INDIAN JOURNAL OF POPULATION AND DEVELOPMENT
Volume 2(1), January 2022: 1-24

Child Vulnerability across Life Cycle in District Chhindwara of Madhya Pradesh, India

Aalok Ranjan Chaurasia

Abstract

This paper analyses child vulnerability in the rural areas of district Chhindwara, Madhya Pradesh, India following a vulnerability criterion related to the well-being of children. The analysis reveals that close to half of children in the rural areas of the district are vulnerable in the sense that they have higher probability of an adverse outcome or a welfare loss in different domains of well-being that are relevant to the age of the child. The analysis also reveals that vulnerability among children of the district is influenced by child level as well as household level and village level factors. The paper class for improving the organisational effectiveness of child well-being efforts to mitigate the vulnerability faced by the children of the district.

Background

Children are not full social and economic agents. They need care and support for their survival, physical growth, cognitive development, and protection from a range of social, economic, and environmental hazards. If the care and support is missing or if it is inadequate, the normal growth and development of the child is compromised, and the child becomes vulnerable in the sense that it has relatively higher probability or chance of an adverse outcome or welfare loss which has implications for the well-being of the child. To mitigate the vulnerability faced by children, specific interventions focussing on different domains of child well-being – survival, physical growth, cognitive development, and protection from a range of social, cultural, economic, and environmental hazards - constitute an integral component of every social and economic development agenda. These interventions are directed towards specific dimensions grouped into four domains of child well-being and universal coverage of these interventions is argued to be necessary to mitigate child vulnerability. A simple, yet straightforward, approach to measure vulnerability faced by children may, therefore, be evolved in terms of the coverage of different interventions that are specifically directed towards different domains of child well-being - interventions that secure survival, promote physical growth and cognitive development, and ensure protection of children from social, cultural, economic, and environmental hazards. If the coverage of these

interventions is not universal, then, a proportion of children is left vulnerable in at least one dimension of child well-being and the lower the coverage the higher the proportion of vulnerable children.

The concept of child vulnerability has frequently been discussed in child development and child rights literature (Schweiger, 2019; Jopling and Vincent, 2016; Brown, 2011), but there is no universally accepted framework for analysing child vulnerability (OECD, 2019). A vulnerable child has been defined as the one whose basic rights including right to survive, right to growth and development, and right to protection remain unfulfilled (Skinner et al, 2006). This definition, however, is difficult to be quantified, although it is possible to quantify some situations or conditions that make a child vulnerable in specific dimensions of child well-being. For example, children born with a low birth weight have relatively higher risk of death during childhood compared to children born with normal birth weight so that children born with a low birth weight may be classified as vulnerable children as far as the survival dimension of child well-being is concerned.

Measurement of child vulnerability and identification of factors associated with it is important from at least three perspectives. The first is related to the monitoring of the coverage different interventions that are directed to specifically mitigate child vulnerability. The second rationale of measuring, and analysing determinants of child vulnerability is related to informing resources requirements necessary for providing adequate care and protection to every child so that survival, growth, development, and protection of the child can be ensured. Lastly, measuring, and analysing child vulnerability is needed to generate the evidence necessary for properly targeting different child well-being interventions so as to increase their effectiveness and maximise their impact. Child vulnerability analysis is also necessary to create a constituency for the well-being of children. Children are the future of the mankind and roots of the well-being of the future generation lie in the well-being of children.

Child vulnerability, however, is highly contextual as the extent and the nature of care and support to children is determined by a host of social, cultural, economic, and environmental factors that operate at the level of the child as well as at the level of the family and the community. Child vulnerability is also influenced, up to a significant extent, by the organisational effectiveness of the agencies involved in the delivery of child well-being services. The situation is compounded further because the well-being needs of children of different ages are essentially different so that meeting the well-being needs of children is essentially a multidimensional perspective. As such, some children are more vulnerable than others given the same social, cultural, economic, and environmental context.

In this paper, we measure the vulnerability faced by children and analyse factors associated with it in children living in the rural areas of district Chhindwara of Madhya Pradesh, India. Madhya Pradesh is one of the poorly developed states of the country. It has the dubious distinction of having the highest risk of death during infancy

(Government of India, 2022a) and in the first five years of life (Government of India, 2022b). The state also has the lowest probability of survival during the childhood period in the country which suggests that child vulnerability in the state is quite pervasive and has persisted over time. District Chhindwara had an area of 11815 square Kms and a population of around 2.1 million at the 2011 population census which was distributed across 1906 villages and 24 towns. Around 24 per cent of the district population lives in the urban areas as defined at the 2011 population census. Scheduled Tribes constitute almost 37 per cent population of the district whereas Scheduled Castes constitute about 11 per cent. The effective literacy rate or the proportion of the population aged seven years and above who can read and write with understanding was around 71 per cent at the 2011 population census while the work participation rate was almost 46 per cent. However, more than 44 per cent of the work force was engaged as agricultural labourer. The under-five mortality rate in the district is estimated to be 57 under-five deaths for every 1000 live births in the year 2017 (Chaurasia, 2021). According to the latest round of the National Family Health Survey, the proportion of women who had at least four antenatal care visits during their last pregnancy was only 67 per cent but more than 92 per cent of deliveries in the district were reported to be institutional deliveries. Around 44 per cent children below 3 years of age were reported to have been breastfed within one hour of the birth whereas around 65 per cent children aged 12-23 months were found to be fully immunised. On the other hand, around 24 per cent children aged 0-5 years were found to be stunted whereas almost 33 per cent were found to be underweight (Government of India, 2021).

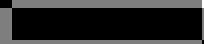
The paper is organised as follow. The next section of the paper describes the conceptual framework that has been adopted for constructing a vulnerability index for measuring and analysing child vulnerability. Section three describes the data used to measure child vulnerability and analyse its determinants. Estimates of the child vulnerability index and its covariates are presented in section four. Section five analyses determinants of child vulnerability using the multilevel logistic regression analysis approach which recognises that child vulnerability is influenced by individual, household, and community level factors. The last section of the paper summarises the main findings of the analysis and puts forward a set of recommendations to reduce child vulnerability.

