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Wayamba University of Sri Lanka

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AN APPROACH TO DETERMINE MULTI-DIMENSIONAL POVERTY INDEX FOR SRI LANKA: A COMPARATIVE STUDY

H V S de Silva
S P Premaratna

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Abstract

Poverty consists of two types: monetary poverty and multi-dimensional poverty. Monetary poverty is measured by determining whether income of a person falls below the poverty line while multidimensional poverty is measured using a method where it measures whether a person satisfies a set of specified basic needs. In 2010, the Oxford Poverty and Human Development Initiative (OPHI) in collaboration with the United Nation's Development Program's Human Development Report Office developed the Global Multidimensional Poverty Index (MPI) to measure multidimensional poverty under certain assumptions. Applying the Equal Weighting System by taking unit as the household, to compute MPI is one of the important assumptions which needs to be improved. The aim of this study is to propose an unequal weighting system taking unit as the individual to address the research problem of applying the equal weighting system taking the unit as the household. This study makes a significant contribution by offering a comprehensive exploration of the multidimensional poverty situation in Sri Lanka, both at the national level and within individual districts. The methodology applied in obtaining MPI is the Alkire - Foster Methodology based on Counting Approach. In the context of the Sri Lankan socio-cultural background, a more accurate national MPI was obtained by selecting indicators together with an unequal weighting structure. The Household Income and Expenditure survey – 2016 data were obtained from the Department of Census and Statistics, Sri Lanka for the analysis. This study reveals variations in the weighting system across dimensions and indicators, challenging the equal weighting approach adopted by the OPHI. Furthermore, it highlights that 68.7% of the population aged 10 or above in Sri Lanka experience multidimensional poverty. This would enable policy makers to have more accurate national and regional MPIs to implement efficient poverty reduction strategies covering all the districts in the country.

Keywords: Multidimensional Poverty, Monetary Poverty, Oxford Poverty and Human Development Initiative, Counting approach, Sri Lanka

H V S de Silva
(Corresponding Author)
Faculty of Graduate Studies, University of Colombo, Sri Lanka
Email: hvisaka@gmail.com
Tel: +94 71 1198 916
https://orcid.org/0009-0000-2342-9465

S P Premaratna
Department of Economics, University of Colombo, Sri Lanka
Email: spp@econ.cmb.ac.lk

1. INTRODUCTION

Lack of money cannot be considered as the sole reason for being poor. There are two types of poverty: monetary poverty and non- monetary poverty. Monetary poverty is measured using an indirect method or income approach where it determines whether income of a person falls below the poverty line. The poverty line is the income level at which some specified basic needs can be satisfied. Non- monetary poverty known as multidimensional poverty is measured using a direct method where it measures whether a person satisfies a set of specified basic needs such as health, education, standard of living and deprivation of basic rights (Alkire & Santos, 2010). To implement a direct approach in measuring multidimensional poverty, in 2010 the Oxford Poverty and Human Development Initiative (OPHI) in collaboration with the United Nation's Development Program's Human Development Report Office developed the Multidimensional Poverty Index (MPI). MPI identifies people with joint deprivations in a set of specified basic needs. The construction of a mathematical structure for MPI where deprivation cutoffs, weights and the poverty cutoff are parameters consists of several steps and assumptions. According to Alkire and Santos (2010), MPI was computed using the Equal Weighting System considering household as the unit of analysis.

The aim of this study is to propose an unequal weighting system to eliminate inaccuracies of MPI under the existing system when comparing MPIs among regions, capturing the multiple deprivations poor people experience with respect to Health, Education and Living standards specific to Sri Lanka, considering individual as the unit of analysis. Further, the research also aims to identify the factors contributing to the multidimensional poverty in districts based on the available data using the proposed approach. The index is obtained using Alkire – Foster (AF) Methodology by updating indicators of poverty dimensions and applying the proposed unequal weighting system typically valid to Sri Lanka.

MPI has been widely recognized as its novelty and strength, because understanding the deprivations people face at the same time is of independent ethical and policy interest (Deaton et al., 2011). Sen (2000) shows that poverty measurements should consider many different factors contributing to poverty (OPHI). Alkire et al., (2015) stated in their paper on "Overview of Methods for Multidimensional Poverty Assessment" that many methods of measuring multidimensional poverty were motivated by the basic needs approach, the social inclusion approach and the capability approach. According to, Alkire et al., (2011) the Dashboard approach is a starting point in measuring multidimensionality of poverty, assessing the level of the deprivation in dimensions separately, in other words, applying a standard uni-dimensional measure to each dimension, dashboards assess each and every dimension separately.

