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A MULTIDIMENSIONAL APPROACH TO CHILD POVERTY: THE CASE OF VIETNAM

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DECLARATION

I, hereby, declare that the Thesis entitled "*A multidimensional approach to child poverty: the case of Vietnam*" submitted to the Consortium of Erasmus Mundus International Development Studies in 2020 is my original work. The study has not been submitted to any university or academic organizations before. The information derived from previous works has been duly cited in the text and reported in the reference list.

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Zásady pro vypracování

The study is conducted to approach the gap in measuring multidimensional child poverty at an individual-based level. The main goal of the study is to conduct the multidimensional poverty index for child poverty. The specific objectives include (1) exploring dimensions and indicators which compose the child poverty in the context of Vietnam, (2) evaluating the contributions of determinants to the child poverty and to each dimension and (3) proposing suggestions and implications to improve the deprivations in children in Vietnam. The theoretical background is referred to previous studies (i.e. Asselin and Anh, 2008; Espinoza-Delgado and Klasen, 2018; Le, Nguyen and Phung, 2014; Mahadevan and Hoang, 2016; Musiwa, 2019; Qi and Wu, 2015; Vijaya, Lahoti and Swaminathan, 2014). The principle dataset used for the study is drawn from the most recent Vietnam Household Living Standards Survey in 2016 by the General Statistics Office, Vietnam. In terms of methodology, the Analytic hierarchy process will be exploited to develop the scale for each item in each dimension of poverty. Next, Factor analysis and Cluster analysis will be used to find out the items constructing dimensions and classify each child into different groups ranging from non-poor to poor, respectively. Afterward, logit regression estimation will be employed to determine what affect the risk of being multidimensionally poor of a child. The main statistical tool for handling and analyzing data is Stata version 14.1.

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ABSTRACT

The study aims to establish a comprehensive framework to measure multidimensional child poverty in Vietnam. The study evaluates the deprivations of 9693 Vietnamese children, whose data is drawn from the Vietnam Household Living Standard Survey 2016. The study employs factor analysis and cluster analysis to find poverty dimensions and identify multidimensionally poor children. The results show that from 18 proposed indicators, child poverty is measured by five dimensions: social security, food security, shelter quality, living conditions, and information access. Based on the poverty dimensions, Vietnamese children are clustered into four groups ordering from multidimensionally poor to non-poor. Two poorest groups of children are characterized by either acute social insecurity or food insecurity, respectively. Partially poor children are deprived of information access. Non-poor children have adequate conditions in most dimensions. The study finds that the age of children, geographical location, family conditions, and household-head characteristics are determinants of the probability of being multidimensional poor in children. The study also proposes and suggests child-specific strategies to reduce poverty and improve the living standards of Vietnamese children.

Keywords: child poverty, food security, information access, living conditions, multidimensional poverty, Vietnam.

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LIST OF ABBREVIATIONS

FAO	Food and Agriculture Organization of the United Nations
GSO	General Statistics Office
ILO	International Labor Organization
MIC	Ministry of Information and Communication
NIN	National Institute of Nutrition
OPHI	Oxford Poverty & Human Development Initiative
UDHR	Universal Declaration of Human Rights
UN	United Nations
UNFPA	United Nations Population Fund
UNCRC	Convention on the Rights of the Child
UNDP	United Nations Development Program
UNICEF	United Nations Children’s Fund
VHLSS	Vietnam Household Living Standards Survey
WB	World Bank
WEF	World Economic Forum
WFP	World Food Program

CHAPTER 1 INTRODUCTION

Children play a crucial role in the prosperity of a country. The development and learning process of children are the foundation and motivation for the well-being and evolution of society (UNICEF, n.d.). The shortage of children will lead to a decline in human capital accumulation. Moreover, it also causes the age imbalance in population and burdens the social security. Mainly, a low fertility rate contributes to the aging population. The decline in the working population results in the inefficient use and allocation of material capital per capita and a relatively higher proportion of the old-age population. The elderly has lower productivity or merely depends on social security services or social assistance (Weil, 2006). Fertility rates of some developed countries such as the Republic of Korea, Japan, Italy and Spain have been lower than 1.5 for more than two decades (WB, n.d.) while the globally recommended rate is 2.1 (UN, 2017). These countries have implemented many policies to increase immigration and/or encourage citizens to have more children to sustain society (Boling, 2008; Lutz et al., 2003).

Child poverty has a significant influence on the well-being of an individual and a society. Poverty limits opportunities to access education, healthcare, and social participation. Children experiencing persistent poverty are not fully entitled to many fundamental human and children's rights (Minujin, 2012; Ogwumike & Ozughalu, 2018; Pemberton et al., 2012). They grow up with limited social skills and low education and thus, become less competitive in the labor market and gain lower earnings. Poverty in childhood is associated with poverty in adulthood and the long-term (Wang & Man, 2019). In other words, they are trapped in the vicious cycle of poverty (Ogwumike & Ozughalu, 2018). Notably, they end up having restricted capability and resources to prepare for and invest in the next generations to escape from poverty. When a vast proportion of children live in poverty, the economy is likely to have low human capital accumulation and quality and reduced productivity and economic output (Wang & Man, 2019). Problems regarding social security and employment for low-skilled laborers become heavier burdens to the economy. In the United States, the annual economic cost of child poverty is estimated at 500 billion dollars and accounts for approximately 4% of GDP (Holzer et al., 2008).

The way poverty and child poverty defined and measured provides essential instructions and substantive solutions to combat poverty. Child poverty traditionally bases on the concept of monetary poverty. Child poverty is usually aligned with the overall household poverty (Abdu

& Delamonica, 2018; Ogwumike & Ozughalu, 2018; Qi & Wu, 2015). A child considered monetarily poor is when he/she lives in a family of which average income or consumption is lower than an accepted threshold. The monetary definition and measures seem to be easily interpreted by the public and internationally or nationally-comparable. However, the solution to monetary poverty is to increase household income, which does not directly eradicate child poverty and relevant issues (Abdu & Delamonica, 2018). The higher household income does not capture how the money is allocated and spent and assure the access to public services (Alkire & Santos, 2013; Le et al., 2014). Many public services have non-market values. Additionally, this approach also fails (i) to capture natural and social needs-related differences between adults and children, (iii) to inform the distribution of household income within members and purposes (Ogwumike & Ozughalu, 2018), (iii) to incorporate the non-market-based goods which are influential to child well-being (Leu et al., 2016; Minujin et al., 2006).

Multidimensional indices help to evaluate poverty more comprehensively when incorporating basic human needs; hence, compensate for shortcomings of unidimensional monetary lines. Poverty is not only the problem of lack of financial source but also the deprivation of capabilities to access, achieve and utilize the fundamental resources for functionings (Le et al., 2014; Trani & Cannings, 2013). In many cases, children experience the deprivations might not be considered monetarily poor (Minujin et al., 2006). Within two decades, several studies, reports, and projects approached child poverty multidimensionally (Duke University, n.d., n.d.; Ferrone et al., 2019; Ge & Wang, 2019; Gordon et al., 2003; Hague, 2008; Leu et al., 2016; Trani & Cannings, 2013; UNICEF Vietnam, 2015; Young Lives, n.d.). Designs and applications of indices and dimensions captured various aspects of poverty, such as educational attainment, cognitive achievement, nutrition, child care, child labor, living standards, essential housing services, and so on.

Multidimensional measure reveals a more transparent picture of poverty in Vietnam. Vietnam's population is ranked at 15th internationally and soon reached 100 million in 2026 (GSO & UNFPA Vietnam, 2016c). Vietnam was one of the pioneers applying ten non-monetary indices along with income-based standard, as the official poverty measurement in 2015 (OPHI, n.d.; UNDP Vietnam, 2018). Ten dimensions covered education, healthcare, health insurance, housing, water, sanitation, telecommunication service, and information access. Vietnam still has around 9 million poor people living under national standards. Only 36% of the population are not deprived of any indicators in terms of multidimensional poverty in 2016 (UNDP Vietnam, 2018). Whereas, based on the international line, only 2% of the Vietnam population live below 1.98 US dollars per day in 2016 (WB, 2019). Many people are not financially poor but lack access to social services or drinkable water, sanitation, and vice versa (Le et al., 2014; Pimhidzai, 2018; UNDP Vietnam, 2018). Multidimensional indices show that poor people are underrepresented if only using monetary lines. They also shed light on inequality in terms of region, gender across the areas, and subnational regions. The multidimensional poverty rate in children below 16 is higher than in other age groups (UNDP Vietnam, 2018). Approximately 5.5 million children are deprived of at least two from education, health, nutrition, shelter, water, and social inclusion (UNICEF, 2018).