Conceptual Framework

We conceptualise child vulnerability in terms of the age of the child and in terms of dimensions of child well-being. Consideration of the age of the child is important as the well-being needs of children of different age are different and all child well-being needs are not relevant to all children. On the other hand, different dimensions of child well-being can be grouped into different domains of child well-being. The conceptual framework maps the well-being needs of children of different ages to different domains of child well-being. From the perspective of well-being,

children can be divided into five age-groups: 1) 0-1 year; 2) 1-3 years; 3) 3-6 years; 4) 6-14 years; and 5) 14-19 years. Similarly, different child well-being interventions can be grouped into four domains of well-being – survival, physical growth, cognitive development, and protection and each domain is relevant to children of different age groups. For example, the most relevant well-being domain for children aged 0-1 year is survival domain whereas the most relevant domain for children aged 1-3 years is physical growth domain. Table 1 presents the relevance of different domains to children of different age groups - the darker the colour of the cell the more relevant the domain for the age group. We consider only the most relevant domain for the construction of the vulnerability index for children of different ages.

Table 1: The relevance of different child well-being domains in analysing vulnerability in children of different ages.

Age	Domains of child well-being			
	Survival	Physical growth	Cognitive development	Protection
0-1 year				
1-3 years				
3-6 years				
6-14 years				
14-19 years				

Remarks: The darker the colour of a cell, the more relevant is the domain of child well-being for the analysis of child vulnerability.

Source: Author

Table 2: Age- and domain-specific child well-being dimensions identified for the construction of vulnerability index.

Age of the child	Domains of child well-being			
	Survival	Growth	Development	Protection
0-1 year	Full antenatal care during pregnancy	Breastfeeding		
		Nutrition		
	Birth registration			
1-3 years	Full immunisation	Nutrition		
		Vitamin A		
3-6 years		Nutrition	Early childhood education	
6-14 years		Nutrition	Schooling	No paid work
14-19 years		Nutrition	Schooling	No paid work

Source: Author

The next step in the construction of the child vulnerability index is to identify key dimensions in different domains of child well-being that is relevant for children of different age groups in accordance with the conceptual framework presented in table 1. We have identified 15 dimensions grouped into four domains of child well-being (Table 2). For example, care and attention during pregnancy is a key child well-being dimension which is directed to reducing the adverse survival outcome in children aged 0-1 year. Similarly, schooling is an important child well-being dimension that is directed towards reducing the welfare loss in terms of the cognitive development of children aged 6-14 years whereas prevention of child labour is an important child well-being dimension that is directed towards protecting children aged 6-19 years from a range of social, economic, and environmental hazards.

Based on table 2, the child vulnerability criterion for constructing the child vulnerability index is summarised in table 3. The criteria follow the counting approach to classify a child as vulnerable or not vulnerable. For example, a child aged 0-1 year is classified as vulnerable if the mother of the child had not received full antenatal care during pregnancy, or if the birth of the child is not registered, or if breastfeeding was not initiated within one hour of the birth of the child or if the child is low weight-for-age. Similarly, a child aged 1-3 years is classified as vulnerable if the child is not fully immunised or if the child is stunted or low height-for-age or if the child has not received five doses of Vitamin A prophylaxis and a child aged 3-6 years is classified as vulnerable if the child has low body mass index-for-age or if the child is not attending an early childhood education centre. In the same manner, children aged 6-14 years and 14-19 years may be classified as vulnerable following table 3.

Table 3: The vulnerability criteria for children.

Age	A child is classified as vulnerable if
0-1 year	1. Mother of the child did not have at least four antenatal care visits during pregnancy, or 2. Child is not breast fed within one hour of birth, or 3. Birth of the child is not registered, or 4. Child is low weight-for age.
1-3 years	1. Child is not fully immunised, or 2. Child is low height-for-age, or 3. Child has not received 5 doses of Vitamin A prophylaxis.
3-6 years	1. Child is not attending the early childhood education centre, or 2. Body mass index of the child is low for age.
6-14 years	1. Child is not attending school, or 2. Body mass index of child is low for age, or 3. Child is working outside home for money.
14-19 ears	1. Child is not attending school, or 2. Body mass index of the child is low for age, or 3. Child is working outside home for money.

Source: Author

The vulnerability index for children of a given age group may now be calculated simply as the proportion of the vulnerable children to the total children in that age group. Finally, the child vulnerability index covering all children (0-19) years may be calculated as the ratio of the sum of the vulnerable children in different age groups to the sum of all children in different age groups. It is obvious that the child vulnerability index so calculated ranges between 0 and 1 so that the child vulnerability index also reflects the probability of a child being vulnerable in the context of the respective dimension of different domains of child well-being. When the child vulnerability index is 0, there is no child who is vulnerable or has relatively high probability or chance of an adverse outcome or welfare loss in any of the 15 dimensions of the four domains of child well-being considered in the present analysis. On the other hand, the higher the child vulnerability index the higher the probability of adverse outcome or welfare loss. When the index is equal to 1, child vulnerability is universal.

Data

The data for the study come from a household survey that was carried out in 2019 in the rural areas of district Chhindwara of Madhya Pradesh, India. The survey covered 1000 households from 100 villages which were selected through a two-stage sample selection procedure. In each selected household, information related to different dimensions of child well-being was collected from all children (persons aged 0-19 years) through direct interview with the head of the household. When the head of the household was not available, information was collected from a responsible adult member of the household. The survey identified 1500 children aged 0-19 years in 1000 households.

The analysis of the collected data was carried out in three stages. At the first stage, every child was classified as vulnerable or not vulnerable according to the vulnerability criterion described in table 2. Based on this classification the child vulnerability index was calculated for children of different age groups and for all children. In the next step, bivariate analysis was carried out to analyse village, household, and child level covariates of child vulnerability and to get first-hand idea about how village-specific, household-specific, and child-specific factors influence child vulnerability. Subsequently, multi-level, logistic regression analysis was carried out to determine village, household, and child level determinants of child vulnerability. Finally, children were classified according to their vulnerability status and their distinguishing individual, household, and village level characteristics. Recursive partitioning technique was adopted for the classification modelling exercise.