AF methodology is a general framework for measuring multidimensional poverty and it uses the counting approach with a "dual-cutoff" to identify the poor considering the joint distribution of deprivations. With this methodology many key decisions such as the selection of the unit of analysis, dimensions, deprivation cutoffs (to determine when a person is deprived in a dimension), weights (to indicate the relative

importance of the different deprivations), and poverty cutoff (to determine when a person has enough deprivations to be considered poor) were taken into consideration. This flexibility enables the methodology to have many diverse applications (Alkire & Santos, 2015). Based on AF counting approach, multidimensional poverty index (MPI) proposed by Alkire and Santos (2010) was constructed considering three dimensions: Health, Education, Living Standards and ten indicators: Nutrition, Child Mortality, Years of Schooling, School Attendance, Cooking Fuel, Sanitation, Water, Electricity, Floor, Assets under the assumption that dimensions are equally weighted and indicators within the dimensions are also equally weighted. Multidimensional poverty of a person was decided based on weighted deprivation score However, application of the same indicators mentioned above and equal weights for dimensions and indicators are questionable in the Sri Lankan context due to socio- economic background of the country.

The current study aims to fill this gap by capturing deprivations in the same three dimensions: Health, Education and Living Standards, but in eight indicators which are different from global indicators as explained below, taking unit of analysis as the person while applying unequal weights for indicators. Considering unit of analysis as the individual is important since it helps to investigate whether multidimensional poverty is strongly linked to any demographic factors such as gender, age and ethnicity. The proposed new weighting system which is used to obtain a weighted deprivation score is explained below.

One of the important gaps in the existing literature is non-availability of a dimension "Recreation and entertainment" which shows the status of emotional satisfaction of a person. The future research is suggested on issues related to intra-household inequalities which will enable policy makers to obtain a more detailed picture of both structure and dynamics of poverty in the society.

The United Nations Development Program's Human Development Report Office in 2010 developed MPI to measure multidimensional poverty at household level considering 3 dimensions based on AF Methodology. Further MPI was calculated under the assumption that each dimension is equally weighted and each indicator within the dimension is also equally weighted (Equal Weighting System). Isn't it inaccurate to consider the Equal Weighting System to calculate MPI in Sri Lanka, as effects of different dimensions and indicators on multidimensional poverty are not the same? If so, what would be the new approach to obtain a weighting system which provides a more reliable multidimensional poverty assessment for our country to address the research problem of applying the equal weighting system taking the unit as the household?

This research attempts to address the research problem of applying the equal weighting system taking the unit as the household using the same global dimensions: health, education, living standards due to data constraints. The study aims to construct a new way of deciding weights of dimensions and indicators so that a more reliable weighted deprivation score can be obtained to decide multidimensionally poor, in Sri Lankan context where the unit of analysis is taken as the individual. It also attempts to obtain MPI values nationally and at district level using a proposed unequal

weighting system which helps to carry out a comparative study of multidimensional poverty. Furthermore, a study would be carried out to decide whether multidimensional poverty is strongly linked to any demographic factors such as gender, age and ethnicity.

Main objective of this research is obtaining an unequal weighting system to determine more accurate national and district-wise multidimensional poverty indices for Sri Lanka and to carry out a comparative study of multidimensional poverty within districts depending on Household Income and Expenditure survey- **2**016 data. Using the proposed unequal weighting system, it is also planned to study whether multidimensional poverty is strongly linked to any demographic factors such as gender, age and ethnicity and to investigate significant contributions of poverty indicators to the multidimensional poverty in each district.

2. LITERATURE REVIEW

Santos and Villatoro (2018) propose a new MPI for Latin America. The index has been obtained considering both the monetary and non- monetary indicators by including new indicators other than the traditional indicators introduced by Alkire and Foster (2010). The index is composed of 13 indicators grouped into five dimensions taking unit of identification as the household where all the members are considered poor if the household is identified as poor. The five dimensions considered were Housing, Basic Services, Education, Employment & Social Protection and Living Standards where dimensions are not equally weighted. However, the weighting structure and poverty cut-off proposed are not justified by any specific methodology. In the proposed research it is planned to obtain an unequal weighting structure taking monetary poverty and non- monetary poverty as complimentary entities.

According to Alkire (2018), OPHI working paper No. 119 focuses on counting based approaches to multidimensional poverty measurement which reflect overlapping deprivations. In most countries, when constructing MPIs the household has been taken as the pivotal unit for identifying who is poor but the paper explains that a household MPI does not probe intra household inequalities to see whether women are more deprived than men or girls than boys. In the proposed study the pivotal unit is taken as the person which helps to decide whether age and gender make a significant impact on multidimensional poverty.

Literature related to the concepts, determinants and measurement approaches of poverty shows that the measurement approaches mainly differ in the scope of needs to live and function in the society. The study conducted by Akinyetun et al., (2021) on “Assessment of the Prevalence of Multidimensional Poverty in Nigeria” adopts a social exclusion theory which considers people in the social exclusion category: women, people from lower levels of society & girls. Silver (1994) & Khan (2012) observes that social exclusion is “both a cause and an effect of inequality”. Determinants of poverty suggested by the existing literature include socio-demographic and economic conditions of household, socio/cultural issues. The evolution of the global poverty alleviation strategies was discussed. Among many

approaches of multidimensional poverty measurement Alkire and Foster method of obtaining Multidimensional Poverty Index (MPI) received widespread international recognition where the unit of analysis is taken as the household under the assumption that every individual inside a household has the same level of poverty as the household itself together with equal weighting system.