There are several studies conducted to measure and map the poverty in Vietnam. However, most of them focus on the household level (Asselin & Anh, 2008; Le et al., 2014; Mahadevan & Hoang, 2016; UNDP Vietnam, 2018) or only aim at measuring living conditions of a subgroup of children (UNICEF Vietnam, 2015). The extent of child poverty aspects that these indices and dimensions reflect and encompass are still simple and generally not applicable to all Vietnamese children. The methodologies and techniques to identify the poor employed in these studies are also varied, namely Alkire-Foster methods, Venn diagram, latent class analysis, multiple correspondence analysis. Therefore, this study aims to (1) propose indicators and dimensions to measure child poverty in Vietnam, (2) evaluate the poverty situations and features of children, (3) identify the determinants of child poverty and (4) offer suggestions that help lift children out of poverty sustainably. The study particularly uses factor analysis, cluster analysis, and ordered logistic regression as the analyze children data from Vietnam household living standard survey (VLHSS). These methods are applied in many previous studies on poverty (Alkire & Santos, 2013; Luzzi et al., 2008) but are novel in child poverty research and the context of Vietnam. The following chapter explains the approach of the study and selection of indicators and dimensions. Chapter 3 reviews adopted methodology. Chapter 4 elaborates on the results from statistical analysis. Chapter 5 are the discussion of findings and policy implications.

CHAPTER 2 LITERATURE REVIEW

2.1 Children’s right-based poverty approach

Convention on the Rights of the Child ratified in 1989 and implemented in more than 190 country members is seen as a reference to evaluate child poverty by specific conditions. Children's rights associating with their unique needs, rights, and responsibilities regarding their ages (UNICEF, n.d.) are set out in the Convention with 42 out of 54 articles. As every human being below the age of eighteen, children deserve the same rights as other individuals to have a decent living standard. Children are dependent on others from birth for the provision of needs and most easily vulnerable and strongly affected by the cultural, political, social, and economic environment (Ferrone et al., 2019; Ogwumike & Ozughalu, 2018). They have the right to be a part of families, protected from discrimination, abuse, trafficking and violence. They should also have privacy, voice, and views respected (*UNCRC*, 1989). Missing rights or having low basic living standards in childhood may limit a child's full potentials to develop comprehensively and have adverse causal effects on his/her later outcomes (Minujin et al., 2006; UNICEF, n.d.). Thus, these rights emphasize the importance of a unique and multidimensional measure for child poverty besides the monetary measure.

Trani & Cannings (2013), UNDP (2010), UNICEF (2008) emphasize that definition of child poverty should also base on specific and distinct aspects, which have impacts on the full development of children. The concept of deprivation could be a good proxy for poverty and child poverty. It could to cover many aspects related to the living standard and basic needs which are not necessarily dependent on income (Gordon et al., 2003). The deprivations prevent children from exercising their basic rights, affect the physical and mental development of children, reduce the potentials, and their ability to break the vicious circle of poverty when they grow up ((Minujin et al., 2006; Ogwumike & Ozughalu, 2018).

This study employs the child rights-based approach to define multidimensional child poverty. A group of deprivation indicators is used to measure child poverty. A child is considered multidimensionally poor when his/her living standards, which are a range of physical and social supports and services, are below the minimally acceptable level (Leu et al., 2016; Musiwa, 2019). He/she suffers deprivations related to material, spiritual and emotional resources. In many child poverty studies, i.e. Ferrone et al. (2019), Gordon et al. (2003), Young Lives (n.d.), deprivations can be considered violated children’s rights. Children’s rights play instrumental roles and assist in identifying the poor and combating child poverty (Minujin et al., 2006; Pemberton et al., 2012).

2.2 Dimensions of child poverty

Studies about child poverty show that the selection of scales, indicators, and dimensions is greatly conditional upon the context and data availability. Although children in more than 190 countries are entitled to the same rights, the poverty of children in developing countries is different from that in developed countries. Long-term studies and projects directly collecting data on aspects of children's lives can cover more precisely the children's deprivations and track the outcomes of poverty. Whereas, studies using national household survey have a limited choice of indicators and deprivations. Some dimensions, such as educational attainment or access to healthcare, can be measured. In contrast, some others are too broad and cannot be embraced by one indicator or easily quantified, i.e., social participation or respect for children's views.

In this study, the selection of indicators and dimensions relies on the VHLSS database. Dimensions of child poverty include: social security, food security, shelter, living conditions, and information access. These dimensions are acknowledged as basic rights that every child should be well-deserved (Qi & Wu, 2015) to achieve comprehensive development and fulfill his/her potentials. They are empirically found to have significant long-lasting impacts on child well-being and child development (Gordon et al., 2003).

Education access

Education is one of the most fundamental needs and an important instrument in poverty alleviation and development (Becker, 1995; Berg, 2008). The right to access to education for everyone is recognized in the Universal Declaration of Human Rights (1948) and the Convention on the Right of the Child (1989). Notably, in Article 28 of *UNCRC (*1989), primary education needs to be compulsory and provided free, secondary education should be developed in various forms and obtainable to every child. Article 29 emphasizes that education shall aim at the "development of the child's personality, talents, and fundamental freedoms"(*UNCRC*, 1989). Universal primary education achievement is Goal 2 in Millennium Development Goals (2000). Failure to achieve an educational level is reckoned as capability poverty (Espinoza-Delgado & Klasen, 2018). Education and training add more values to the process of human capital accumulation and then translate into productivity and wage rate increase (Berg, 2008). A highly educated person has more opportunities in the job market and earns a higher income than a low educated one. There are also some positive links between education and lower criminal involvement (Lochner & Moretti, 2004) and higher probability of political participation (Persson, 2015).

The indicator to measure the educational attainment of children is whether they attended school in the past 12 months. However, children below six might not go to kindergarten. Education of the head is used as the proxy for that of children who are below six and do not attend any kind of pre-school (Espinoza-Delgado & Klasen, 2018).

Healthcare access

Access to healthcare is also one of the primary public services and as crucial as access to education. Every child has the right to attain the best standard of health and utilize health establishments and medical assistance for illness treatment (*UNCRC*, 1989). Article 24 of UNCRC (1989) indicates that the achievement of this right should be gauged through the decline in child mortality and morbidity, child malnutrition, and the increase in knowledge of the public about child health. Indeed, the expansion of public healthcare insurance programs for children results in a significant reduction of child mortality and child morbidity (Currie & Gruber, 1996). Access to basic healthcare services is found to impact childhood health positively and later health outcomes in studies by Cohodes et al., (2016), Currie & Gruber (1996).

In this study, health insurance coverage is used as a proxy for healthcare access. Health insurance is viewed as an instrument to utilize health care services when it makes primary services available free and reduces the medical burden in case of hospitalization and severe illness treatment (Mebratie et al., 2019). Health insurance helps to promote equality in access to healthcare services between privileged people and marginalized, disable, and vulnerable people (Brown et al., 2000). Insurance coverage puts children in a better path of childcare, which lowers the probability of contracting preventative illnesses and contributes to yield better health conditions in adulthood (Currie et al., 2008). The vaccination coverage is higher among insured children than that of uninsured children (Hill et al., 2016; Smith et al., 2006).

Access to education and access to healthcare are closely linked. Free formal childcare is available to every child below six, while health insurance is mandatory to students at all school levels in Vietnam. On the one hand, children having poor health usually have low educational achievement (Currie & Madrian, 1999). Cohodes et al.(2016) show that insurance programs covering many groups of children have close links to higher rates of people obtaining high-school and higher-education degrees. On the other hand, higher education leads to better health input processes (Currie & Madrian, 1999). DeWalt et al. (2004) shows the association between literacy and health outcomes, including health status, health knowledge, utilization of healthcare, and investment in healthcare. The indicators measuring education and healthcare access still have some shortcomings. School attendance does not encompass the actual knowledge amount and skills a child obtains or reflects the education quality provided to the child. It only represents the opportunity to "be exposed to a learning environment" (Alkire & Santos, 2010, p.14 in Espinoza-Delgado & Klasen, 2018). Similarly, health insurance fails to capture the degree of utilization of childcare services as well as the efficiency of the health and insurance system.

Food security

Deprivation of food is one of the violations of basic human rights and has a long-lasting effect on child development. Not being nourished adequately prevents a person from enjoying a decent living standard (*UNCRC*, 1989; *UDHR*, 1948). Children are not nourished adequately because their family lacks access and resources to acquire sufficient food in term of quantity and quality for every member (Cook & Frank, 2008; Gundersen & Ziliak, 2015). In other words, it is the result of food insecurity. Children, who are food-insecure in early years of life or whose mother is food-insecure during pregnancy, are at higher risks of some certain birth defects of the brain and spine (Carmichael et al., 2007). Food-insecure children are more likely to have poorer educational attainment (Alaimo et al., 2001), cognitive and behavioral problems (Cook & Frank, 2008), have increased incidence of chronic diseases, anxiety and aggression (Gundersen & Ziliak, 2015). Poor health in childhood prevents children from participating in social and physical activities (Espinoza-Delgado & Klasen, 2018).