The villages covered under the study varied widely in terms of their social, economic, and demographic characteristics. The population of the villages surveyed ranged from 36 to 6926 with a median population size of 661 while the average household size ranged from 3.44 to 6.26 with a median of 4.81 according to the 2011 population census. Similarly, the proportion of population below 7 years of age ranged

from 8.2 to 24.8 per cent while the population sex ratio ranged from 782 to 1192 females for every 1000 males and was favourable to females in Scheduled Tribes but highly unfavourable to females in the literate and working population. The entire population of some of the villages was Scheduled Tribes whereas in some villages, there was virtually no Scheduled Tribes population. The same was the case with Scheduled Castes. Around 44 per cent villages surveyed were within a distance of 20 Kms from their respective sub-district headquarters whereas around 5 per cent villages were at a distance of more than 60 Kms (Table 4). More than four-fifth of the villages were connected through surfaced road. Health facility of any type was available in only 15 per cent villages.

In majority of the villages, villagers had very little knowledge about the existence of Village Health, Nutrition and Sanitation Committee. Even in those villages where villagers knew about the Committee, there was little knowledge about the meeting of the Committee. The Village Health and Nutrition Day was also reported to be organised in only 60 per cent of the villages. However, ASHA (Accredited Social Health Activist) was available in 95 per cent of the villages but in some villages, she did not live in the village. In 3 villages, there was no Aanganwadi Centre and in 7 villages, the Aanganwadi Worker did not stay in the village. In 5 villages, there was no school. In 91 villages, a government school was available, but in most of the government schools, the staff did not stay in the village. The availability of facilities like safe drinking water was also found lacking in most of the villages. In most of the villages, the drainage system was in poor shape and in at least 70 villages, water clogging was common.

The characteristics of the households surveyed were also quite diverse. The religion of most of the households was Hindu but majority of the Hindu households belonged to either Scheduled Tribes or Scheduled Castes. More than 53 per cent of the households surveyed were below the poverty line. Almost 95 per cent of the households had their own house, but the proportion of households having a pucca house was small. Moreover, more than 38 per cent households were single room households. The most common source of drinking water in the households surveyed was either the public tube well or the public hand pump. Only about four-fifth of the households were having latrine in the household premises but there was no proper drainage system in most of the households. Separate kitchen was not available in more than 44 per cent of the households surveyed. Wood and cow dung cakes was the most common cooking fuel, although around 15 per cent of the households surveyed were having an LPG connection. Electricity was not available in about 10 per cent households. The most common household asset was the mobile phone. Television was available in around 50 per cent of the households whereas two-wheeler auto vehicle was available in one third of the households surveyed. Other household assets were available in only a small proportion of the households surveyed.

During the survey, information about the availability of 13 household assets was also collected from every household surveyed. Based on the availability of these household assets, a standard of living index was constructed for every household

through the application of the factor analysis technique. This exercise suggested that the household standard of living index was the poorest (less than 20 per cent) in almost 60 per cent of the households surveyed. Based on the availability of household assets, the standard of living was found to be either poor or very poor in most of the households surveyed. There was only a small proportion of the households surveyed where the standard of living as measured through the household standard of living index was at least average.

The survey identified 1500 children aged 0-19 years in 1000 households from 100 villages covered under the study. The sex ratio of the children enumerated during the study was 958 girls aged 0-19 years for every 1000 boys aged 0-19 years. Around 6 per cent of the children were aged 0-1 year; around 12 per cent in aged 1-3 years; around 17 per cent aged 3-6 years; around 37 per cent aged 6-14 years; and around 28 per cent aged 14-19 years according to the information given by either the head of the family or any other family member. Around 38 per cent children were the first child of their parents whereas around 35 per cent children were second order births and 28 per cent children were third and higher order births.

Child Vulnerability

The classification of children according to the vulnerability criteria given in table 3 suggests that child vulnerability was quite pervasive in the rural areas of the district. It is estimated that around 46 per cent children aged 0-19 years in the rural areas of the district were vulnerable in at least one of the 15 dimensions of child well-being. Child vulnerability is found to be the highest, almost universal, in the age group 1-3 years. In this age group more than 90 per cent children were classified as vulnerable - having relatively higher risk probability of an adverse outcome or welfare loss because they were either not fully immunised or were stunted (low height-for-age) or they had not received five doses of Vitamin A prophylaxis. Similarly, in the age group 0-1 year, more than 73 per cent children were found to be vulnerable in the sense that either the mother of these children did not have at least four antenatal visits during pregnancy, or these children were not breastfed within one hour of birth or they were low weight-for-age, or their birth was not registered as required by the law. In the age group 14-19 years, on the other hand, around 52 per cent children were classified as vulnerable as they were either not attending the school or their body mass index was low age, or they were engaged in some paid work outside the home (Table 4).

It is logical to argue that a child may be classified as vulnerable in more than one dimension of different domains of child well-being. It may also be argued that the higher the number of dimensions in which the child is classified as vulnerable the deeper and more complex the vulnerability faced by the child. This analysis, however, reveals that child vulnerability in the district was generally not deep and complex. Around 41 per cent children aged 0-1 years were found to be vulnerable in only one dimension of the survival domain whereas there was no child in this age group who was

vulnerable in all the four dimensions child well-being relevant to this age group (Table 5). On the other hand, child vulnerability appears to be quite complex and deep in children aged 1-3 years as almost 20 per cent of children of this age group are classified as vulnerable in all the three dimensions of child well-being relevant to the age group whereas less than one third of children of this age group are classified as vulnerable in only one dimension. There were less than 10 per cent children in this age group who are not classified as vulnerable in any of the three dimensions of child well-being relevant to the age group. The physical growth domain of child well-being is the most relevant domain of child well-being for children of this age group. In children aged 14-19 years also, a small proportion of children is classified as vulnerable in all the three dimensions of child well-being relevant to the age group. Table 5 suggests that the depth or the complexity of child vulnerability is not the same for children of different age groups. This means that an age-specific approach should be adopted to reduce child vulnerability.