Deepawansa and Dunusinghe (2018) introduced a novel methodology called the "Synthesis Method" to measure poverty in the context of Sri Lanka. This approach combines fuzzy sets method and counting method to provide a comprehensive assessment of poverty. This approach effectively tackles certain shortcomings found in existing analytical approaches, specifically: (a) the focus on monetary metrics, (b) arbitrary weight assignments, and (c) insufficient consideration of dimensions and examines poverty across three dimensions: housing facilities, consumer durables, and basic lifestyle. The findings of the study demonstrated that housing facilities made the most significant contribution to material deprivation. Moreover, the study uncovered that individuals experiencing deprivation tend to reside in houses characterized by low quality and limited amenities.

In accordance with the approach outlined by Alkire and Santos (2010), Kumara and Gunawardene (2017) conducted a study focusing on poverty among households that include disabled individuals. For the Multidimensional Poverty Index (MPI), Kumara and Gunawardene (2017) employed three dimensions: "health," "education," and "living standards." The study utilized data from the Household Income and Expenditure Survey conducted in 2006/07 and 2009/10 to estimate both monetary and multidimensional poverty. To assess the three dimensions, a total of ten indicators were utilized in the study: two indicators were employed for each of the health and education dimensions, while the remaining six indicators were used to measure the living standards dimension. The study utilizes the Alkire and Foster (2009; 2011) approach to calculate various measures of multidimensional poverty, including multidimensional poverty incidence, intensity, and acute multidimensional poverty.

The study revealed that households with disabled individuals experience higher levels of both monetary and multidimensional poverty than households without them. The three dimensions - health, education, and living standards - examined in the study have nearly equal contributions to the incidence of poverty, indicating that addressing poverty reduction in Sri Lanka necessitates improvements in all three dimensions for poor households, regardless of whether they have disabled individuals or not. But employing equal weighting systems for indicators and dimensions would not reveal the true picture of poverty; the proposed study is meant to tackle this problem.

According to the study, housing facilities were found to make the most significant contribution to material deprivation. It further unveiled that individuals experiencing deprivation reside in houses with low quality and limited amenities. The utilization of the Synthesis method is expected to stimulate further research analysis on poverty from a multidimensional perspective.

Due to the socio-economic background of the country, application of the indicators with equal weights as found in the literature survey is questionable within the Sri

Lankan context. Furthermore, taking unit of analysis as the household does not allow in obtaining gendered MPIs. Therefore, the main goal of this study is to construct a new weighting structure for proposed indicators and dimensions, considering unit of analysis as the individual to fill above mentioned gaps.

3. METHODOLOGY

This study used secondary analysis of existing quantitative survey data of Household Income and Expenditure Survey (HIES) conducted by the Department of Census and Statistics. The survey is conducted once in three years and the latest survey was conducted in 2016. Population of the proposed study consists of 68168 individuals in 23 districts whose age is greater than or equal to 10 years.

MPI is a measure of multidimensional poverty which is the inability of a person to meet minimum international standards in indicators related to the Millennium Development Goals[1] and to core functioning[2], such as being well nourished, being educated or drinking clean water. MPI combines two highly relevant pieces of information: Incidence of poverty and the intensity of deprivation.

Incidence of poverty is the proportion of people (within a given population) who experience multiple deprivations while intensity is the average proportion of (weighted) deprivations the poor people experience. Global MPI was calculated at the country level using globally comparable data. In the Human Development Report (HDR) 2011 the global MPI was presented for 109 countries using the method described below (Alkire & Santos, 2011).

This process consists of identification and aggregation of data. Identification focused on identifying the poverty indicators. Aggregation considered the thresholds of each indicator. After aggregation the poverty threshold was defined, the deprivation of each person is weighted by the weight of the indicator as given below. If the sum of the weighted deprivations is 33 percent or more of possible deprivations, the person is considered to be multidimensionally poor.

The main objective of this study is to obtain a novel approach in determining multidimensional poverty index for Sri Lanka relying on Alkire – Foster methodology (AF Methodology) which is based on the counting approach as explained below. In the proposed approach new weighting structures for indicators and dimensions are introduced. The Alkire-Foster (AF) methodology is a way of measuring multidimensional poverty developed by OPHI‟s Alkire and Foster (2007). Building on the Foster-Greer-Thorbecke poverty measures, it involves counting of different types of deprivation that individuals experience at the same time, such as, a lack of education or employment, or poor health or living standards. These deprivation profiles are analyzed to identify who is poor, and then used to construct

[1] The Millennium Development Goals (MDGs) are eight goals with measurable targets and clear deadlines for improving the lives of the world's poorest people.

[2] Functionings are the beings and doings that a person can achieve.

a multidimensional index of poverty (MPI). (OPHI, 2018). The following are the steps in building global MPI using Alkire – Foster methodology.