The international anthropometric measure of food security and nutrition is Body Mass Index, which requires information about height and weight. However, the information about height and weight is not available in the database. Basing on household expenditure information in VHLSS, the study employs calorie intake ratio and food expenditure share instead. They are the standardized indicators developed and applied in previous studies (FAO, 2008; WFP, 2017). First, the calorie intake ratio is used to measure the food sufficiency. It is the ratio of total calorie intake to total energy need of a household. The total energy need is the sum of minimally required calories of all members basing on their age and gender. Total calorie intake is the sum of the calorie intake of each food item. The calorie intake of a food item is calculated by multiplying its consumed amount with its corresponding calorie value. The study refers to the Vietnam food composition table (NIN, 2007) for information about the energy value of food items. Second, food expenditure share is the ratio of income part spent on food to total income. It is the proxy for the economic vulnerability (WFP, 2017), which measures whether a household spends too much income purchasing food. In this case, these families are highly vulnerable because they can only devote a small share of their budget to saving or other investment activities such as education or healthcare. However, the food security dimension fails to take into account the diet quality (nutrients) because the information is not available in the VHLSS. Besides, neither of the indicators reports the real amount of food consumption of children in the household.

Shelter quality

Children spend a considerable amount of time at home rather than other places, especially in their early years of life. At home, they have daily interactions and communication with family members. They are chronically exposed to physical and emotional resources and thus obtain learning materials and opportunities (Iltus, 2006). The association between home environment and child development has been studied extensively (Evans et al., 2000, 2001; Leventhal & Newman, 2010; Rollings et al., 2017). Having a deficient shelter is recognized as one of the basic human rights (*UDHR*, 1948) and childrent's rights (*UNCRC*, 1989). Poor housing quality has a significantly negative impact on the psychological well-being of members in the household. An inadequate house usually distresses or frustrates parents and makes them worry about potential problems worsening housing conditions. They are sometimes stricter and impose tighter control over children to minimize the problems. However, they place an invisible burden on their child's psychological health (Evans et al., 2001). Overcrowded dwelling facilitates the transmission of infectious diseases (Gordon et al., 2003). Furthermore, a shelter in the absence of stability, cleanliness, and orderliness also has a damaging impact on children's performance at school and their behavioral development. These children usually have persistence in age-appropriate problem-solving deteriorated (Rollings et al., 2017). Moreover, the higher prevalence of physical hazards and respiratory diseases is found in children living temporary houses or houses with poor indoor quality, flimsy structure, poor construction, and maintenance (Northridge et al., 2010).

Shelter quality is usually incorporated in the framework of the multidimensional (child) poverty in both household-based and individual-based studies. It could be a separate poverty dimension (Gordon et al., 2003; Mahadevan & Hoang, 2016) or with other home indicators construct the living condition dimension (Espinoza-Delgado & Klasen, 2018; UNICEF Vietnam, 2015). In this study, shelter quality is developed as a latent dimension which accounts for observer-based physical condition indicators, in accordance with data availability in VHLSS. Responses regarding housing and living conditions are based on the self-assessment of respondents combined with the observation of interviewers. Information about the primary housing material and flooring, roofing, wall composition, the surface house type is available. Deficient flooring, roofing, and wall composition are closely linked to poor indoor climatic conditions. Small living area, temporary house-type, or a shared-kitchen-and-bathroom house imply the limited numbers of rooms or a crowded residential space. Therefore, they can be used as proxy indicators for structural quality, construction quality, privacy, and shelter stability.

Living conditions

Living conditions, including water supply, sanitation facility, lighting source, and waste management, measure the second dimension of the home environment. They are the primary services and material resources contributing to fundamental living conditions (Bradley & Putnick, 2012) that an individual has the right to enjoy. Thus, the absence of proper housing facilities also affects the functionings of a person. Deprivations of safe water, sanitation, waste treatment, and lighting depend not only on the household income but also on the provision of public services. These indicators are aligned with the Sustainable Development Goal 6 and 7 of which target "universal and equitable access to safe and affordable drinking water, sanitation and hygiene for all" and "universal access to reliable and modern energy service," by 2030 respectively (UN, 2015).

Along with deficient dwelling, they are generally attributed to the high incidence of infant and child mortality in many developing countries (Gunther & Fink, 2010), malnutrition and infectious childhood diseases such as diarrhea (Gordon et al., 2003; Yaya et al., 2018), cholera, sepsis, malaria (Bradley & Putnick, 2012; Howard & Bartram, 2003). Severe water deprivation is the lack of access to clean and safe water sources, long-distance to a water source, and water insufficiency for various purposes such as hydration, personal hygiene, and cooking (Howard & Bartram, 2003). Carrying water daily from long distance is a burden, especially for children and women, in terms of time and potential injuries, and could impact school attendance and time for the study of children (Gordon et al., 2003). Moreover, toilets without a drainage system to handle the sewage and dumping/burying domestic garbage near home contaminate the water source, air, and soil and aggregately facilitate the conditions to spread diseases and undermine health. A household that has electricity access is more likely to expand the social network, communication opportunities and to abandon polluting cooking fuels and facilities, which can cause indoor air pollution and respiratory diseases (Bradley & Putnick, 2012).

The measures for water supply, sanitation, waste management, and lighting are based on their conditions or the types of their services a household gets access to. However, similarly to housing indicators, they are used and shared among family members. It is not possible to assess the actual quantity and the benefits children drive from these facilities and services. Thus, it is assumed that every member has equal access to shelter, facilities, and services, and use them effectively (Espinoza-Delgado & Klasen, 2018).

Information access

In a technically advanced society, the process of knowledge acquirement of children not only depends on teaching and studying activities at school but also is through informal learning materials and mass media. Children have the right to get access to information sources as long as they are beneficial to their comprehensive development in terms of personality, talents, and abilities (*UNCRC*, 1989). Article 17 in *UNCRC (*1989) emphasizes the necessity of producing and diffusing children's books, information, and materials from various sources and channels. Learning and playing resources that children are exposed in their homes such as books and toys stimulate children's exploration, creativity (Livingstone, 2009) and problem-solving skills (Iltus, 2006). The growth of mass media provides a borderless source of knowledge. Through mass media, children entertain, develop new opinions, raise awareness of contemporary events, expand the social network, find more opportunities for communication and learning (Reid-Chassiakos et al., 2016). Mass media also helps improve access to social support systems for disabled children and fosters social integration for marginalized children. Knowledge, information, and education are the keys for children to develop new skills, accumulate experience and fit the demand of the job market; to address their new concerns, interests, and needs; to develop their own identity in a new environment(Livingstone, 2009).

The indicators of information access cover the ownership of some household assets and goods (television, radio, computers, and books) and internet connection. Like shelter and living condition indicators, the ownership does not fully reflect the effective use of these assets and services by children in the household. Furthermore, the indicators do not control the drawbacks of access to mass media. Indeed, mass media also has negative influences on children's health, awareness, and overall development. Children spending a substantial amount of time sitting in front of the television or computer screen are at high risk of obesity, eating disorders, and visual impairment (Brown & Witherspoon, 2002; Reid-Chassiakos et al., 2016). Exposure to unhealthy information can cause stress, pessimistic thoughts and age-inappropriate behaviors such as drinking, smoking, and violence (Brown & Witherspoon, 2002; Livingstone, 2009; Reid-Chassiakos et al., 2016). However, the indicators still present possible learning tools and materials that contribute to children's well-being and partly fulfill children's rights.

CHAPTER 3 DATA AND METHODOLOGY

3.1 Deprivation indicators and dimensions

Five dimensions that are expected to measure child poverty include: (1) social security, (2) food security, (3) shelter, (4) living conditions and (5) access to information. They are considered abstract and latent terms. Indicators are the quantifiable items and help measure dimensions. There are 18 indicators.Table 3.1 describes five dimensions and the associated indicators.

Table 3.1 Definition and measurement of indicators

Items	Description	Scale
Social security		
School enrolment	Attained school over the past 12 months. For children under 6, the head's education is used as the proxy.	1: if yes (or the head completed secondary school) 0: if no (or the head did not complete secondary school)
Health insurance	Have any kind of health insurance over the past 12 months	1: if yes 0: if no
Food security		
Calorie intake ratio	Average adult-equivalent daily amount of food energy consumed compared to the recommended daily amount according to age and gender	Continuous. The values are closer to 1 are better.
Food expenditure share	Proportion of expenditure on food of the total household income per month	Continuous. The lower values imply the better food security condition in economic term.
Shelter		
Poles	Type of pole materials (4 types): reinforcement concrete (4), bricks/stones (3), iron/steel/good wood (2), poor-quality wood/bamboo (1)	From 1 to 4. 1 is the worst material and 4 is the best one.
Roofing	Type of roofing (4 types): reinforcement concrete (4), tiles (3), root slabs (2), leave/straw (1)	
Walls	Type of house wall material (5 types): reinforcement concrete (5), bricks/stones (4), wood/metal (3), calcareous soil/straw (2), bamboo/partition/hardboards (1)	From 1 to 5. 1 is the worst material and 5 is the best one.

