidimensional poverty. The child ratio is another important determinant of increased poverty in developing countries. Overall, these findings emphasize the importance of considering household demographics when formulating policies intended to reduce multidimensional poverty. The results in Column 1 show that an increase in the child ratio increases the likelihood of households being multidimensionally poor by 0.17%. These findings are similar to those of previous studies, which have suggested that additional children in a household increases the likelihood of the household falling into poverty and fosters the intergenerational transmission of poverty (Fabrizi and Mussida 2020; Munoz Boudet et al. 2018). The empirical results show that households with higher child ratios are more likely to be multidimensionally poor. This finding is consistent with theoretical expectations and is supported by the sociocultural context in Pakistan, where having more

**Fig. 3** Percentage of deprived households by indicator



children is preferred and early marriage is common. Women in such households have limited autonomy in their reproductive health decision-making and often face health risks due to increased childbearing. Moreover, a high child ratio increases the household dependency ratio, resulting in a greater burden on the household and leading to a higher likelihood of multidimensional poverty. This result is consistent with the findings of other studies, including Salam et al. (2020) and Najitama et al. (2020), who identified the child ratio as a contributing factor to multidimensional poverty. In summary, the empirical results suggest that the high child ratio in Pakistani households exacerbates the risk of multidimensional poverty. Policymakers should address this issue through targeted interventions designed to improve women's reproductive health, education, and access to employment opportunities.

### Employment characteristics

Household employment characteristics were captured by three indicators: youth employment, household labor force, and female economic participation. The results demonstrate that the engagement of young people in economic activities reduces the likelihood of being multidimensionally poor by 0.39% at the household level in Pakistan. Investing in youth through training, education, and job opportunities in both the public and private sectors can be a key strategy for achieving the SDGs and promoting long-term development in Pakistan. The labor force ratio of households reduced the probability of being multidimensionally poor by 0.42%. As an essential demographic factor, the labor force ratio can help reduce the likelihood of multidimensional poverty. Households with a large proportion of working-age members are more likely to escape poverty. In addition, the results highlight that the participation of more female family members in the labor market lowers the probability of being multidimensionally poor by 0.12%. The findings of this study are similar to those of previous studies (Mulugeta 2021; Sohail 2014). Given Pakistan's male-dominated social structure and the limited opportunities available to females in terms of education, decision-making, and earnings, promoting greater female participation in the labor force could have significant positive impacts on the nation's economy and society as a whole.

Columns 2 and 3 of Table 4 present the regional results and columns 4 to 7 the provincial results regarding the effect of the household demographic characteristics on multidimensional poverty subgroups. Overall, the results are similar to the main findings, with a few variations. The demographic characteristics of urban and rural regions show effects on poverty status like those shown for the national level. However, family type does not have a significant impact on household poverty in urban regions. The results regarding the family structure, population structure, and employment

structure characteristics for the Punjab and Sindh provinces are similar to those shown at the national level. Moreover, the results indicate that all household demographic indicators except the youth employment and labor force ratios are significant contributors to multidimensional poverty in Balochistan province households. The empirical findings suggest that the female employment ratio does not have a significant impact on multidimensional poverty in the KPK. This can be attributed to the conservative cultural and social norms prevalent in these areas, which limit women's participation in economic activities. In such areas, women's roles are typically confined to household chores and child rearing, and their access to education and employment opportunities is limited. As a result, the female employment ratio had a negligible effect on reducing multidimensional poverty in KPK. This finding is consistent with the literature on gender inequality and poverty in developing countries, highlighting the need to address cultural and social barriers to women's economic empowerment in order to promote sustainable and inclusive development.

Most of the control variables—such as household head characteristics, ownership of property by households, remittances received by households, and region and province of residence—significantly affect the multidimensional poverty status of households, consistent with the literature.

### Robustness and diagnostic checks

We used alternative multidimensional poverty cut-offs as a robustness analysis to measure the sensitivity of the multidimensional poverty estimates, as shown in Table 5. The results indicate that the overall MPI value and H decreased as poverty cut-offs increased, whereas A increased along with higher poverty cut-offs. This result indicates that MPI, H, and A are sensitive to changes in poverty cut-off values. The poverty ranking between regions and provinces remained robust at various cut-off values. The rural region is poorer than the urban region, and Balochistan is the poorest province, followed by Sindh, KPK, and Punjab at all cut-offs.