Table 4: Child vulnerability by the age of the child in District Chhindwara, Madhya Pradesh

Vulnerability criteria	Age of the child in years				
	0-1	1-3	3-6	6-14	14-19
Mother did not receive full antenatal care (%)	23.7				
Birth not registered (%)	14.0				
No breastfeeding within 1 hour of birth (%)	37.6				
Low weight-for-age (%)	36.6				
Not fully immunised (%)		36.7			
Low height-for-age (%)		56.1			
Not received 5 doses of Vitamin A (%)		76.1			
No registered in early childhood education (%)			2.4		
Low body mass index-for-age (%)			23.1	26.2	23.8
Not attending school (%)				7.8	33.5
Working for money outside home (%)				1.6	17.1
Child vulnerability index	0.731	0.911	0.231	0.333	0.521

Source: Author

Table 5: Depth of child vulnerability

Age	Proportion (Per cent) of children by the number of dimensions in which they are vulnerable						N
	0	1	2	3	4	All	
0-1 year	26.9	40.9	25.8	6.5	0	0	93
1-3 years	8.9	32.8	38.9	19.4		19.4	180
3-6 years	76.9	22.3	0.8			0.8	251
6-14 years	68.9	29.3	1.8	0		0	550
14-19 years	47.7	34.2	15.1	3.4		3.4	426
0-19 years	54.9	24.4	18.2	3.7	0	3.7	1500

Source: Author

Covariates of Child Vulnerability

The village level, household level and child level covariates of child vulnerability are presented in table 6. The probability of a child being vulnerable is more than two times higher in villages which were connected by unsurfaced road compared to villages connected by surfaced road. Similarly, probability of a child being vulnerable is almost 13 per cent higher in villages at a distance of more than 50 Kms from the sub-district headquarters compared to villages at a distance of less than 20 Kms. Child vulnerability is found to be more than 16 per cent higher in villages where children constituted at least 15 per cent of the village population compared to villages where child population was less than 10 per cent. On the other hand, child vulnerability is found to be around 22 per cent lower in villages having effective literacy rate at least 60 per cent compared to villages having effective literacy rate less than 40 per cent. However, effective female literacy rate does not have any impact on child vulnerability. The proportion of main workers in the labour force in the village, however, has an impact on child vulnerability. The probability of a child being vulnerable is more than 50 per cent higher in those village where main workers constituted at least 60 per cent of the village labour force.

The education of the head of the household is found to be directly related to vulnerability risk of children in the household. The probability of a child being vulnerable is found to be almost 30 per cent less in households where the household head was educated at least up to high school level compared to households where the household head was illiterate. Similarly, child vulnerability risk is found to be substantially higher in households of other religions compared to households of Hindu religion. Moreover, child vulnerability risk is found to be directly related to the household standard of living. The probability of a child being vulnerable is estimated to be almost 20 per cent lower in non-poor households compared to very poor households as identified through the household standard of living index. Similarly, in households without latrine, the probability of a child being vulnerable is found to be more than 25 per cent higher compared to households having latrine while this probability is 40 pr cent higher in households having mixed kitchen compared to households having separate kitchen. The child vulnerability risk is found to be almost 20 per cent lower in household using LPG for cooking compared to households using wood and cow dung. On the other hand, the probability of a child being vulnerable is found to be more than 34 per cent higher in household using coal for cooking compared to households using wood and cow dung for cooking.

The probability of a child being vulnerable, or the child vulnerability risk is found to be associated with the sex of the child and its birth order. The vulnerability risk in the surveyed households is found to be marginally lower in girls a=compared to boys. On the other hand, the child vulnerability is found to increase with the increase in the birth order of the child. The probability of a child being vulnerable is found to be more than 15 per cent higher in 3rd and higher birth order children compared to 1st birth order children. Similarly, the probability of a child being vulnerable is found to be almost 7 per cent higher in 2nd birth order children compared to 1st birth order children.

Table 6: Village, household, and child level covariates of child vulnerability in district Chhindwara, Madhya Pradesh.

Covariates	Child vulnerability		Risk ratio	Odds ratio	N
	Index	Odds			
Village level covariates					
Village connectivity					
Surfaced road	0.456	0.838	1.000	1.000	1204
Unsurfaced road all weather	0.485	0.942	1.064	1.123	265
Unsurfaced road dry weather	0.645	1.817	1.414	2.168	31
Distance from sub-district headquarters					
Less than 20 km	0.434	0.767	1.000	1.000	603
20-50 km	0.460	0.852	1.060	1.111	705
50 km and more	0.464	0.866	1.069	1.129	192
Child population					
Less than 10 per cent	0.422	0.730	1.000	1.000	90
10-15 per cent	0.473	0.898	1.121	1.229	711
15 per cent and more	0.459	0.848	1.088	1.162	699
Effective literacy rate					
Less than 40 per cent	0.530	1.128	1.000	1.000	134
40-60 per cent	0.441	0.789	0.832	0.700	513
60 per cent and more	0.467	0.876	0.881	0.777	853
Effective female literacy rate					
Less than 40 per cent	0.455	0.835	1.000	1.000	308
40-60 per cent	0.465	0.869	1.022	1.041	763
60 per cent and more	0.466	0.873	1.024	1.045	429
Main workers as proportion to all workers					
Less than 40 per cent	0.393	0.647	1.000	1.000	369
40-60 per cent	0.468	0.880	1.191	1.359	329
60 per cent and more	0.494	0.976	1.257	1.508	802
Household level covariates					
Education of household head					
Illiterate	0.496	0.984	1.000	1.000	704
Below high school	0.423	0.733	0.853	0.745	586
High school and above	0.410	0.695	0.827	0.706	210
Religion					
Hindu	0.461	0.855	1.000	1.000	1476
Others	0.709	2.436	1.538	2.849	24
Social Class					
Scheduled Castes	0.422	0.730	1.000	1.000	136
Scheduled Tribes	0.465	0.869	1.102	1.190	930
Others	0.464	0.866	1.100	1.186	434