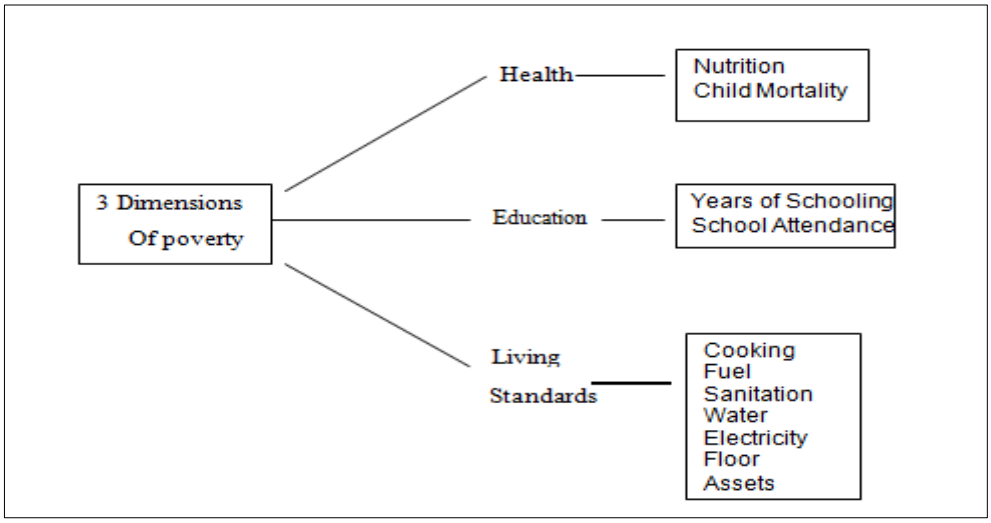
Step 1: Determine unit of identification

e.g. Household or Individual

Each person is assessed based on household achievements to determine if the person is below the deprivation cutoff in each indicator.

Step 2: Define dimensions and a set of indicators

Global MPI consists of three dimensions and ten indicators as given in the Figure 1.



Source: Training Material for producing National Human Development Reports (ophi@qeh.ox.ac.uk)

Figure 1: Conceptual Framework of obtaining global MPI

Step 3: Set Deprivation Cut-off

Deprivation cutoffs for each indicator are as follows:

Education

Years of Schooling: Deprived if no household member has completed five years of Schooling.

i.e. A person living in a household where there is at least one member with five years of schooling is considered non- deprived even though the person may not be educated.

School Attendance: Deprived if any school-age child is not attending school in years 1 to 8.

i.e. A person living in a household where there is at least one child not attending school is considered deprived in the indicator even though the person may have completed schooling.

Health

Child Mortality: Deprived if any child has died in the family

Nutrition: Deprived if any adult or child for whom there is nutritional information as malnourished. The nutritional indicator for children relates to being under-weight which means the child is two or more standard deviations below the median of the reference population. Nutritional indicator for adults is the Body Mass Index (BMI). An adult having a BMI lower than 18.5 is considered as undernourished.

Living Standards

Electricity: Deprived if the household has no electricity

Drinking Water: Deprived if the household does not have access to clean drinking Water or clean water is more than 30 minutes- walk from Home (round trip). Water source for clean drinking is any one of the following types: Piped water, public tap, borehole or pump, protected well, protected spring or rainwater.

Sanitation: Deprived if the household lacks adequate sanitation or if their toilet is shared.

Flooring: Deprived if the household has a dirt, sand or dung floor.

Cooking Fuel: Deprived if the household cooks with wood, charcoal or dung.

Asset Ownership: Deprived if the household does not own more than one of: radio, TV, telephone, bicycle, motorcycle, or refrigerator; and does not own a car or tractor.

Step 4: Apply the Deprivation Cut-off Find out whether a person is deprived in each indicator. If indicator's deprivation cutoffs are denoted by z_i then person i is considered deprived when the achievement of the indicator x_i is below the cut-off. i.e. $x_i < z_i$.

Step 5: Select the relative weights of each indicator. These weights must sum up to one. When developing global MPI the three dimensions were considered as equally weighted. Therefore, each of the dimensions received a weight of 1/3 and the indicators within each dimension were also equal weighted. Then each indicator within the health and education dimension received a weight of 1/6 while each indicator within the living standards dimension received a weight of 1/18.

Step 6: Obtain a weighted sum of deprivations named as deprivation score each person is assigned a deprivation score depending on the person‟s deprivations in the component indicators. It is calculated by taking a weighted sum of the number of deprivations, so that the deprivation score for each person lies between 0 and 1. If

deprivation score of the person i is c_i , $c_i = \sum_{i=1}^{d} w_i I_i$, where $I_i = 1$ if the person is deprived in indicator otherwise $I_i = 0$ and $\sum_{i=1}^{d} w_i = 1$.

Step 7: Determine Poverty cut-off (x%)

e.g. an individual is multidimensionally poor if the deprivation score > x%.

Step 8: Calculate the headcount ratio. This is the proportion of people who are poor.