We evaluated the accuracy of our estimated model using the receiver operating characteristic (ROC) curve diagnostic test, which is a graph of sensitivity versus one minus specificity, to differentiate between sensitivity and specificity (Zou et al. 2007). Here, sensitivity is the likelihood of accurately identifying positive multidimensionally poor households that are correctly classified, and specificity is the likelihood of correctly identifying true negative multidimensionally non-poor households. The ROC curve test results in Fig. 4 show that the area under the ROC curve for logistic regression is 0.84, which is sufficiently large to imply that our model correctly classified the negative and positive outcomes. Hence, the model is deemed sufficiently accurate for analysis.

**Table 5** Multidimensional poverty estimates at different poverty cut-offs

Poverty estimates		0.25	0.33	0.50
National	H	48.8	36.5	18.6
	A	45.6	51.8	64.1
	MPI (H*A)	0.22	0.18	0.11
Urban	H	27.1	15.0	6.3
	A	39.2	49.1	62.8
	MPI (H*A)	0.10	0.07	0.04
Rural	H	60.3	48.5	25.4
	A	47.2	52.3	64.3
	MPI (H*A)	0.28	0.25	0.16
KPR	H	52.5	39.6	18.5
	A	44.3	49.9	62.3
	MPI (H*A)	0.23	0.19	0.11
Punjab	H	39.0	26.7	10.8
	A	41.3	47.9	61.4
	MPI (H*A)	0.16	0.12	0.06
Sindh	H	54.8	42.9	25.0
	A	48.4	54.3	65.0
	MPI (H*A)	0.26	0.23	0.16
Balochistan	H	75.2	63.1	41.0
	A	53.0	58.0	67.9
	MPI (H*A)	0.39	0.36	0.27

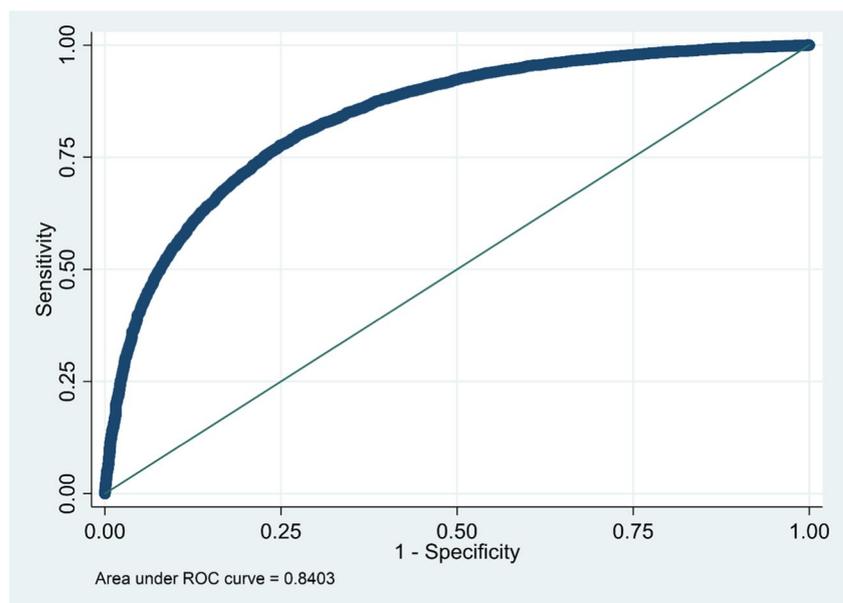
## Conclusion and policy recommendations

This study measured poverty in Pakistan from multiple dimensions and analyzed the impact of household demographic characteristics on multidimensional poverty using

the HIES 2018-19 dataset. The study developed an MPI for Pakistan to capture the non-monetary and monetary dimensions of household poverty using the AF methodology. The MPI comprises four equally weighted dimensions: education, health, living standards, and monetary poverty. One of the unique benefits of the MPI is that it enables a joint estimation of the monetary and nonmonetary dimensions of household poverty.