Covariates	Child vulnerability		Risk ratio	Odds ratio	N
	Index	Odds			
Number of living rooms					
1	0.453	0.828	1.000	1.000	570
2	0.471	0.890	1.040	1.075	862
3 and more	0.450	0.818	0.993	0.988	68
Latrine in the house					
Yes	0.450	0.818	1.000	1.000	1185
No	0.506	1.024	1.124	1.252	315
Kitchen in the house					
Separate	0.415	0.709	1.000	1.000	641
Mixed	0.499	0.996	1.202	1.404	859
Cooking fuel used					
Wood and cow dung cake	0.468	0.880	1.000	1.000	1289
Coal	0.542	1.183	1.158	1.345	24
LPG	0.422	0.730	0.902	0.830	187
Household assets					
None	0.504	1.016	1.000	1.000	125
At least one	0.460	0.852	0.913	0.838	1375
Household standard of living index					
Very poor	0.462	0.859	1.000	1.000	889
Poor	0.466	0.873	1.009	1.016	524
Non-poor	0.412	0.701	0.892	0.816	97
Child level factors					
Sex					
Boy	0.466	0.873	1.000	1.000	766
Girl	0.460	0.852	0.987	0.976	734
Birth order					
1	0.445	0.802	1.000	1.000	567
2	0.461	0.855	1.036	1.067	519
3 and higher	0.480	0.923	1.079	1.151	414

Source: Author

Classification of Children

Table 6 suggests that child vulnerability is influenced by child level as well as household and village level factors which operate simultaneously so that there is substantial degree of endogeneity among child, household, and village level factors affecting child vulnerability. Since child-level factors of child vulnerability are nested in households and households are nested in the village, we have adopted the classification modelling approach, or the segmentation approach for classifying children in terms of their vulnerability status. The classification modelling approach involves classifying

children into one of the several mutually exclusive categories – each category having distinct child-level, household-level and village-level factors that influence the vulnerability status of children using data mining techniques (Han et al, 2012; Tan et al, 2006). The classification modelling approach is different from the regression-based approach that is commonly used for analysing marginal effects of the defining characteristics of children on child vulnerability (Chaurasia, 2012). Unlike the regression-based approach, there is no restriction or limitation on the structure of the independent variables or the defining characteristics of children which are used as explanatory variables in the classification modelling exercise. In the most general terms, the classification or the segmentation emanating from the classification modelling exercise is based on a set of *if-then* logical conditions that permit splitting or classifying or segmenting children into mutually exclusive groups of children. The approach is non-parametric, recursive partitioning approach which allows for specifying a large number of potential influencing variables, which may even be more than the number of observations in the data set. It can be applied to both quantitative and attribute data and the combination of the two.

There are different classification modelling techniques available. These include logistic regression, naïve Bayes, stochastic gradient descent, K-nearest neighbours, decision tree, and support vector machine. We have adopted the decision tree approach of classification modelling in the present analysis. Decision tree approach is simple to understand and visualise, requires little data preparation, and can handle both numerical and categorical data. There are different methods available to construct a decision tree (Song and Lu, 2015). These include CART (Classification and Regression Tree) (Brieman et al, 1984), C4.5 (Quinlan, 1993), CHAID (Chi-squared Automatic Interaction Detection) (Kas, 1980), and QUEST (Quick, Efficient, Unbiased Statistical Tree) (Loh and Shih, 1997). used the classification and regression tree method in the present analysis. The method sort children into mutually groups based on the explanatory variables in such a way that the group homogeneity with respect to the dependent variable – the vulnerability status of the child – is the maximum (Chaurasia, 2018). The process is repeated until either the perfect similarity is achieved, or the pre-decided stopping criteria is met (Ambalavanan et al, 2006; Lemon et al, 2003). The method can be applied to both categorical and continuous dependent variables. If the dependent variable is categorical one, the method provides distribution of the dependent variable in each group or category identified. If the dependent variable is continuous one, then the method estimates of arithmetic mean and standard deviation of the dependent variable in each group. Since the dependent variable in the present case is a categorical one, the classification and regression tree method provided the estimate of child vulnerability index for each group. The variation in the child vulnerability index or the proportion of vulnerable children across the mutually exclusive groups so identified makes it possible to explore how child vulnerability varies given the child-level, household-level, and village-level factors that are different for different groups. Actual calculations were carried out using the Classify routine of the software Statistical Package for Social Sciences (SPSS).

Table 7: Results of the classification modelling exercise showing how village level factors, household level factors and child level factors influence child vulnerability in the context of different dimensions of child well-being.

Age	Village level characteristics *Approach road*	Household level characteristics *Education of family head* *Social class* *Latrine in the house* *Separate kitchen* *Fuel used for cooking*	Child level characteristics *Sex* *Birth order*	Child vulnerability index	N
0-1 year	All	All	All	0.731	93
	Surfaced			0.694	72
	Unsurfaced			0.857	21
1-3 years	All	All	All	0.911	180
	Surfaced		Girl	0.945	73
			Boy	0.848	66
	Unsurfaced			0.951	41
3-6 years	All	All	All	0.231	251
	Surfaced	Family head education below middle		0.275	143
		Family head education above middle		0.146	48
	Unsurfaced	Scheduled Castes/Scheduled Tribes		0.125	48
		Other Castes		0.417	12
6-14 years	All	All	All	0.333	550
	Surfaced	Family head education below middle		0.348	330
		Family head education above middle		0.243	103
	Unsurfaced	Scheduled Castes/Scheduled Tribes		0.318	85
		Other Castes		0.500	32

Age	Village level characteristics *Approach road*	Household level characteristics *Education of family head* *Social class* *Latrine in the house* *Separate kitchen* *Fuel used for cooking*	Child level characteristics *Sex* *Birth order*	Child vulnerability index	N
14-19 years	All	All	All	0.521	426
	Surfaced	Latrine in the house		0.468	279
		No latrine in the house		0.706	68
	Unsurfaced	Separate kitchen		0.379	29
		No separate kitchen		0.680	50
All	All	All	All	0.463	1500