Step 9: Calculate the intensity of poverty among the poor. This is calculated by adding the deprivation scores of the poor and dividing it by the total number of poor people.

Step 10: Calculate the MPI. This is the product of the headcount ratio of Step 8 and the intensity of poverty of Step 9.

Source: United Nations Economic Commission for Europe conference of European Statistical Seminar on poverty measurement (2016). Chapter 4: Multidimensional Poverty and its Measurement guide on poverty measurement.

In constructing the new weighting system, the same three global dimensions are used due to unavailability of data for the suggested new dimension Recreation & Entertainment. Since it is inaccurate to consider an equal weighting system to calculate MPI a new weighting system known as “proportional weighting system” is suggested as explained below. It is a dynamic measure of the multidimensional poverty in Sri Lanka.

The study considers three dimensions as Health, Education and Living Standards where Health has only one indicator “suffer from chronic illnesses", Education dimension also has one indicator as “Highest Educational Qualification” and Living Standards has six indicators as “Electricity, Sanitation, Drinking Water, Cooking Fuel, Asset Ownership, and Structure”. Deprivation cut offs are set as explained below. Taking into consideration, the data in the survey representing the whole country, percentages of people who are deprived of Health, Education and Living Standards are obtained and using ratios among these dimensions and weights of the dimensions are calculated as follows:

If R_1: R_2: R_3 are ratios of the dimensions (i.e. R_1: R_2: R_3 = Health: Education: Living Standards) the corresponding weights are,

$$\frac{R_1}{R_1 + R_2 + R_3}, \frac{R_2}{R_1 + R_2 + R_3}, \frac{R_3}{R_1 + R_2 + R_3}.$$

Similarly, for a particular dimension weights of the indicators can be obtained by considering percentages of people deprived of the corresponding indicator. Then ratios among indicators are obtained and weights of the indicators relative to that particular dimension are calculated.

Using deprivation cut-offs of the indicators for each person's deprivation status, that is whether the person is deprived or not is obtained and then a weighted deprivation score is calculated as stated below. According to Santos and Alkire (2011, 2013), a person is identified as poor if that person has a weighted deprivation score higher than or equal to 1/3. In my study also the same poverty cut off that a weighted deprivation score greater than equal to 1/3 is applied.

Hence the number of multidimensionally poor people (q) and the sum of weighted deprivation scores of the multidimensionally poor (C) can be obtained for the study population. Then,

$$H = \frac{q}{n}, \quad A = \frac{C}{q}$$

If deprivation status of the i^{th} indicator of a person is $(DS)_i$ with weight W_i of the i^{th} indicator then deprivation score of that person is given by

$$\text{Weighted deprivation score(C)} = \sum_{i=1}^{m} (DS)_i \times W_i$$

Where; m is the number of indicators

$$(DS)_i = \begin{cases} 1 & ,value\ of\ the\ indicator i < deprivation\ cutoff\ of\ indicator i \\ 0 & ,otherwise \end{cases}$$

n is the size of the population. Then MPI = $H \times A$

MPI gives the percentage of people in a country deprived along the dimensions of wellbeing (World Bank Group3). The MPI for Sri Lanka which is calculated depending on the data obtained by Household and Expenditure Survey-2016 is a dynamic measure which is composed of three dimensions and 8 indicators as explained below. Initially four dimensions as Health, Education, living standards and Recreation & Entertainment were proposed for a more comprehensive measure for MPI but because of the unavailability of the relevant data the dimension, Recreation & Entertainment was discarded.

Deprivation cutoffs used in this study are as follows:

[3] World Bank Group is a unique global partnership of five institutions working for sustainable solutions that reduce poverty and build prosperity in developing countries.

A person is considered as deprived of health if that person suffers from chronic illnesses which are Cancer, Diabetes, Asthma, Blood Pressure, heart conditions and Kidney diseases. A person is considered as deprived of education if the highest education attained is less than "Passed sixth grade in school". Living standards dimension consists of six indicators which includes three standard MDG (Millennium Development Goals) indicators: Drinking water, Sanitation and cooking fuel. It also includes three non-MDG indicators: Electricity, Asset Ownership and Structure of the house.

A person is considered as deprived of drinking water if that person has no access to drinking water from any one of the types: protected well within the premises, tap inside home, tap within unit/premises then the person is considered deprived of access to water.

A person is considered to have access to sanitation if a toilet is available within the unit exclusive for the household or available outside the unit exclusive for the household. Otherwise the person is considered deprived of sanitation.

If a person does not have access to electricity he is considered to be deprived of electricity.

A person is considered to be deprived of cooking fuel if that person does not have electricity or gas for cooking.

If a person does not own more than one out of Radio, TV, Telephone, Refrigerator, Bicycle or Motorbike that person is considered deprived of Assets Ownership.

The indicator structure means the structure of the house. A person is considered as not deprived of Structure indicator if the roof of the house is of one out of Asbestos, Concrete, Metal Sheet or Tile and if the floor of the house belongs to one out of Cement, Terrazzo/Tile, Concrete and also, if the house is one out of Single house (single floor), Single house (double floor), Single house (above double floor), annex, flat, condominium luxury apartment, twin houses.