This study provides fresh estimates, finding that 22% of Pakistani households suffer multidimensional poverty in 25% of the selected poverty dimensions, as reflected by monetary and non-monetary indicators. Moreover, the study finds heterogeneity in multidimensional household poverty status between regions and across provinces. The poverty ranking between regions and provinces is robust to various poverty cut-offs. The MPI was significantly higher in rural regions, indicating that poverty is more evident in rural areas. Baluchistan has the highest poverty level among the provinces, which calls for urgent action. The contribution of the education dimension to multidimensional poverty is highest at the national, regional, and provincial levels. Most households are deprived of basic health facilities, indicating that the health system in Pakistan is inefficient and cannot provide sufficient healthcare facilities (Kurji et al. 2016; Farooq and Ali 2020).

Further, logistic regression was employed to explore the impact of household demographic characteristics (i.e., family size, family type, child ratio, dependency ratio, youth employment ratio, female employment ratio, labor force ratio) on multidimensional household poverty. The results show that large demographic characteristics have significant effects on households' multidimensional

**Fig. 4** ROC for the estimated model

poverty status. The evidence suggests that households with greater household sizes, dependency ratios, and child ratios are more likely to be poor. The findings also indicate that female economic participation reduces the probability of households being multidimensionally poor. Similarly, the engagement of young people in employment activities significantly reduces multidimensional poverty.

The empirical results offer important implications useful for policies aimed at eliminating multidimensional poverty. First, the MPI findings suggest that policymakers should consider both monetary and nonmonetary dimensions when attempting to address multidimensional poverty. Government institutions should also carefully consider regional disparities when designing policies intended to alleviate poverty. One approach could be to conduct a comprehensive analysis of poverty and its determinants at the sub-national level, identifying the areas and populations most in need of assistance. Based on this analysis, the government could allocate resources more effectively and implement targeted poverty-reduction programs in these areas. The government could also prioritize infrastructure development in the regions most affected by poverty. This would include improving access to basic services, such as education, health care, clean water, and sanitation. Governments could also work to enhance transportation networks, communication systems, and electricity supplies, which are critical to economic growth and poverty reduction. Moreover, the government should undertake initiatives to expand access to primary and secondary school education for

poor households across the country. Health infrastructure should be strengthened through the construction of more hospitals and by increasing the number of medical personnel to ensure sufficient basic health facilities for poor households. Social protection programs targeting vulnerable households, such as cash transfers, can also help reduce monetary poverty. Second, this study finds that households with higher dependency and child ratios are more likely to be multidimensionally poor. These findings suggest the need for effective policies aimed at controlling population growth, such as introducing social awareness programs to educate about family planning services, particularly in rural areas. Subsidies for family planning services should also be provided to low-income households. Third, the study finds that female and youth participation in the labor market is associated with lower multidimensional poverty. This finding suggests the need for more employment opportunities and the creation of an environment conducive to increasing female and youth labor market participation. Policies for promoting gender equality, such as providing equal access to education and job opportunities for women, can also help reduce poverty. Women's economic participation can be enhanced by investing in female human capital, enacting gender-sensitive laws, and improving social norms.

This study is limited in terms of its survey time, as its dataset was drawn from a single survey period. The use of panel survey data could improve research in this field by assessing dynamic changes in multidimensional poverty and exploring how it is impacted by household demographic characteristics.

## Appendix

**Table 6** Percentage of households deprived in each indicator at the regional and provincial levels

Indicator	Region		Province			
	Urban	Rural	KPK	Punjab	Sindh	Balochistan
Year of schooling	23.26	48.56	36.34	36.05	43.22	53.20
School attendance	9.85	21.30	20.06	8.18	23.56	40.39
Basic health facilities	60.57	53.11	57.99	50.37	56.24	77.69
Child mortality	6.96	10.33	7.04	9.91	10.18	6.36
Drinking water	20.63	30.41	28.47	18.75	30.38	55.95
Sanitation	4.00	34.48	15.22	13.49	35.76	58.18
Housing quality	10.36	38.75	35.05	14.87	37.01	63.21
Fuel for cooking	16.19	77.59	63.90	52.68	52.46	63.08
Electricity	2.33	15.89	12.77	4.87	16.37	24.71
Asset ownership	24.97	40.45	37.54	33.55	32.97	41.94
Per-capita consumption expenditure	9.11	27.75	22.01	24.8	26.36	33.64

**Author Contribution** Conceptualization: Weihong Zeng, Rashida Saddique; Methodology: Rashida Saddique, Weihong Zeng, Pianpian Zhao, Ashar Awan; Formal analysis and investigation: Rashida Saddique; Writing - original draft preparation: Rashida Saddique; Writing - review and editing: Rashida Saddique, Weihong Zeng, Pianpian Zhao, Ashar Awan; Resources: Rashida Saddique, Weihong Zeng, Pianpian Zhao, Ashar Awan; Supervision: Weihong Zeng. All authors have made a substantial contribution to this manuscript. All authors read and approved the final manuscript.