Items	Description	Scale
House type	Type of housing accommodation (5 types): villas (5), house with a private kitchen and bathroom (4), house with a shared kitchen or bathroom (3), semi-permanent house (2), temporary and others (1)	
Mean area	Living area per capita (squared meters)	Continuous variable
Living conditions		
Water access	Main water supply (3 types): tap water (3), protected water source (2), unprotected water source (1)	From 1 to 3. 1 is the worst material and 3 is the best one.
Lighting	Main lighting in the househod (3 types): national-grid electricity (3), battery or generator (2), Gas/oil lamps (1)	
Toilet	Type of toilet (2 types): sanitary types (1) and non-sanitary types (0)	1: if sanitary 0: if non-sanitary
Waste management	Method that household treat daily waste over past 12 months (5 types): somebody else collects it (5), landtill burial (4), burning (3), dumping into ponds, lakes, rivers, streams (2), dumping in a nearby site (1)	From 1 to 5. 1 is the worst material and 5 is the best one.
Information		
TV/radio	The household has at least one TV (either color or black and white) or one radio owned by the household	1: if yes 0: if no
Telephone	The household has at least either a landline/ mobile phone	
Computer/laptop	The household has at least a computer/ laptop	
Internet access	The household has access to the internet	
Books	Number of books and/or cartoon stories the household have for the child	From 1 to 10

Source: Author's summarization and elaboration

The scale of the indicators varies from binary to continuous forms. The higher value indicates a better condition in each indicator. Six indicators consisting of school enrolment, health insurance, tv/radio, telephone, computer, and internet access are dummy with 1 assigned to "yes" and 0 assigned to "no". Groups of indicators in "shelter" and "living conditions" dimensions (except mean area) are ordinal and receive more than two values with 1 is the lowest or the worst physical condition, and the highest value is the standardly best condition. Four indicators, which are calorie intake, the share of food spending, mean living area, are continuous. Calorie intake ratio and food expenditure share are proportional compared to the recommended daily intake and the total family income, respectively. Regarding calorie intake ratio, if the value intake is lower than 1, the child is considered not to have enough quantity of food. If the value higher than 1, the child is deemed to consume too much food. The value is better when it is closer to 1. The mean area is measured in squared meters. Books taking values from 1 to 10 depicts numbers of books are bought for children in each household. If the child has more than 10 books at home, the indicator still takes the value of 10.

3.2 Data and sample

The principle data used in this study is drawn from Vietnam Household Living Standard Survey (VHLSS) 2016, which was proceeded in the direction of the General Statistics Office of Vietnam in April 2016. The object of the survey is the members currently residing in the household at the time of the investigation. The unit of the survey is the household. The scale of the survey is the whole country. VHLSS 2016 is the sample-selected survey with the sample size guaranteeing representativeness at the province level and between urban and rural areas. It covers 7640 enumeration areas and 305600 households. The stratified sampling method was designed with two stages: (1) enumeration area selection and (2) household selection. Data collection was performed using the face-to-face survey method. The head was the main respondent providing the household's general information and precise details about resident members. The data is used to analyze fluctuations in population, family planning, and living quality of residents in various aspects of education, health, employment and incomes, expenditures, living conditions, and aid schemes. In total, the survey investigated 9399 households and 35787 individuals in 64 provinces.

The object of this study is children, and the unit of analysis is individual. Thus, the information related to children aged under 17 years old is extracted. Children living in households in different geographical and economic conditions also guarantee the representativeness of children in the country. Individual information includes demographics (resident area, age, gender, family members, and so on), school enrollment, and health insurance. The study focuses on the non-money deprivation in children; thus, the household datasets consisting of living conditions, food expenditures, and food lists, durables are employed. For some responses related to shelter and living condition questions, the values could not be attached, and they are considered as missing values. They account for around 5.4% of the total data. This proportion is acceptable in social science studies (Bennett, 2001) as discarding observations containing these values does not necessarily cause bias. In total, there are 9693 children under 17 in 5519 out of 9399 households to be brought into analysis.

3.3 Methodology

With the first goal to construct comprehensive dimensions of child poverty at the individual level from proposed indicators, exploratory factor analysis is employed. Second, to identify different child groups having various deprivations, I used cluster analysis to categorize children based on their characteristics according to newly created dimensions. Third, in relation to the number of generated child groups, ordered logistic regression is used to examine the potential determinants contributing to child poverty.

In multidimensional poverty measurement, there are several approaches, including the dashboard approach, Venn diagrams, statistical approach, fuzzy sets, dominance approach, and axiomatic approach. Among them, Alkire-Foster measures that incorporate counting and axiomatic methods are the most prevalent and best-known in reports and academic studies about non-monetary deprivations. However, based on the research goals and features and quality of the data, factor analysis, and cluster analysis are preferred in this study. The ultimate research goal is not computing an overall poverty index or setting poverty cut-offs, but (i) establishing relevant and important poverty dimensions for children in Vietnam and (ii) estimating the determinants as well as their contribution to the child poverty. Furthermore, non-monetary child poverty is regarded as a latent concept. Factor analysis provides a broader perspective on deprivations constructing child poverty when more and more indicators can be considered and included in the model. This method also accounts for the joint distribution of deprivations and the role of the relationship between observed indicators and unobserved dimensions to explain the child poverty conception (Alkire et al., 2015). Later, cluster analysis helps find the child groups characterized by specific, distinct dimensions and depriving levels. Besides, the set of indicators is incorporated and combined from different sources and can be considered novel in child poverty measurement. Their scale varies from ordinal to numeric forms. Many indicators use household-specific proxy due to the absence of standard indicators from the original questionnaires and database. The exploratory factor analysis is the ideal choice in the circumstance of data complexity and uncertainty of identifying the most important or relevant indicators in the data (Kline, 1994). Factor analysis and cluster analysis have been applied in studies in multidimensional poverty (Luzzi et al., 2008), welfare, and health inequality (Bollen et al., 2002; Sahn & Stifel, 2003 in Alkire et al., 2015).

3.3.1 Exploratory factor analysis

Factor analysis is a process that transforms a data structure from multiple variables into fewer variables but still retains the principal data information and minimizes information loss (Hair et al., 2010; Kline, 1994). In the context of the study, indicators are observable variables and dimensions are unobservable variables. Dimensions are formed by simplifying the relationships among a large set of initial observable indicators and defining those that highly correlate with each other (Kline, 1994). In other words, dimensions fundamentally incorporate indicators and collectively and meaningfully represent them. Each observable indicator is explained by a few independent latent dimensions and error terms through a linear function.

$$X_i = \beta_{io} + \beta_{i1}D_1 + \beta_{i2}D_1 + \cdots + \beta_{ij}D_j + e_j \quad (\text{j< i}) \qquad (\text{equation 3.1})$$

In the equation 3.1, X_i is the i^{th} indicator and D_j is the j^{th} dimension with the condition j smaller than i as there are more indicators than dimensions. e_j is the error terms which are unexplainable variance of indicators in the model,

$$\mathrm{Var}(X_i) = \underbrace{\beta_{i1}^2 + \beta_{i2}^2 + \cdots + \beta_{ij}^2}_{\text{Communality}} + \underbrace{\sigma_i^2}_{\text{Uniqueness}} \qquad (\text{equation 3.2})$$

In detail, the variance of an indicator contains (1) common variance, which is shared with others to explain the common dimension and (2) unique variance, which is specific to a particular indicator (equation 3.2). The parameters are known as loadings. Loading is the correlation between an indicator and a dimension. The nature of the dimension is defined by loadings (Kline, 1994). The higher loadings are, the greater weight in the structure the indicators account for.

Principal component analysis is applied to extract statistically meaningful dimensions and identify the set of specific indicators explaining each of them. Principal component analysis assumes common variance as the total variance. It will compute to generate dimensions that have the largest proportions of communality (Tryfos, 1998).

The decision on the optimal number of dimensions is based on the eigenvalues and total extracted variance. Only dimensions having eigenvalues greater than 1 and total extracted variance greater than 50% are regarded as significant (Hair et al., 2010). With these conditions, generated dimensions will significantly correlate with at least one indicator and contain more than half of the original information. A scree plot is also used to visualize the optimal number of dimensions to be determined.

For post-estimation, Kaiser-Meyer-Olkin test is used to check the adequacy of sampling for each indicator and overall structure. The requirements are fulfilled when KMO values are higher than 0.5.