Source: Author

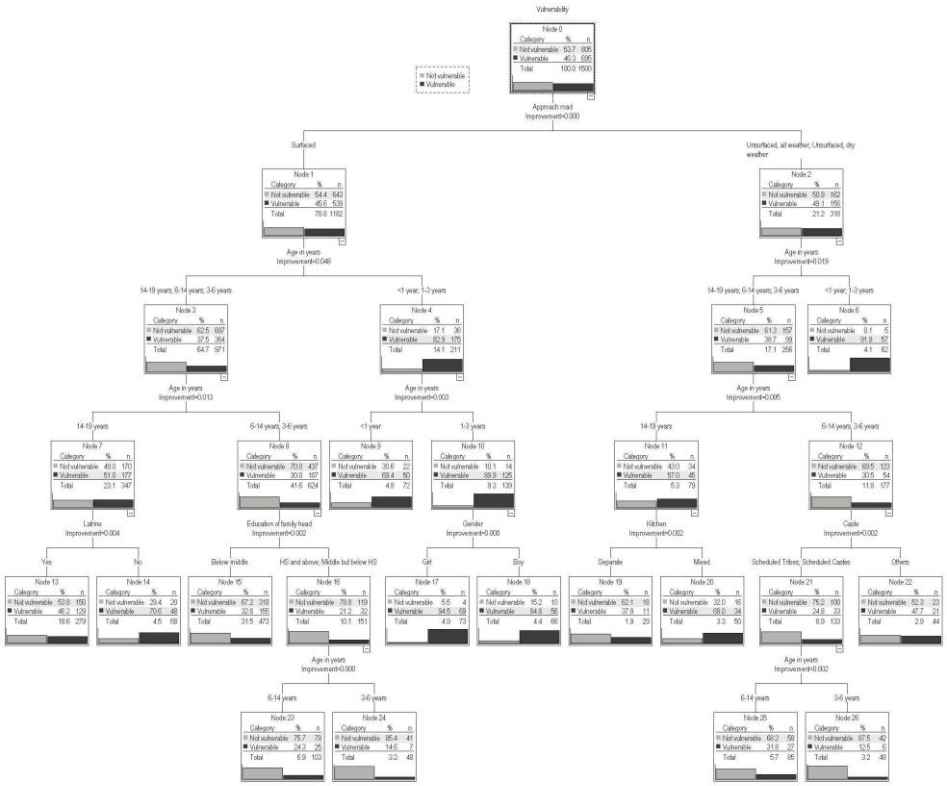


Figure 1: Classification of children by their distinguishing child level, household level and village levels characteristics and child vulnerability in different groups

Results of the classification modelling exercise are presented in table 7 and the classification tree is depicted in figure 1. The exercise suggests that the 1500 children can be divided into 14 mutually exclusive and exhaustive groups and each group has distinct child-specific, household-specific, and village-specific characteristics. Moreover, the child vulnerability index or the proportion of vulnerable children to total children is different in different mutually exclusive groups. In children below 1 year of age, it is the connectivity of the village which is the key determinant of child vulnerability. Child vulnerability is substantially lower in children aged 0-1 year living in those villages which are connected through the surfaced road as compared to children living in villages which are not connected through the surfaced road irrespective of whether the unsurfaced road is an all-weather road or only a dry weather road. The effect of the type of road connectivity of the village on the vulnerability of children aged 1-3 years is also very strong. On the other hand, in villages connected through a surfaced road, the vulnerability in girls aged 1-3 years is found to be substantially higher than the

vulnerability in boys of the same age group and living in villages connected through a surfaced road. In villages not connected through the surfaced road, there appears no impact of different distinguishing characteristics of children on vulnerability in the context of child well-being.

In children aged 3-6 years, education of the head of the family matters is an important household level factor in deciding child vulnerability in villages which are connected by a surfaced road while social class matters in child vulnerability in villages which are not connected through a surfaced road. In children living in villages connected through a surfaced road, child vulnerability is lower in those households in which the head of the household is having at least middle level of education compared to child vulnerability in households where the head of the household is either illiterate or having less than middle level education. On the other hand, in villages not connected through a surfaced road, child vulnerability is found to be very high in Other Castes households compared Scheduled Castes and Scheduled Tribes households.

In children 6-14 years also, the level of education of the head of the household and the social class of the household are the main influencing factors of child vulnerability and the pattern is very similar to that in children aged 3-6 years, although child vulnerability is relatively higher in children aged 6-14 years as compared to children aged 3-6 years. Interestingly, in children of this age group also, child vulnerability is found to be comparatively lower in Scheduled Castes and Scheduled Tribes households in villages which are not connected through a surfaced road as compared to child vulnerability in Other Castes households.

Finally, in children aged 14-19 years, availability of latrine in the household appears to be the most important factor in deciding child vulnerability in villages connected through a surfaced road whereas a separate kitchen in the household matters the most in deciding child vulnerability in villages not connected through a surfaced road. In villages connected through a surfaced road, child vulnerability is substantially high in households without latrine compared to households having a latrine. Similarly, in villages not connected through a surfaced road, child vulnerability is substantially higher in households not having a separate kitchen compared to households having separate kitchen.

Among the 14 mutually exclusive groups identified through the classification modelling exercise, vulnerability is found to be the highest in girls aged 1-3 years living in villages connected with a surfaced road. In this group of children almost 95 per cent children are found to be vulnerable in the context of the physical growth domain of child well-being. Gender discrimination appears to play a crucial role in deciding child vulnerability in children below 1 year of age living in village connected by a surfaced road. Household level factors appear to play little role in deciding the vulnerability status of children of this group. Child vulnerability is also found to be very high in children below 3 years of age living in villages not connected by a surfaced road and in children aged 14-19 years living in households not having latrine in villages connected

by a surfaced road or in households not having separate kitchen in villages not connected by surfaced road.