**Funding** This research did not receive any specific grant from funding agencies in the public, commercial, or non-for-profit sectors.

**Data availability** The Household Integrated Economic Survey (HIES) is used for analysis in the current study and accessed from the Pakistan Bureau of Statistics (PBS) website <https://www.pbs.gov.pk/content/pslm-hies-2018-19-provincial-level-survey>. The HIES survey data is publicly accessible that includes all of the data documentation, including the survey questionnaires, instruction manual, coding scheme, and metadata in SPSS and STATA files.

## Declarations

**Ethics approval** Hereby, the authors consciously assure that this manuscript is not currently being considered for publication elsewhere and reflects the authors' own research and analysis in a truthful and complete manner.

**Consent to participate** Not applicable.

**Consent for publication** All authors have read the manuscript and agreed to submit it in its current form for consideration for publication in the journal.

**Competing interests** The authors declare no competing interests.

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## References

- Ahmad R, Faridi MZ (2020) Socio-Economic and Demographic Factors of Poverty Alleviation in Pakistan: A Case Study of Southern Punjab. *Rev Econ Dev Stud* 6(2):525–538. <https://doi.org/10.47067/reads.v6i2.220>
- Al-Tal R, Mursheed M, Ahmad P, Alfar AJK, Bassim M, Elheddad M, Nurmakhanova M, Mahmood H (2021) The Non-Linear Effects of Energy Efficiency Gains on the Incidence of Energy Poverty. *Sustainability* 13(19):11055. <https://doi.org/10.3390/su131911055>
- Alkire S, Chatterjee M, Conconi A, Seth S, V A (2015) Global multidimensional poverty index. *Pak Dev Rev* 4:287–299
- Alkire S, Apablaza M, Chakravarty S, Yalonetzky G (2017) Measuring chronic multidimensional poverty. *J Policy Model* 39(6):983–1006. <https://doi.org/10.1016/j.jpplmod.2017.05.020>
- Alkire S, Fang Y (2019) Dynamics of Multidimensional Poverty and Uni-dimensional Income Poverty: An Evidence of Stability Analysis from China. *Soc Indic Res* 142(1):25–64. <https://doi.org/10.1007/s11205-018-1895-2>
- Alkire S, Jahan S (2018) The new global MPI 2018: Aligning with the sustainable development goals. United Nations Development Programme (UNDP). [https://www.ophi.org.uk/wp-content/uploads/OPHIWP121\\_vs2.pdf%0Ahttps://ophi.org.uk/multi-dimensional-poverty-index/global-mpi-2017/mpi-methodology/](https://www.ophi.org.uk/wp-content/uploads/OPHIWP121_vs2.pdf%0Ahttps://ophi.org.uk/multi-dimensional-poverty-index/global-mpi-2017/mpi-methodology/). Accessed 21 Sept 2022
- Alkire S, Kanagaratnam U (2021) Revisions of the global multidimensional poverty index: indicator options and their empirical assessment. *Oxf Dev Stud* 49(2):169–183. <https://doi.org/10.1080/13600818.2020.1854209>
- Alkire S, Kanagaratnam U, Nogales R, Suppa N (2020) Revising the global Multidimensional Poverty Index: Empirical insight and robustness. OPHI Research in Progress 56a, Oxford Poverty and Human Development Initiative, University of Oxford, June, 3. <http://files/913/Alkire et al. - 2020 - Revising the global Multidimensional Poverty Index.pdf>
- Alkire S, Santos ME (2010) Sabina Alkire and Maria Emma Santos. *Human Dev*
- Alkire S, Santos ME (2014) Measuring Acute Poverty in the Developing World: Robustness and Scope of the Multidimensional Poverty Index. *World Dev* 59:251–274. <https://doi.org/10.1016/j.worlddev.2014.01.026>
- Alkire S, Seth S (2015) Multidimensional Poverty Reduction in India between 1999 and 2006: Where and How? *World Dev* 72:93–108. <https://doi.org/10.1016/j.worlddev.2015.02.009>
- Alkire S, Foster J (2011) Understandings and misunderstandings of multidimensional poverty measurement. <https://doi.org/10.1007/s10888-011-9181-4>
- Ambros PF, Saxena KK (2018) Logistic regression approach for the determinants of acute poverty at household level in Tanzania. 3(6), 131–142
- Artha DRP, Dartanto T (2018) The multidimensional approach to poverty measurement in Indonesia: Measurements, determinants and its policy implications. *J Econ Cooperation Dev* 39(3):1–38
- Atkinson T, Cantillon B, Marlier E, Nolan B (2002) *Social Indicators: The EU and Social Inclusion*. Oxford University Press. <https://doi.org/10.1093/0199253498.001.0001>
- Awan A, Bilgili F, Rahut DB (2022) Energy poverty trends and determinants in Pakistan: Empirical evidence from eight waves of HIES 1998–2019. *Renew Sustain Energy Rev*, 112157. <https://doi.org/10.1016/j.rser.2022.112157>
- Azeem MM, Muger A, Schilizzi S (2016) Poverty and vulnerability in the Punjab, Pakistan: A multilevel analysis. *J Asian Econ* 44:57–72. <https://doi.org/10.1016/j.asieco.2016.04.001>
- Bayudan-Dacuycuy C, Lim JA (2013) Family size, household shocks and chronic and transient poverty in the Philippines. *J Asian Econ* 29:101–112. <https://doi.org/10.1016/j.asieco.2013.10.001>
- Belete GY (2021) Children's multidimensional deprivation, monetary poverty and undernutrition in Ethiopia. *Rev Econ Household*. <https://doi.org/10.1007/s11150-021-09568-5>
- Bersisa M, Heshmati A (2021) A Distributional Analysis of Uni- and Multidimensional Poverty and Inequalities in Ethiopia. *Soc Indic Res* 155(3):805–835. <https://doi.org/10.1007/s11205-021-02606-w>
- Boudet AMM, Bhatt A, Azcona G, Beegle K (2021) A Global View of Poverty, Gender, and Household Composition. World Bank, February
- Braybrooke D (2008) *The Standard of Living*. Amartya Sen et al. Cambridge: Cambridge University Press, 1987, xiv + 125 pages. *Econ Philos* 6:339–350. <https://doi.org/10.1017/S0266267100001334>