Loadings bigger than 0.5 are regarded as practically significant. Loadings ranging from 0.3 to 0.4 are seen as minimal good and meet the minimum requirement of structure explanation (Hair et al., 2010). However, with sample size having more than 9600 observations, loadings larger than 0.3 are acceptable (Hair et al., 2010) and are employed in this study. Orthogonal factor rotation (varimax rotation) is applied to interpret dimensions. Dimensions will be computed using standardized values of indicators and their corresponding loadings as weights..

3.3.2 Cluster analysis

Cluster analysis is a process partitioning objects into different groups using a clustering algorithm. In the context of the study, children as observations are objects of the cluster analysis. The method is used to classify children based on their characteristics in terms of deprivations which are constructed dimensions resulting from actor analysis.

In the family of cluster analysis methods, the k-means method is preferred in this study. K-means method is a member in the category of partitioning methods that separate a dataset having n observations into k exclusive clusters ($k \leq n$). Each cluster contains at least one observation and each observation belongs to only one cluster. Observations are similar to each other in one group and are distinct to observations in other groups in terms of a set of characteristics (Hair et al., 2010; Han & Kamber, 2012).

K-means clustering process employs the centroid-based technique and iterative procedures to distribute observations (Han & Kamber, 2012). First, *k* group centers are randomly selected from *n* observations in the dataset, and they initially represent their groups. Next, other observations are assigned to a group, the central point of which they are closest to or resemble the most. This similarity is measured based on Euclidean distance between each observation and the group centers. Using the k-means method, the new center of a group is defined again by the mean of current observations in that group. Observations are kept displacing to other groups if the similarity between them and the center of these groups is greater than that of the previous iteration. This process repeats until there is no change in observations in every group between two consecutive iterations.

The quality of a newly constructed group is evaluated through the intra-group homogeneity, which is measured by the within-group variation (Han & Kamber, 2012). Within-group variation is the sum of squared error (SSE) between all observations within a group and its center. Thus, the quality of grouping is the total within-group sums of squared of all observations (WSS_i), presented as follows:

$$\text{SSE} = \sum_{p \in Gi} dist(p, ci)^2 \qquad \text{(equation 3.3)}$$

$$\text{WSS} = \sum_1^k WSSi \qquad \text{(equation 3.4)}$$

In the equation, c_i is the center of *i*th group (*i* = 1, *k*), *p* signifies the observations in that group; and dist (*p*, c_i) is the Euclidian distance between an observation and the center within a group. The smaller the distance between an observation and the center within a group is, the greater the relatedness between them is. Hence, small total within-group variation is preferred. The appropriate minimization of total within-group variation structurally depends on the choice of *k* value (Han & Kamber, 2012).

However, the selection of the number of groups (*k*) is arbitrary and k must be pre-determined. To decide the ideal *k*, solutions with different k values will be performed and then compared to each other. (Makles, 2012) suggests that criteria to assess the solutions be the within-group sum of squared error (TWSS) and its logarithm. Two other criteria also derived from within-group sum of squares are μ^2 coefficients and proportional reduction of error coefficients (PRE). The μ^2 coefficient measures the proportions of change in WSS between solutions, relative to the total sum of squares (TSS) (equation 3.5). PRE presents the proportions of difference in WSS between two consecutive k values (equation 3.6).

$$\mu_k^2 = 1 - \frac{WSS_k}{WSS_i} = 1 - \frac{WSS_k}{TSS} \qquad \text{(equation 3.5)}$$

$$PRE_k = \frac{WSS_{k-1} - WSS_k}{WSS_k} \ \forall\, k \geq 2 \qquad \text{(equation 3.6)}$$

$$Pseudo - F = \frac{BSS/(k-1)}{WSS/(n-k)} \qquad \text{(equation 3.7)}$$

Results based on these four criteria are also visualized by scree plots. Importantly, the Calinski/Harabasz Pseudo F indices are conducted to compare the ratios of between-group to within-group sum of squares between scenarios of proposed k values (Calinski & Harabasz, 1974) (equation 3.7).

As a result, a new variable containing information of the group that each observation belongs to is generated. Interpretation of common characteristics of observations in each group is based on evaluating the mean, standard deviation, minimum and maximum values of dimensions by group. Afterward, groups of children will be ranked from non-poor to poor with level one assigned to the poorest group and the level will be higher when the extent of deprivations reduces. The analysis of variance is also used to investigate whether there is a statistical difference between groups in each dimension.

3.3.3 Ordered logistic regression

The study aims to identify the predictors of multidimensional child poverty. Cluster analysis partitioned children into multiple groups, ordering from the poorest to the non-poor – this is the dependent variable of the model. The explanatory variables in the model to be investigated are described in table 3.2. The ordered logistic regression is employed to find the probability that a child falls at or below or above a level of poverty.

Table 3.2 Definitions and measurement of variables

Variable name	**Type**	**Data type**	**Code**
Poverty group	Dependent	Ordinal	To be determined in chapter 4
Gender	Explanatory	Binary	0: Male, 1: Female
Age group	Explanatory	Categorical	0: 0-5 years old 1: 6-17 years old
Household size *Square of household size*	Explanatory	Numeric	Minimum: 1 member Maximum: 13 members
Region	Explanatory	Categorical	1: Red river delta 2: Northern highlands 3: Southcentral coast 4: Central highlands 5: Southeast region 6: Mekong river delta
Ethnicity	Explanatory	Binary	0: Ethnic minorities 1: Kinh & Hoa[1]
Rural/Urban	Explanatory	Binary	0: Rural

[1] Chinese origin

			1: Urban
Gender of the head	Explanatory	Binary	0: Male 1: Female
Education of the head	Explanatory	Categorical	0: Not complete primary school 1: Primary school 2: Secondary school 3: High school 4: Higher education
Age of the head *Squared age of the head*	Explanatory	Numeric	Minimum: 14 years old Maximum: 104 years old
Marital status of the head	Explanatory	Categorical	1: Single 2: Married 3: Widowed 4: Divorced 5: Separated
Relationship to the head	Explanatory	Categorical	1: Child 2: Grandchild and others

Source: Author's summarization and elaboration

In Agresti (2007), due to the ordering characteristic of the categories of independent variable *Y*, probabilities and logits for *Y* outcomes are accumulative. Let *k* be the number of categories of *Y* with Y_1 the lowest level and Y_k the highest level. Respective probabilities that a child might fall at each level of poverty are $\{P_1 \ldots P_k\}$ with the total probabilities equal to 1. In a case that a child falls at a level which is denoted *m* or lower ($Y \leq m$), accumulative probability equals the aggregated probabilities from level 1 to level *m* (equation 3.8). The accumulative logit for the outcome *m* in the ordered logistic model resembles a binary logistic model (equation 3.9). There is eventually a pair of outcome groups in which levels from 1 to *m* are combined to form the first category and levels from (*m*+1) to k are combined to create the second category. Generally, if $k > 2$, an ordered logistic model is considered equivalent to a series of binary logistic models. For an example of $k = 3$, when $m = 1$ ($Y \leq 1$) the separation is between level 1 and combination of all higher levels 2 and 3 as one binary logistic equation. When $m = 2$ ($Y \leq 2$) the separation is between combined levels 1, 2 and level 3 as the second binary logistic equation.

$$P(Y \leq m) = \pi_{1+} \ldots + \pi_m, \; m = \overline{1, k} \qquad \text{(equation 3.8)}$$

$$logit[P(Y \leq m)] = \log\left[\frac{P(Y \leq m)}{1 - P(Y \leq m)}\right] \qquad \text{(equation 3.9)}$$

An important assumption of ordered logistic model is proportional odds or also called parallel regressions. It means that the relationship between two outcome groups in each binary logistic model equation is the same (Agresti, 2007). Particularly, for the effect of each explanatory variable in the model, there are a single odds ratio and a single estimated coefficient (β) for every equation (in the end, there is still only one model) (equation 3.10). Approximate likelihood-ratio test and Brant test are employed in the study to check whether the assumption is violated or not and for which variables it is violated (Williams, 2006). If the model meets the assumption, ordered logistic regression is used (equation 3.10). If the model fails to meet the assumption, generalized ordered logistic regression is substituted. Under this model, the results are generated separately and differently for each equation as the effect of exploratory variables on the dependent variable in each outcome varies. Unlike the normal model, the generalized model has distinct parameters β_m for each outcome of Y (equation 3.11).

$$P(Y \leq m) = g(X\beta) = \frac{1}{1 + \{\exp(\alpha_m + X_m\beta)\}} \qquad \text{(equation 3.10)}$$

$$P(Y \leq m) = g(XB_m) = \frac{1}{1 + \{\exp(\alpha_m + X_m B_m)\}} \qquad \text{(equation 3.11)}$$

CHAPTER 4 RESULTS OF ANALYSIS

4.1 Descriptive statistics

4.1.1 Demographic characteristics

This section presents the demographic characteristics of children regarding gender, age, geographical location, family and head-related features (see table 1 and 2 in Appendix). Among 9693 children, girls are outnumbered approximately 3% by boys, with corresponding proportions of 48.56% and 55.44%. In terms of age, around 33% of children are under six years old. The number of children by age is rather proportional, mostly ranging from 4.7% to 5.9%. Exceptionally, children born in 2013, 2012 and 2007 account for 6.17%, 6.48%, and 6.07% . The region that has the biggest number children is Southcentral coast (22.54%), which is followed by Northern highlands (21%), Red river delta (19%), Mekong river delta (16%), Southeast region (11%), and Central highlands (9.55%). Concerning ethnicity and place of residence, the majority is Kinh and Hoa children (76%), and children mainly live in rural areas (72%). In comparison, the minorities account for a modest 24%, and only 28% of children live in urban areas.