On the other hand, vulnerability is found to be the lowest in Scheduled Castes and Scheduled Tribes children aged 3-6 years living in villages not connected by a surfaced road. Vulnerability is also very low in children aged 3-6 years of those households of villages connected by a surfaced road where the head of the household is having at least middle level education. Less than 15 per cent children of this group have been found to be vulnerable in the context of the cognitive development domain of child well-being.

Discussion and Conclusions

Madhya Pradesh has the dubious distinction of having the highest risk of death during childhood (Government of India, 2022). This means that vulnerability of children of the state in the context their well-being which can be conceptualised in terms of survival, physical growth, cognitive development of children and their protection from a range of social, cultural, economic, and environmental hazards is unacceptability high. However, very little is currently known about the factors that contribute to unacceptably high child vulnerability in the state. Children are the future of the society and their vulnerability in terms of survival, physical growth, cognitive development, and protection has implications for social and economic development and improvement in the quality of life. Mitigating child vulnerability, therefore, is an integral component of any social and economic development agenda. Investing in children is investing in the future of the society.

The present paper, based on a primary survey carried out in the rural areas of district Chhindwara of Madhya Pradesh, India reveals that child vulnerability in the context of child well-being is quite pervasive in the district and a cause of development concern. Classification of children as vulnerable or not vulnerable was carried out following a 15-point vulnerability criterion which assumes that the dimensions of vulnerability are age-specific and different for different domains of child well-being. The development of the vulnerability criterion was based on mapping the most relevant domain of child well-being to children of different ages.

The present analysis reveals that nearly half of the children in the rural areas of the district appear to be vulnerable in terms of increased probability of adverse outcome and expected welfare loss in the sense that these children are not covered through specific interventions directed towards securing survival, ensuring normal physical growth and cognitive development, and protecting children from social, cultural, economic, and environmental hazards. The analysis reveals that vulnerability varies widely by the age, sex, and birth order of the child. In children aged 1-3 years, vulnerability appears to be nearly universal as more than 90 per cent children of this age group have not been found to be vulnerable in terms of at least one dimension of

child well-being relevant for the age. Child vulnerability has also been found to be very high in children aged 0-1 year and children aged 14-19 years. On the other hand, vulnerability is found to be higher in girls compared to boys and in higher birth order children compared to children of first birth order. Vulnerability is found to be particularly marked in girls aged 1-3 years.

Both household level and village level factors have been found to influence child vulnerability in addition to child-specific factors. The most important household factor having bearings on child vulnerability is the education of the head of the household. Child vulnerability is found to decrease with the increase in the education of the head of the household. Household standard also has bearings on child vulnerability. More specifically, vulnerability in children aged 14-19 years is found to be high in households not having latrine and not having a separate kitchen.

At the village level, the most important factor influencing child vulnerability is the village connectivity. Child vulnerability is found to be relatively high in villages not connected by a surfaced road. It appears that the delivery of child well-being services in the rural areas of the district are contingent upon the village connectivity and delivery of these services are not up to the mark in villages where connectivity is a problem. The situation appears to be particularly serious in those villages which get cut off from the rest of the world during the rainy season. In these villages, delivery of child well-being and child welfare services is disrupted during rains which results in higher vulnerability of children living in these villages.

The analysis suggests that children in the rural areas of the district can be segmented or grouped into 14 mutually exclusive groups and each group has distinct individual, household, and village level characteristics. Moreover, child vulnerability, as measured in terms of the child vulnerability index, varies widely across these mutually exclusive groups. In children aged 0-3 years, it is the village connectivity which is the key determinant of child vulnerability. On the other hand, children aged 1-3 years, vulnerability is markedly high in girls as compared to boys in villages connected through a surfaced road. In villages not connected through a surfaced road, there is little distinction in vulnerability faced by girls and boys. In children aged 3-6 years, it is the education of the head of the family that matters the most in villages connected through a surfaced road while social class matters in villages not connected through a surfaced road. In children aged 6-14 years also, education of the head of the family and the social class of the household are the main influencing factors of child vulnerability. Finally, in children aged 14-19 years, availability of a latrine or a separate kitchen in the household are the key influencing factors.

The sensitivity of child vulnerability or the proportion of children having higher probability of adverse outcomes or welfare loss to a host of child-level, household-level and village-level highlights the complexities involved in mitigating child vulnerability in the prevailing social, economic and cultural context. Most of the factors influencing child vulnerability are exogenous to the child well-being services delivery system and

reflect the impact of the prevailing social, cultural and economic environment on child vulnerability. These factors can be address only through a broader development approach that focuses on broader social and economic development.

At the same time, exceptionally high child vulnerability in the rural areas of the district also reflects the poor organisational effectiveness of child well-being services and interventions. Ideally, all child well-being and child welfare services are designed to deliver a comprehensive set of child well-being services to all children irrespective of social, cultural, and economic characteristics of children. The present analysis, however, reveals that child well-being and child welfare services are neither able to reach all children nor able to deliver comprehensive child well-being and child welfare services so as to mitigate child vulnerability. The prevailing child well-being and child welfare services do not appear to be able to counter the exogenous factors of child vulnerability. It is well known that the only way to address the exogenous factors that contribute to child vulnerability is to improve the organisational effectiveness of child well-being and child welfare services. The current organisation of child well-being and child welfare services in the district seems to be wanting in this regard.

The limitations of the current organisation of child well-being and child welfare services in mitigating child vulnerability appear to be both conceptual and operational. A mapping of the goals and objectives of a number of child well-being and child welfare schemes on the 15-point vulnerability criteria adopted in the present study suggests that there is no scheme, programme or intervention which addresses all the dimensions of child vulnerability in a comprehensive yet cohesive manner. The current approach to mitigating child vulnerability can best be described as fragmented and piece-meal. There does not appear to be any scheme, programme or intervention that follows the child right from the day of conception to the time the child reaches18 years of age and ensures that the child receives a comprehensive set of services and entitlements necessary for its well-being which vary with the age of the child. The need of such an approach was emphasised by the First Health Survey and Development Committee in India (commonly known as Bhore's Committee) way back in 1946 (Government of India, 1946) but it could not be materialised till to date. All the schemes that are currently in vogue focus on selected aspects of child well-being but ignores other aspects and thus contribute to child vulnerability. Individually, these schemes may be efficient in their own context, but they are collectively inefficient in mitigating child vulnerability as revealed through the present analysis.