- Callan T, Nolan B (1991) Concepts of Poverty and the Poverty Line. *J Econ Surv* 5(3):243–261. <https://doi.org/10.1111/j.1467-6419.1991.tb00134.x>
- Callander EJ, Schofield DJ, Shrestha RN (2013) Chronic health conditions and poverty: a cross-sectional study using a multidimensional poverty measure. *BMJ Open* 3(11):e003397. <https://doi.org/10.1136/bmjopen-2013-003397>
- Cappellari L, Jenkins SP (2002) Who stays poor? Who becomes poor? Evidence from the British household panel survey. *Econ J* 112(478):C60–C67. <https://doi.org/10.1111/1468-0297.00028>
- Chakravarty SR, Deutsch J, Silber J (2008) On the Watts Multidimensional Poverty Index and its Decomposition. *World Dev* 36(6):1067–1077. <https://doi.org/10.1016/j.worlddev.2007.10.003>
- Cheema AR (2021) Poverty and Its Correlates in Pakistan. January 2020
- Cheema AR, Nadeem M (2020) Poverty and Its Correlates in Pakistan. 3675–3719
- Chen KM, Leu CH, Wang TM (2019) Measurement and Determinants of Multidimensional Poverty: Evidence from Taiwan. *Soc Indic Res* 145(2):459–478. <https://doi.org/10.1007/s11205-019-02118-8>
- Chishti MZ, Azeem HSM, Khan MK (2023a) Asymmetric nexus between commercial policies and consumption-based carbon emissions: new evidence from Pakistan. *Financial Innov* 9(1). <https://doi.org/10.1186/s40854-022-00421-x>
- Chishti MZ, Dogan E (2022) Analyzing the determinants of renewable energy: The moderating role of technology and macroeconomic uncertainty. *Energy Environ*, 0(0), 0958305X2211375. <https://doi.org/10.1177/0958305X221137567>
- Chishti MZ, Rehman A, Murshed M (2022) An estimation of the macroeconomic determinants of income poverty in Pakistan? Evidence from a non-linear <sc>ARDL</sc> approach. *J Public Affairs* 22(4). <https://doi.org/10.1002/pa.2719>
- Chishti MZ, Sinha A (2022) Do the shocks in technological and financial innovation influence the environmental quality? Evidence from BRICS economies. *Technol Soc* 68 (August 2021):101828. <https://doi.org/10.1016/j.techsoc.2021.101828>
- Chishti MZ, Sinha A, Zaman U, Shahzad U (2023b) Exploring the dynamic connectedness among energy transition and its drivers: Understanding the moderating role of global geopolitical risk. *Energy Econ* 119(January):106570. <https://doi.org/10.1016/j.eneco.2023.106570>
- Debebe S, Wuletaw T (2022) Comparative Analysis of Rural to Urban Multidimensional Poverty and Its Correlates at Household Level in Gamo Zone of Southern Ethiopia. *Soc Indic Res* 162(1):107–121. <https://doi.org/10.1007/s11205-021-02833-1>
- Debela GM, Tamiru S (2016) Biofuels, Poverty, Food Security and Growth in Ethiopia: A Computable General Equilibrium Microsimulation Analysis. In *Economic Studies in Inequality, Social Exclusion and Well-Being*. [https://doi.org/10.1007/978-3-319-30981-1\\_11](https://doi.org/10.1007/978-3-319-30981-1_11)
- Decancq K, Lugo M (2010) Weights in Multidimensional Indices of Well-Being: An Overview. *Economet Rev* 32. <https://doi.org/10.2139/ssrn.1571124>
- Deyshappriya NPR, Feeny S (2021) Weighting the Dimensions of the Multidimensional Poverty Index: Findings from Sri Lanka. *Soc Indic Res* 156(1). <https://doi.org/10.1007/s11205-021-02656-0>
- Dogan E, Chishti MZ, Karimi Alavijeh N, Tzeremes P (2022) The roles of technology and Kyoto Protocol in energy transition towards COP26 targets: Evidence from the novel GMM-PVAR approach for G-7 countries. *Technol Forecast Soc Chang* 181(January):121756. <https://doi.org/10.1016/j.techfore.2022.121756>
- Dutta I, Nogales R, Yalonetzky G (2021) Endogenous weights and multidimensional poverty: A cautionary tale. *J Dev Econ* (Vol. 151). <https://doi.org/10.1016/j.jdeveco.2021.102649>