Regarding family characteristics, most of the Vietnamese households are male-headed with over 80%. Besides, about 70% of the heads are parents of the child. The number of household heads with high school is rather modest (13%), and only a small proportion achieves higher education (8%). Besides, above 87% of the heads are married. Other marital statuses take tiny percentages, for example, separated (0.59%), single (0.75%) and divorced (1.69%). The average age of the head is 46.67 years old. The youngest head is 14 years old, and the oldest is 104 years old. Lastly, 4.89 is the number of family members living together with children on average. The most crowded family has 13 members while there is a child living alone.

4.1.2 Descriptive results of poverty indicators

In the model, 18 indicators present different deprivations to be included and estimated in factor analysis to identify the latent dimensions of poverty (see table 3, 4 & 5 in Appendix).The majority of children attend school in the past 12 months (84%) and have at least one kind of health insurance (95%).

Regarding housing conditions, approximately 98% of children can get access to the electricity while a small share of children has gas/oil (1.2%) or battery (1.2%) as the lighting source at home. Only around 35% of them have safe and clean tap water to use. Whereas, the protected water (e.g., covered stream water, well or bought water) is still the main supply and accounts for 48% of households in Vietnam. Next, 65% of children have the flush toilet to use, and up to 28% of them have to use unsanitary types, which are either pour flush toilet or double vault compost latrine. The remaining (7%) do not have a proper toilet at home and have to use bins, pots, or even toilet directly to the water or environment. Regarding waste management, garbage collected by someone else (47%) and burying garbage (35%) are popular ways in households. However, dumping is still applied by almost one-fifth of households.

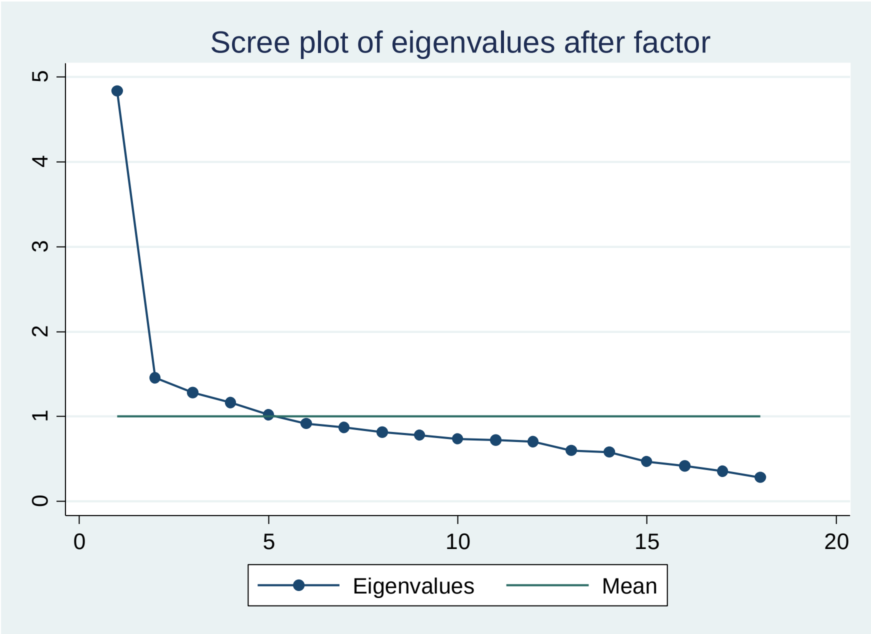
Concerning the shelter, prevalent materials of these children's households for poles are bricks/stones (43%) and reinforcement concrete (36%); for walls bricks/stones (77%), and for roofs root slabs (52%), followed by tiles (25%) and concrete (21%). According to the estimation, the mean surface space where a child lives is 18.84 square meters on average (standard deviation 0.21) and semi-permanent type account for the biggest share with around 61%. Proportions of children having at least one mobile/landline phone (64%) and one television/radio (92%) in their house are noticeably high. Whereas, less than one-third of them have access to the internet (27%) and slightly more than one-fifth have at least a computer (22%) at home. An average child owns 3.49 books. More than 50% of children do not have any book at home, but 40% of them are below six years old.

In terms of food security, food expenditure share indicator ranges from 3% to 320% over the total household income. Up to 26% of households spend more than 50% of household income on food. The average value of food expenditure share is 42%. The calorie intake ratio takes values ranging from 28% to 472% in relation to the standard. The mean calorie intake ratio is 128%. More than 26% of children consume a lower amount of daily calories than the recommendation, and the proportion of children having consumption double than recommendation is 5.7%.

4.2 Results of factor analysis

Exploratory factor analysis with the principal component method is proceeded (see table 6 & in the Appendix). The optimal number of principal-component dimensions is five (5) at which Eigenvalue is 1.03, which is greater than 1 (figure 4.1). The total explained variance is 0.5418, which confirms the validity of the exploratory factor analysis. Five dimensions explain 54.18% of the information of 18 initial indicators. KMO index for overall data is 0.8588, which indicates that the sampling is adequate and suitable for the structure-defining process. After the varimax rotation, the indicators in each dimension and their loadings are in table 4.1.

Figure 4.1. Scree plot of eigenvalue identification



In table 4.1, indicators water supply, toilet type, waste management, pole material, wall material, and living area have factor loadings higher than 0.3 in more than one dimension (see table 8 in Appendix). Is means their structure can be explained not only by a single dimension. The factor loadings are kept when they account for the relationship between the indicator and corresponding dimension as expected and predicted by the literature review and reported in other studies in the field. Besides, the majority of kept factor loadings have the highest absolute values, which implies that the indicators are explained the most in the corresponding dimension. Other blanks present the factor loadings of which absolute value is below 0.3 that does not meet the minimum requirement.

Table 4.1 Dimensions and loadings of indicators

Indicator	**Social security**	**Food security**	**Shelter**	**Living conditions**	**Information access**
School attainment	0.725				
Health insurance	0.787				
Food spending		0.630			
Calorie intake		0.823			
Pole material			0.604		
Wall material			0.561		
Roofing			0.817		

Indicator	Social security	Food security	Shelter	Living conditions	Information access
Living area			0.444		
House type			0.825		
Lighting source				0.697	
Water supply				0.308	
Toilet type				0.507	
Waste management				0.354	
Telephone				0.503	
Tv/radio				0.773	
Books					0.505
Internet access					0.784
Computer					0.802

Also from table 4.1, the first dimension, including school attainment and health insurance is called "social security". The second dimension ("food security") accounts for food spending and calorie intake. The third dimension ("shelter") contains information about pole material, wall material, roofing, living area, and house type. The fourth dimension ("living conditions") represents lighting source, water supply, toilet type, waste management, tv/radio, and telephone. The last dimension explains "information access" with indicators measuring access to books, computer and the internet. Afterward, these five dimensions of poverty are created using standardized values of indicators and factor loadings as weights; thus, they now have no measurement unit and all have mean approximate 0. The higher values in these poverty dimensions the child has, the less poor he/she is (see table 9 in Appendix).

4.3 Results of cluster analysis

Children are categorized based on their conditions in terms of dimensions, i.e., social security, food security, shelter, living conditions, and information access. To partition 9693 children into few distinct groups, the optimal number of groups is identified by using within-group sums of squares (WSS), their logarithm (log(WSS)), μ_k^2 coefficients, PRE proportions and important Calinski/Harabasz pseudo-F indices. Table 4.2 describes the values of these criteria for 10 options of *k*. At *k* = 4 there is the largest change in values of the within-group sum of squares and its logarithm from values at the previous *k*. Particularly, PRE at *k* = 4 is 21.9% presenting the biggest proportion of change in within-group sum of squares between two successive k values after the PRE at k = 2 as 25.9%. Importantly, pseudo-F at k = 4 (3661.863) indicating the greatest ratio between between-group to within-group sum of squares confirms four (4) as the optimal number groups at which the highest quality of the taxonomy is guaranteed.