At the same time, the poor to very poor organisational effectiveness of individual interventions or schemes directed towards a specific component of child well-being as characterised in terms of survival, physical growth, cognitive development, and protection of children, especially, at the local level also appears to be a major concern in mitigating child vulnerability. There is a need to carry out a comprehensive organisational effectiveness analysis of different child well-being and child welfare schemes at the local level by linking inputs into the scheme or intervention to outcomes and impact via processes and outputs. The present analysis, however, suggests that

there is significant scope of improving the organisational effectiveness of different ongoing schemes, programmes and interventions at the local level, the interface with the community. There are many factors endogenous to the child well-being services delivery system that constrain the delivery of child well-being and child welfare services at the local level, thereby affecting the efficacy of these services in mitigating child vulnerability. Very little is currently known about these endogenous factors. However, improving the organisational effectiveness of the ongoing child wellbeing and child welfare services is important because child vulnerability attributed to factors exogenous to the child well-being and child welfare services delivery system can best be addressed through improving the needs effectiveness and capacity efficiency of the child well-being and child welfare services.

In conclusion, the present analysis reveals that an unacceptably high proportion of children in the rural areas of the district are vulnerable. It appears that child well-being services in the district are, either conceptually or operationally, not effective enough to address the vulnerability faced by children. The vulnerability faced by the children of the district have also been found to be influenced by a host of factors exogenous to child well-being services delivery system. This implies child vulnerability is essentially a broader development concern and not just delivery of specific child well-being interventions. It is, therefore, important that mitigating child vulnerability is recognised as a priority development agenda. It must also be recognised that one way of addressing child vulnerability is to improve the organisational effectiveness of child well-being services, particularly, at the local level, the interface with the people. A comprehensive analysis of the organisational effectiveness of child well-being services at the local level, therefore, is the need of the time. Such an analysis will also help in assessing up to what extent existing child well-being services are able to overcome household and village level factors of child vulnerability. At the same time, it is also important to analyse how the resources and inputs made available to meet the well-being needs of children are get translated into positive outcomes for children which are necessary to mitigate child vulnerability in the context of their well-being – survival, physical growth, cognitive development, and protection from a range of social, cultural, economic, and environmental hazards.

References

Ambalavanan N, Baibergenova A, Carlo WA, Saigal S, Schmidt B, Thorpe KE (2006) Early prediction of poor outcome in extremely low birth weight infants by classification tree analysis. *The Journal of Pediatrics* 148(4): 438.e1-444.e1.

Brieman L, Friedman JH, Olshen RA, Stone CJ (1984) *Classification and Regression Trees*. Boca Raton, CRC Press.

Brown K (2011) 'Vulnerability': Handle with care. *Ethics and Social Welfare* 5(3): 313-321.

Chaurasia AR (2012) Contraceptive use in India: a data mining approach. *International Journal of Population Research*. Volume 2014, Article ID 821436.

Chaurasia AR (2018) The state of development in villages of India: an analysis of 2011 census data. *Indian Journal of Human Development* 12(3): 305-325.

Chaurasia AR (2021) A non-parametric approach to small areas estimation with application to Madhya Pradesh, India. *Indian Journal of Population and Development* 1(2): 185-208.

Government of India (1946) *Report of the Health Survey and Development Committee.* New Delhi, Ministry of Health, and Family Welfare.

Government of India (2021) *National Family Health Survey (NFHS - 5) 2019-21. Compendium of Fact Sheets. Key Indicators India and 14 States/UTs (Phase – II)*. New Delhi, Ministry of Health, and Family Welfare.

Government of India (2022a) *Sample Registration System (SRS) - Bulletin 2022 Volume 55-1*. New Delhi, Office of the Registrar General and Census Commissioner India.

Government of India (2022b) *Sample Registration System (SRS) - Statistical Report 2019*. New Delhi, Office of the Registrar General and Census Commissioner India.

Han J, Kamber M, Pei J (2012) *Data Mining: Concepts and Techniques*. Amsterdam, Elsevier.

Jopling M, Vincent S (2016) *Vulnerable Children: Needs and Provision in the Primary Phase, CPRT Research Survey 6 (New Series)*. Cambridge, Cambridge Primary Review Trust.

Kass GV (1980) An exploratory technique for investigating large quantities of categorical data. *Applied Statistics* 29: 119-127

Lemon SC, Roy J, Clark MA, Friedmann PD, Rakowski W (2003) Classification and regression tree analysis in public health: methodological review and comparison with logistic regression. *Annals of Behavioral Medicine 26*(3): 172–181.

Loh W, Shih Y (1997) Split selection methods for classification trees. *Statistica Sinica* 7: 815-840.

OECD (2019) *Changing the Odds for Vulnerable Children: Building Opportunities and Resilience*. Paris, OECD Publishing.

Quinlan RJ (1993) *C4.5: Programs for Machine Learning*. San Mateo, California, Morgan Kaufmann Publishers, Inc.

Schweiger G (2019) Ethics, poverty, and children's vulnerability. *Ethics and Social Welfare* 13(3): 1-14.

Skinner D, Tsheko N, Mtero-Munyati S, Segwabe M, Chibatamoto P, Mfecane S, Chandiwana B, Nkomo N, Tlou S, Chitiyo G (2006) Towards a definition of orphaned and vulnerable children. *AIDS and Behavior*10(6): 619-26.

Tan P-N, Steinbach M, Kumar V (2006) *Introduction to Data Mining*. New Delhi, Pearson Education.

World Bank (2005) *The OVC Toolkit for SSA. A Toolkit on How to Support Orphaned and Other Vulnerable Children (OVC) in Sub-Saharan Africa (SSA)*. Washington, DC, The World Bank.