Binary logistic regression is used to investigate significant contributions of poverty indicators to the multidimensional poverty in each district.

4. RESULTS AND DISCUSSION

4.1. Measurement of National MPI for Sri Lanka

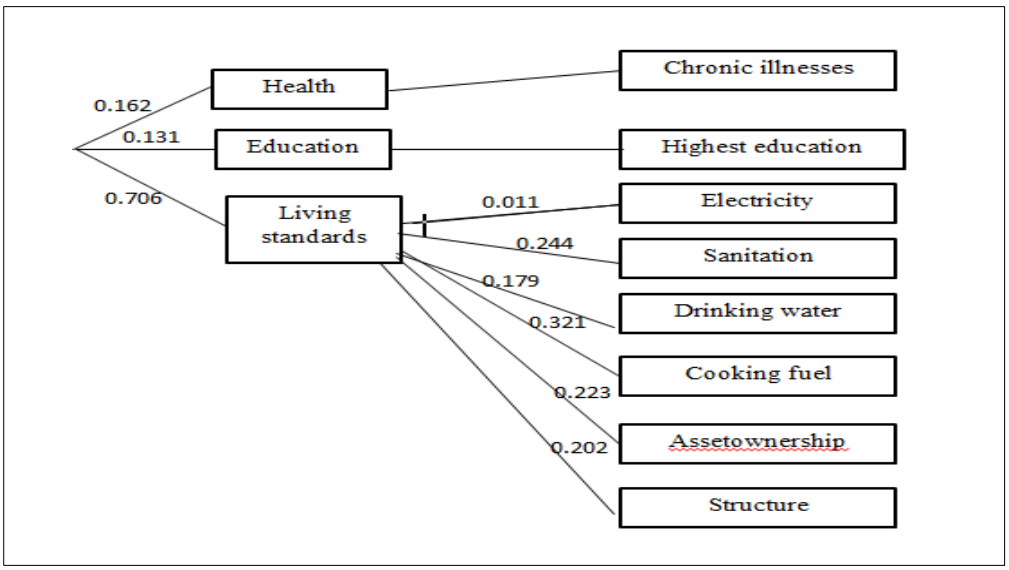
As mentioned in the methodology MPI is calculated as the product of headcount ratio of multidimensional poverty(H) and intensity of multidimensional poverty(A). H is defined as the proportion or incidence of people in a given population who experience multidimensional poverty and A is defined as the intensity of the deprivation of the people where intensity means the average deprivation score of the multidimensionally poor people (Alkire and Santos, 2011, P.12). World Bank (2002) explained ways of improving MPI by taking deprivation thresholds of dimensions at levels more suitable for Malaysia. The thresholds of the indicators used in the study which are more

suitable in Sri Lankan context, are stated above. In the population of the study, the percentages of people who are deprived of Health, Education and Living standards are 19.7%, 16% and 85.5% respectively. The dynamic ratio among deprivations of Health, Education and Living Standards is 9.7: 16: 85.8. Therefore, weights of the dimensions Health, Education and Living Standards are 0.162, 0.131 and 0.706 respectively.

Similarly, percentages of deprivations in Electricity, Sanitation, Drinking water, Cooking Fuel, Asset Ownership and Structure of the House in the country are 2.5%, 55.1%, 40.4%, 72.5%, 50.4% and 4.6% respectively. Then ratios among indicators are 2.5: 55.1: 40.4: 72.5: 50.4: 4.6 and corresponding weights within the dimension Living standards are 0.011, 0.244, 0.179, 0.321, 0.223 and 0.020 respectively while weights for the calculation are .0077, .172, .126, .226, .157, .014 as shown in the figure 2.

Table 1: Weights of the indicators

Indicators	Weights
Chronic illnesses	0.162
Highest education attained	0.131
Electricity	0.706 x 0.011= 0.0077
Sanitation	0.706 x 0.244= 0.172
Drinking water	0.706 x 0.179= 0.126
Cooking Fuel	0.706 x 0.321= 0.226
Asset Ownership	0.706 x 0.223= 0.157
Structure	0.706 x 0.020= 0.014



Source: Author's computation

Figure 2: Weights of the dimensions and indicators

Proposed unequal weighting system can be written as follows:

Weights of the dimensions Health, Education and Living Standards are 0.162, 0.131 and 0.706 respectively. Weights within the dimension Living Standards are 0.011, 0.244, 0.179, 0.321, 0.223 and 0.020 for indicators: Electricity, Sanitation, Drinking water, Cooking fuel, Asset Ownership and structure respectively.

This paper suggests a way to obtain a new weighting system taking individuals as the unit. As explained above, under methodology applied, Weighted deprivation score = $\sum_{i=1}^{8}(DS)_i \times W_i$

Using SPSS version 20, for each person weighted deprivation scores are obtained. Then a person is considered multidimensionally poor if weighted deprivation score is greater than or equal to poverty cut-off k. k is defined as the share of (weighted) deprivations a person must have in order to be considered poor and in the MPI a person is identified as poor if that person has a deprivation score higher than or equal to 1/3. (Alkire & Santos, 2011, P.11).