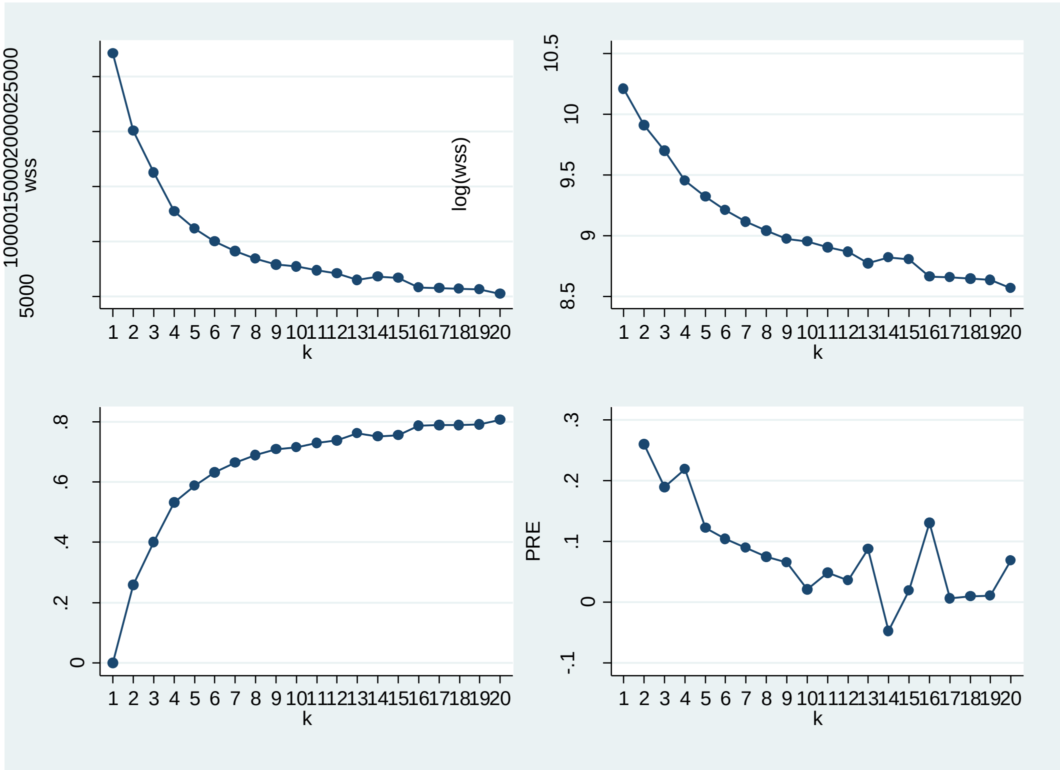
Table 4.2 Within-group variance related indices and Pseudo-F tests

Number of groups (k)	**WSS**	**log(WSS)**	μ_k^2	**PRE**	**Pseudo-F**
1	27087.441	10.207	0.000	.	.
2	20060.905	9.907	0.259	0.259	3394.371
3	16253.571	9.696	0.400	0.190	3229.450
4	**12694.337**	**9.449**	**0.531**	**0.219**	**3661.863**
5	11150.416	9.319	0.588	0.122	3461.707
6	9994.777	9.210	0.631	0.104	3313.263
7	9103.351	9.116	0.664	0.089	3189.190
8	8425.833	9.039	0.689	0.074	3064.346
9	7877.303	8.972	0.709	0.065	2952.009
10	7713.606	8.951	0.715	0.021	2702.250

**Note: see full result in table 10 in Appendix*

The values of four criteria WSS, its logarithm, μ_k^2 , PRE are also visualized in the scree plots (figure 4.2). In the figure, an "elbow point" can be found in the plots of within-group sum of squares (WSS) and of μ_k^2 coefficient but not really obvious in the log(WSS) line. In the plot of PRE, the segment between k =3 and k = 4 is much longer than other nearby segments.

Figure 4.2 Scree plots of within-group variance related indices



Cluster analysis with the k-means method and $k = 4$ is proceeded and the result is depicted in table 4.3. Based on the mean values of dimensions, each group represents a discriminant level of multidimensional poverty. Group 4 contains the best characteristics when most of their mean values in five dimensions are the highest among the four and are remarkably close to the maximum value of dimensions. 2310 children in this group face no deprivation, so they are the "non-poor" group. Group 3 has most of mean values medium, which are all greater than two remaining groups and above 0, except the information access. The low mean of this dimension indicates the children in group 3 are deprived of information access. Thus, the largest group with around 45% of children in (4392) is considered "partially poor."

Table 4.3 Descriptive statistics of four poverty groups by dimension (k = 4)

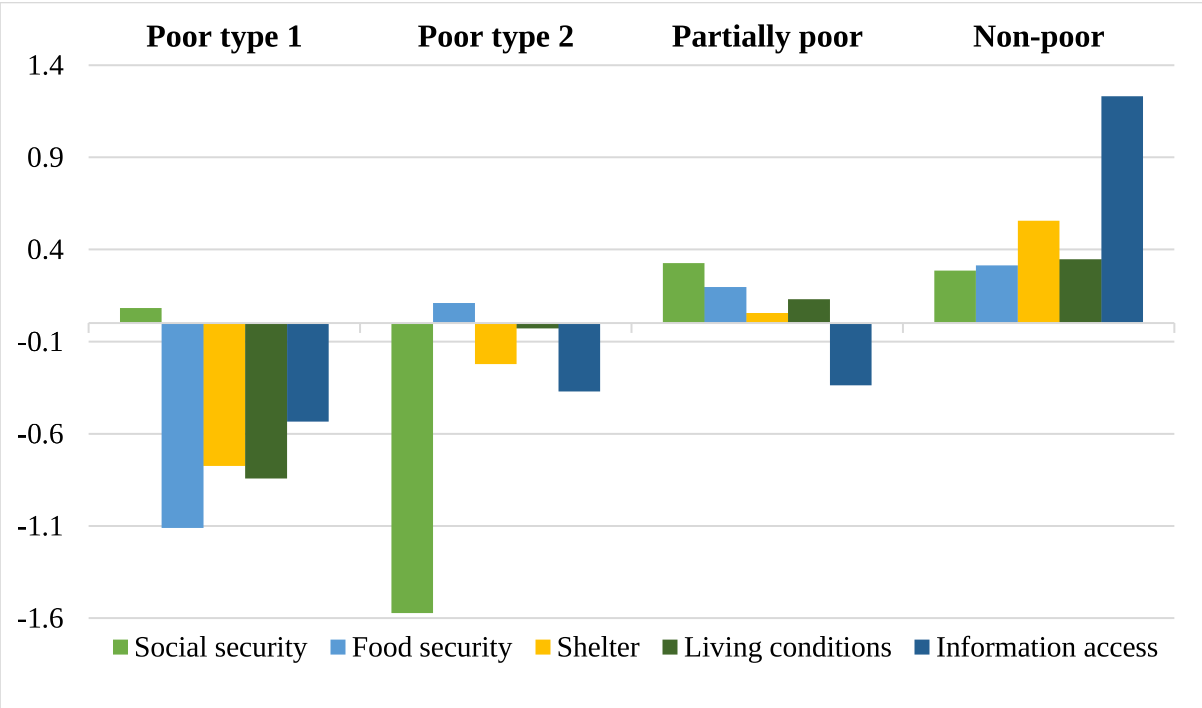
Group (number of children)	Statistics	Social security	Food security	Shelter	Living conditions	Information access
Group 1	Mean	***0.083***	***-1.111***	***-0.774***	***-0.843***	***-0.534***
(1576)	SD	0.517	0.966	0.614	1.001	0.227
Group 2	Mean	***-1.573***	***0.110***	***-0.222***	***-0.029***	***-0.370***
(1415)	SD	0.889	0.591	0.597	0.475	0.475
Group 3	Mean	***0.326***	***0.198***	***0.056***	***0.130***	***-0.337***
(4392)	SD	0.000	0.505	0.576	0.329	0.330

Group (number of children)	Statistics	Social security	Food security	Shelter	Living conditions	Information access
Group 4	Mean	***0.286***	***0.314***	***0.557***	***0.346***	***1.231***
(2310)	SD	0.229	0.504	0.660	0.186	0.454

**Note: see full result in table 11 in Appendix*

Two remaining groups (numbers 1 and 2) are both considered multidimensionally poor. Their mean values in dimensions are small, and some of them even much lower than the overall mean of these dimensions. Particularly, 1576 children in group 1 (named "poor type 1") are not too poor at social security but are deprived severely of food security, following living conditions, shelter and information access. Concerning group 2 (named "poor type 2"), 1415 children confront the most intense social insecurity (-1.573) while other aspects are also poor but less acute. Food security seems to be the dimension they are less deprived of, compared to other dimensions. In summary, only 24% of children are considered non-multidimensionally poor and 76% of children are deprived of at least one dimension. With the analysis of variance, groups are statistically different from each other in each dimension (see table 13 - 17 in Appendix).