- Evans M, Nogales R, Robson M (2020) Monetary and Multidimensional Poverty: Correlations, Mismatches and Joint Distributions. OPHI Working Papers, July, 39
- Fabrizi E, Mussida C (2020) Assessing poverty persistence in households with children. *J Econ Inequal* 18(4):551–569. <https://doi.org/10.1007/s10888-020-09455-6>
- Farooq I, Ali S (2020) COVID-19 outbreak and its monetary implications for dental practices, hospitals and healthcare workers. *Postgrad Med J* 96(1142):791–792
- Firdausy CM, Budisetyowati DA (2022) Variables, Dimensions, and Indicators Important to Develop the Multidimensional Poverty Line Measurement in Indonesia. *Social Indic Res*. <https://doi.org/10.1007/s11205-021-02859-5>
- Foster J, Greer J, Thorbecke E (1984) A class of decomposable poverty measures. *Econometrica* 52(3):761–766. <https://doi.org/10.2307/1913475>
- Gamboa G, Mingorría S, Scheidel A (2020) The meaning of poverty matters: Trade-offs in poverty reduction programmes. *Ecol Econ* 169(May 2019):106450. <https://doi.org/10.1016/j.ecolecon.2019.106450>
- Greene W (2003) *Econometric Analysis Fifth Edition*
- Jolliffe D, Prydz EB (2016) Estimating international poverty lines from comparable national thresholds. *J Econ Inequal* 14(2):185–198. <https://doi.org/10.1007/s10888-016-9327-5>
- Khan AU, Saboor A, Hussain A, Sadiq S, Mohsin AQ (2014) Investigating Multidimensional Poverty across the Regions in the Sindh Province of Pakistan. *Soc Indic Res* 119(2):515–532. <https://doi.org/10.1007/s11205-013-0511-8>
- Kim H (2019) Beyond Monetary Poverty Analysis: The Dynamics of Multidimensional Child Poverty in Developing Countries. *Soc Indic Res* 141(3):1107–1136. <https://doi.org/10.1007/s11205-018-1878-3>
- Kurji Z, Premani ZS, Mithani Y (2016) Analysis of the health care system of Pakistan: lessons learnt and way forward. *J Ayub Med Coll Abbottabad* 28(3):601
- Lekobane KR (2021) Leaving No One Behind: An Individual-Level Approach to Measuring Multidimensional Poverty in Botswana. *Social Indic Res*. <https://doi.org/10.1007/s11205-021-02824-2>
- Libois F, Somville V (2018) Fertility, household size and poverty in Nepal. *World Dev* 103(March):311–322. <https://doi.org/10.1016/j.worlddev.2017.11.005>
- Liu M, Feng X, Zhao Y, Qiu H (2023) Impact of poverty alleviation through relocation: From the perspectives of income and multidimensional poverty. *J Rural Stud* 99:35–44. <https://doi.org/10.1016/j.jrurstud.2023.02.009>
- Mahmood T, Yu X, Klasen S (2019) Do the Poor Really Feel Poor? Comparing Objective Poverty with Subjective Poverty in Pakistan. *Soc Indic Res* 142(2):543–580. <https://doi.org/10.1007/s11205-018-1921-4>
- Meng X, Gregory R, Wan G (2007) Urban poverty in China and its contributing factors, 1986–2000. *Rev Income Wealth* 53(1):167–189. <https://doi.org/10.1111/j.1475-4991.2007.00222.x>
- Mothkoo V, Badgaiyan N (2021) WIDER Working Paper 2021/1-Estimates of multidimensional poverty for India using NSSO-71 and -75. January. 10.35188/UNU-WIDER/2021/935-8
- Mulugeta G (2021) The role and determinants of women labor force participation for household poverty reduction in Debre Birhan town, North Shewa zone, Ethiopia. *Cogent Econ Fin* 9(1). <https://doi.org/10.1080/23322039.2021.1892927>
- Munoz Boudet AM, Buitrago P, De La Briere BL, Newhouse D, Rubiano Matulevich E, Scott K, Suarez-Becerra P (2018) Gender Differences in Poverty and Household Composition through the Life-cycle: A Global Perspective. *Gender Differences in Poverty and Household Composition through the Life-Cycle: A Global Perspective*, March 2018. <https://doi.org/10.1596/1813-9450-8360>