According to the study population of size 68168(after removing records with missing data) the number of multidimensionally poor people is 46842.

Then as stated above, $H = \frac{46842}{68168} = 0.687$

$$A = \frac{27170.29}{46842} = .580$$

$$MPI = H \times A = 0.687 \times 0.58 = 0.398$$

Therefore, in Sri Lanka the percentage of persons who are of age greater than or equal 10 years, deprived along the dimensions considered in the study is 39.8 %. Bourguignen & Chakravarty (2003) explains an alternative way to consider multidimensional poverty, specifying a poverty line for each dimension. Then, if the person is below at least in one of these different lines that person is considered as poor. Next, he combines these various lines and associated one dimensional gaps to obtain a multidimensional poverty measure.

Zeng et al. (2022) applied a fuzzy set approach to evaluate MPI where calculation of weights of different dimensions depends on the intensity of the deprivations. This gives an unequal weighting system overcoming the deficiency of equal weighting system in AF method.

Lecobane (2022) emphasizes the fact that estimating MPI at household level underestimates the poverty of the society and does not show intra-household inequalities.

4.2. Effect of variables in the study on the national MPI

A logistic regression was carried out to assess the effect of age, ethnicity, gender, marital status, asset ownership, health, education, structure of the house, electricity, drinking water, cooking fuel and sanitation on the likelihood of being multidimensionally poor.

Table 2: Significant variables in the modal fitted for national data

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	Age	-.003	.001	7.092	1	.008	.997	.994	.999
	Ethnicity			416.182	3	.000			
	Ethnicity(1)	1.053	.062	284.755	1	.000	2.867	2.537	3.241
	Ethnicity(2)	1.316	.178	54.861	1	.000	3.730	2.633	5.284
	Ethnicity(3)	.827	.064	168.978	1	.000	2.287	2.019	2.591
	Health(1)	8.986	.233	1492.102	1	.000	7993.664	5066.654	12611.608
	Education(1)	5.712	.171	1111.493	1	.000	302.553	216.251	423.297
	Structure(1)	3.602	.246	214.407	1	.000	36.689	22.653	59.423
	Electricity(1)	4.709	.802	34.457	1	.000	110.938	23.027	534.462
	DrinkingWater(1)	5.428	.148	1340.238	1	.000	227.647	170.240	304.413
	CookingFuel(1)	15.093	.347	1886.976	1	.000	3588673.386	1816260.749	7090709.129
	Sanitation(1)	9.518	.242	1551.752	1	.000	13600.017	8469.837	21837.545
	Constant	-15.582	.353	1950.613	1	.000	.000		

a. Variable(s) entered on step 1: Age, Ethnicity, Health, Education, Structure, Electricity, DrinkingWater, CookingFuel, Sanitation.

The overall model was statistically significant when compared to the null model, ($\chi^2(11)$ =70665.591, p < 0.001), explained 90.7% of the variation of being multidimensionally poor.(Nagelkerke R^2) and correctly predicted 94.6 % of cases. Age ($p < 0.05$), ethnicity ($p<0.001$), health ($p<0.001$), education ($p<0.001$), structure ($p<0.001$), electricity ($p<0.001$), drinking water ($p<0.001$), cooking fuel ($p<0.001$) and sanitation ($p<0.001$) were significant but gender, marital status and asset ownership were not.

Therefore, at the national level, the following can be obtained:

The odds of being multidimensionally poor for people who are deprived of health are very much higher than that of those who are not deprived of health where a person is deprived of health if that person suffers from chronic illnesses which are Cancer, Diabetes, Asthma, Blood Pressure, heart conditions and Kidney diseases.

The odds of being multidimensionally poor for people who are deprived of cooking fuel are very much higher than that of those who are not deprived. A person is considered to be deprived of cooking fuel if that person does not have electricity or gas for cooking.

The odds of being multidimensionally poor for people who are deprived of sanitation are very much higher than that of those who are not deprived. A person is considered deprived of sanitation if a toilet is not available within the unit exclusive for the household or not available outside the unit exclusive for the household.

Therefore, it is revealed that multidimensional poverty is strongly linked to age and ethnicity but not to gender. Also, the analysis showed that apart from age and

ethnicity, Health, Education, Structure, Electricity, Drinking water and Cooking fuel are strongly linked to multidimensional poverty.

Descriptive statistics shows that out of three dimensions, living standards do the greatest contribution to multidimensional poverty in Sri Lanka. Cooking fuel is the indicator which contributes most to MPI.72.5% of people are deprived of cooking fuel which means they do not use electricity or gas for cooking.

55.1% and 40.4% are percentages of deprivations in sanitation and drinking water respectively. In other words 55.1% people do not have a toilet available within the unit exclusive for the household or not available outside the unit exclusive for the household and 40.4% people do not have access to drinking water from a protected well within the premises or from a tap inside home or from a tap within unit/premises.19.7% people are deprived in Health which means they suffer from chronic illnesses such as Cancer, Diabetes, Asthma, Blood Pressure, heart conditions and Kidney diseases while 16% people are deprived in education. In other words, the highest education attained by 16% of people is less than "Passed sixth grade in school". 4.6% of the population in Sri Lanka is deprived of the structure of the house as explained in methodology while 2.5% of the population does not have access to electricity.

4.3. Regional Analysis of MPI

Regions are considered as districts and only 23 districts were taken for the study due to data restrictions. Therefore 23 regional MPIs were obtained according to the proposed approach.

Table 3: Regional MPIs in ascending order

District	MPI	District	MPI
Colombo	0.112	Matale	0.504
Gampaha	0.206	Ratnapura	0.527
Kalutara	0.288	Badulla	0.529
Galle	0.353	Anuradhapura	0.530
Kandy	0.369	Mannar	0.531
Ampara	0.385	Polonnaruwa	0.544
Batticaloa	0.406	Nuwaraeliya	0.557
Trincomalee	0.406	Monaragala	0.557
Matara	0.409	Killinochchi	0.559
Kegalle	0.482	Jaffna	0.561
Kurunagala	0.483	Mullaittivu	0.563
Puttalam	0.490		

Source: Authors computation based on HIES – 2016

From table 3, it is shown that with respect to multidimensional poverty Colombo district is the lowest and Mullaittivu district is the highest. In other words, only 11.2% of people in Colombo district are multidimensionally poor while 56.3% of people in Mullaittivu are multi-dimensionally deprived.

A logistic regression was carried out for each region to assess the effect of age, ethnicity, gender, marital status, assets ownership, health, education, structure, electricity, drinking water, cooking fuel and sanitation on the likelihood of being multidimensionally poor.

According to the analysis, multidimensional poverty in cooking fuel is high in all 23 districts. Apart from that, the people in Gampaha, Kalutara, Matale, Vavuniya, Batticaloa, Ratnapura, Kegalle district are relatively more deprived in Health and people in Nuwara Eliya, Hambantota, Jaffna, Monaragala relatively more deprived in sanitation, people in Mannar relatively more deprived in drinking water and sanitation, people in Ampara are more deprived in drinking water, people in Mullaitivu, Kilinochchi, Anuradhapura relatively more deprived in education In each of these districts, more than 68% people are deprived of cooking fuel as they do not use gas or electricity for cooking due to availability of firewood at very low cost compared to gas or electricity. The highest percentage of deprivation of cooking fuel is in Nuwara Eliya district. Matale, Nuwaraeliya, Matara, Hambantota, Jaffna, Vavuniya, Puttalum, Polonnaruwa, Monaragala and Ratnapura are the districts where more than 61% people are deprived of sanitation. More than 60% of people are deprived of drinking water in Nuwara Eliya, Hambantota, Jaffna and Puttalam districts.In Jaffna, Vavuniya, Batticaloa, Ampara, Puttalum districts more than 62% people are deprived of asset ownership.

5. CONCLUSION

According to the study 68.7% of people in the population of Sri Lanka, whose age is greater than or equal to 10 years are multidimensionally poor. The proposed MPI is obtained using 8 indicators grouped into 3 dimensions: Living standards, Health, Education. Living standards comprises of electricity, sanitation, drinking water, cooking fuel, asset ownership, structure of the house. Health consists of only chronic illnesses indicator. Education dimension comprises highest educational qualification.

The study provides an overview of the current status of multidimensional poverty in Sri Lanka and identifies districts which are lagging behind. It would help to outline a plan of action identifying priority areas for improvement. Analysis by regions has shown higher concentrations of poverty in some districts. More than 30% of people in Kandy, Matale, Nuwaraeliya, Matara, Hambantota, Jaffna, Vavuniya, Batticaloa, Ampara, Kurunegala, Puttalam, Polonnaruwa, Monaragala, Ratnapura and Kegalle districts are multidimensionally poor. Highest percentage of multidimensionally poor people are in Nuwaraeliya district.

Further, from this study it is clear that there are differences in weights among dimensions as well as among indicators which contradicts the equal weighting system applied by the OPHI. Multidimensional poverty is strongly linked to demographic factors such as age and ethnicity but not to the gender. Cooking fuel, sanitation, health, education and drinking water indicators make significant contributions to the national multidimensional poverty in Sri Lanka.

Therefore, policy makers should explore specific types of interventions to implement an effective targeting policy in reducing inequalities between districts. Further research should be carried out with improvements in data collection to design a comprehensive strategy to fight against multidimensional poverty at district level.

One of the important gaps in the existing literature is non-availability of a dimension "Recreation and entertainment" which shows the status of emotional satisfaction of a person. The future research is also suggested on issues related to intra-household inequalities which will enable policy makers to obtain a more detailed picture of both structure and dynamics of poverty in the society.

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