- Murshed M, Khan U, Khan AM, Ozturk I (2023) Can energy productivity gains harness the carbon dioxide-inhibiting agenda of the Next 11 countries? Implications for achieving sustainable development. *Sustain Dev* 31(1):307–320. <https://doi.org/10.1002/sd.2393>
- Murshed M, Ozturk I (2023) Rethinking energy poverty reduction through improving electricity accessibility: A regional analysis on selected African nations. *Energy* 267:126547. <https://doi.org/10.1016/j.energy.2022.126547>
- Murshed M, Saboori B, Madaleno M, Wang H, Doğan B (2022) Exploring the nexuses between nuclear energy, renewable energy, and carbon dioxide emissions: The role of economic complexity in the G7 countries. *Renew Energy* 190:664–674. <https://doi.org/10.1016/j.renene.2022.03.121>
- Najitama E, Maski G, Manzilati A (2020) Analysis of multidimensional poverty dynamics in Indonesia: The effect of demographic and institutional factors. *J Innov Business Econ* 4(02):87–96. <https://doi.org/10.22219/jibe.v4i02.15630>
- Nawaz S, Iqbal N (2021) How cash transfers program affects environmental poverty among ultra-poor? Insights from the BISP in Pakistan. *Energy Policy* 148:111978. <https://doi.org/10.1016/j.enpol.2020.111978>
- OPHI. (2021). Global Multidimensional Poverty Index 2021 - Unmasking the disparities by ethnicity, caste and gender. Oxford Poverty and Human Development Initiative. [http://hdr.undp.org/sites/default/files/2021\\_mpi\\_report\\_en.pdf](http://hdr.undp.org/sites/default/files/2021_mpi_report_en.pdf)
- Pacifico D, Poege F (2017) Estimating measures of multidimensional poverty with stata. *Stata J* 17(3):687–703. <https://doi.org/10.1177/1536867x1701700309>
- Padda IUH, Hameed A (2018) Estimating multidimensional poverty levels in rural Pakistan: A contribution to sustainable development policies. *J Clean Prod* 197:435–442. <https://doi.org/10.1016/j.jclepro.2018.05.224>
- Pham ATQ, Mukhopadhyaya P (2022) Multidimensional Poverty and The Role of Social Capital in Poverty Alleviation Among Ethnic Groups in Rural Vietnam: A Multilevel Analysis. *Soc Indic Res* 159(1):281–317. <https://doi.org/10.1007/s11205-021-02747-y>
- Qurat-ul-Ann A-R, Mirza FM (2021) Multidimensional Energy Poverty in Pakistan: Empirical Evidence from Household Level Micro Data. *Soc Indic Res* 155(1):211–258. <https://doi.org/10.1007/s11205-020-02601-7>
- Saboor A, Khan AU, Hussain A, Ali I, Mahmood K (2015) Multidimensional deprivations in Pakistan: Regional variations and temporal shifts. *Quart Rev Econ Fin* 56:57–67. <https://doi.org/10.1016/j.qref.2015.02.007>
- Sadiq M (2010) Determinants of Poverty in Pakistan. 4, 193–213
- Salam A, Pratomo DS, Saputra PMA (2020) Socio-economic determinants of multidimensional poverty in the rural and urban areas of East Java. *Int J Sci Technol Res* 9(4):1445–1449
- Saleem H, Bilal Khan M (2018) Multidimensional Poverty in Pakistan: A Policy Perspective. September, 35–51. 10.17501/icpsd.2017.4105
- Saleem H, Shabbir MS, Khan B (2021) Re-examining Multidimensional Poverty in Pakistan: A New Assessment of Regional Variations. *Glob Bus Rev* 22(6):1441–1458. <https://doi.org/10.1177/0972150919844412>
- Santos ME, Villatoro P (2018) A Multidimensional Poverty Index for Latin America. *Rev Income Wealth* 64(1):52–82. <https://doi.org/10.1111/roiw.12275>
- Sen (1985). *Commodities and Capabilities*. Elsevier Science Pub. Co, Sole distributors for the USA and Canada
- Sharma S (2019) Pakistan @ 100 Structural Transformation. March. <https://openknowledge.worldbank.org/bitstream/handle/10986/31410/135314.pdf?sequence=4&isAllowed=y>
- Sohail M (2014) Women Empowerment and Economic Development-an Exploratory Study in Pakistan. *J Business Stud Quart* 5(4):210–221
- Sperandei S (2014) Understanding logistic regression analysis. *Biochemia Medica* 24(1):12–18. <https://doi.org/10.11613/BM.2014.003>
- Tran TV, Nguyen HC, Pham LV, Nguyen MH, Nguyen HC, Ha TH, Phan DT, Dao HK, Nguyen PB, Trinh MV, Do TV, Nguyen HQ, Nguyen TTP, Nguyen NPT, Tran CQ, Tran KV, Duong TT, Pham HX, Nguyen LV et al (2020) Impacts and interactions of COVID-19 response involvement, health-related behaviours, health literacy on anxiety, depression and health-related quality of life among healthcare workers: a cross-sectional study. *BMJ Open* 10(12):e041394. <https://doi.org/10.1136/bmjopen-2020-041394>
- Wang X, Feng H, Xia Q, Alkire S (2016) On the relationship between Income Poverty and Multidimensional Poverty in China
- World Bank (2017) Monitoring Global Poverty: Report of the Commission on Global Poverty. In *Monitoring Global Poverty: Report of the Commission on Global Poverty*. <https://doi.org/10.1596/978-1-4648-0961-3>
- Xia W, Murshed M, Khan Z, Chen Z, Ferraz D (2022) Exploring the nexus between fiscal decentralization and energy poverty for China: Does country risk matter for energy poverty reduction? *Energy* 255:124541. <https://doi.org/10.1016/J.ENERGY.2022.124541>
- Yu J (2013) Multidimensional Poverty in China: Findings Based on the CHNS. *Soc Indic Res* 112(2):315–336. <https://doi.org/10.1007/s11205-013-0250-x>
- Zou KH, O'Malley AJ, Mauri L (2007) Receiver-Operating Characteristic Analysis for Evaluating Diagnostic Tests and Predictive Models. *Circulation* 115(5):654–657. <https://doi.org/10.1161/CIRCULATIONAHA.105.59492>

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