Figure 4.3. Bar graph of poverty groups by dimension



There are four groups from multidimensionally poor to non-poor. Although the group 1 seems to have more deprivations which are worse than those of group 2, it is not clear and rational enough to confirm which of the two poor groups is poorer. The main problem is that five dimensions may not have the same weight to child poverty. In the case of three groups of children to be partitioned (k = 3), from the top to the bottom of the table are respectively non-poor, partially poor and poor groups (table 4.4). Two better groups are nearly the same as the ones in the case of four groups (k=4) (table 4.3) in terms of the size and characteristics. The third group (table 4.4) is the combination of two multidimensionally poor groups in the case of four groups (k=4) (table 4.3). Therefore, four-group classification is kept for investigation of poverty features in children. Three-group classification is more appropriate to be used to find the determinants of the multidimensional poverty.

Table 4.4. Descriptive statistics of three poverty groups by dimension (k =3)

Group (number of children)	**Statistics**	**Social security**	**Food security**	**Shelter**	**Living conditions**	**Information access**
Non-poor	Mean	***0.232***	***0.316***	***0.547***	***0.344***	***1.213***
(2409)	SD	0.424	0.507	0.658	0.187	0.464
Partially poor	Mean	***0.202***	***0.179***	***0.057***	***0.129***	***-0.351***
(4963)	SD	0.398	0.539	0.566	0.324	0.326
Poor (2321)	Mean	***-0.672***	***-0.710***	***-0.689***	***-0.632***	***-0.507***
	SD	1.179	1.018	0.600	0.934	0.293

4.4 Results of child poverty characteristic analysis

Distribution of four multidimensional child poverty groups is assessed by demographics, particularly gender, age group, region, location, ethnicity, household size, and head-related features (see table 12 in Appendix). There is no difference in the proportions of poverty groups between girls and boys. Around 45% of each sex is partially poor, and roughly one-fourth of each sex are non-poor. The two poor groups accounts for one-third in each sex. Next, more than 50% of children below six years old are considered multidimensionally poor while this percentage of older children is only 26%. Whereas, being partially poor is the situation of over 48% of children in the older group.

The regions having the highest proportions of children living in multidimensional poverty are Northern (53%) and Central highlands (44%). Notably, the majority of children in Northern highlands (42.05%) are multidimensionally poor with intense food insecurity (poor type 1). In comparison, in Central highlands the distribution of poor among the two groups is equal (22% for poor type 1 and type 2). Northern highlands have the lowest share of non-poor children among the six regions. Southeast region has the highest percentage of children in the non-poor group (38%) and is followed by Red river delta (37%). However, up to 91% of children in Red river delta are considered not multidimensionally poor while the Southeast region has 79% for this. Other regions such as Southcentral coast and Mekong river delta have this proportion as 74% and 67%, respectively.

There is a contrary picture between ethnic minorities and Kinh and Hoa children. The predominant situation of children in ethnic minorities is multidimensionally poor with over 65% of them (poor type 1 and 2) facing severe problems or deprivations in at least four dimensions. While this proportion of Kinh and Hoa is only 20%. Compared to approximately 80% of Kinh and Hoa children, only 34% of ethnic minority children are reckoned non-poor and partially poor.

There is a predominance of children being partially poor in rural areas with a percentage of approximately 49%. In total, nearly 87% of rural children face more than one deprivations (two poor types and partially poor), while this percentage among urban children takes only around 49%. It implies more than half of urban children being non-poor and confronting no severe problems relating to shelter, living conditions, food, social security, and information access.

Regarding head-related characteristics, in male-headed families, the proportion of multidimensionally poor children (17%) is slightly higher, but the percentage of non-poor children (23%) is lower than those of female-headed households (12% and 29%, respectively). Besides, most children are partially poor, particularly in information access when the head is either single, married, widowed, divorced, or separated. The percentage of non-poor children in married-headed families is the highest (25%), compared to families with the head having other marital statuses. Especially, only 10% of children staying with a divorced head are considered poor type 1 (are severely food-insecure). This percentage is the smallest, compared to other family types. However, the total proportion of poor children (type 1 and 2) in divorced and married-headed families is roughly the same, and both at around 30%. Surprisingly, nearly 19% of children staying with parent(s) are reckoned poor type 1 while this type accounts for only 11% of children living with grandparents and others as household heads. Besides, the family head of poor type 1 children seems to be younger than that of non-poor, partially poor, and poor type 2 children (41 versus 48, 47, 48 years old). Poor children (type 1 and type 2) live in families having 5.2 members at mean, which is slightly larger than average 4.8 family members of non-poor and partially poor children.

4.5 Result of ordered logistic regression

In ordered logistic model, the dependent variable is multi-dimensional poverty with three levels of deprivations which are the multidimensionally poor, partially poor and non-poor ranked from 1 to 3. The dependent variable equals 1 if the child is multidimensionally poor, 2 if partially poor, and 3 if non-poor. As the dependent variable has three categories, there are two pairs of outcome groups which are the probability of being at or below poor level ($Y \leq 1$ versus $Y > 1$) and the probability of being at or below partially poor level ($Y \leq 2$ versus $Y > 2$).

The assumption of proportional odds is checked with approximate likelihood ratio test and Brant test (see table 18 in Appendix). The approximate likelihood ratio test is significant with the chi-square 116.3 (p-value < 0.001) that means the assumption for the overall model has been violated. Result of Brant test also indicates the assumption violation of overall model (p-value <0.001). The assumption is met only in gender, age group, age of the head, squared age of the head and marital status of the head (p-value > 0.05) and is violated in others (p-value < 0.05) at the significant level of 5%. Therefore, the model will be estimated using generalized ordered logistic regression.

As a result, the adjusted Wald test shows the final model does not violate the proportional odds assumption (chi-square = 0.70 and p-value = 0.738) at 5% level of significance. Each pair of outcome groups is estimated by a separated logistic model member (table 4.5).

Table 4.5 Result of generalized ordered logit regression (population estimation)

Poverty group	***At/ below Poor level (Y ≤1) M1***			***At /below Partially poor (Y ≤2) M2***		
Determinants	**Coef.**	**Odds-ratio**	**t**	**Coef.**	**Odds-ratio**	**t**
Gender (base: Male)						
Female	-0.024	0.976	-0.52	-0.024	0.976	-0.52
Age group (base: 0-5 years old)						
6-17 years old	0.561	1.752	9.53***	0.561	1.752	9.53***

Poverty group	At/ below Poor level (Y ≤1) M1			At /below Partially poor (Y ≤2) M2		
Determinants	**Coef.**	**Odds-ratio**	**t**	**Coef.**	**Odds-ratio**	**t**
Household size	0.322	1.379	1.98**	0.951	2.587	4.99***
Sq. household size	-0.029	0.972	-1.95*	-0.076	0.927	-4.39***
Region (base: Red river delta)						
Northern highlands	-1.989	0.137	-9.35***	-0.462	0.630	-3.28***
Southcentral coast	-1.634	0.195	-7.73***	-0.677	0.508	-4.79***
Central highlands	-1.925	0.146	-8.34***	-0.585	0.557	-3.1***
Southeast region	-1.388	0.250	-6.01***	0.285	1.330	1.86*
Mekong river delta	-1.909	0.148	-9.29***	-0.577	0.562	-3.92***
Ethnicity (base: Minorities)						
Kinh & Hoa	1.426	4.162	12.14***	1.426	4.162	12.14***
Rural/Urban (base: Rural)						
Urban	0.833	2.299	6.57***	1.325	3.763	13.74***
Gender of the head (base: male)						
Female	0.371	1.449	3.54***	0.371	1.449	3.54***
Education of the head (base: Not finish primary school)						
Primary	0.542	1.720	5.49***	0.882	2.416	6.4***
Secondary	1.318	3.738	12.05***	1.318	3.738	12.05***
High-school	2.125	8.375	15.55***	2.125	8.375	15.55***
Higher education	2.857	17.411	8.14***	3.614	37.123	18.65***
Age of the head	0.050	1.051	3.27***	0.050	1.051	3.35***
Sq. age of the head	-0.0003	0.9997	-2.12**	-0.0003	0.9997	-2.12**
Marital status of the head (base: Single)						
Married	1.207	3.342	4.09***	1.207	3.342	4.09***
Widowed	0.290	1.336	0.9	0.808	2.244	2.53**
Divorced	0.702	2.018	1.83*	0.702	2.018	1.83*
Separated	1.033	2.810	2.53**	1.033	2.810	2.53**
Relationship to the head (base: child)						
Grandchild/others	0.325	1.384	2.39**	-0.157	0.854	-1.1

*Significance levels: * p-value < 0.1; ** p-value < 0.05; *** p-value <0.001*

In the table 4.5, we have two sub-models in two panels M1 and M2 with their respective coefficients and odds ratios estimated for each determinant of multidimensional poverty. If p-value is bigger than 0.05, the variable impacts significantly a child's probability of falling in a multidimensional poverty level at level of 5%. With continuous variables, a positive coefficient indicates that higher value the variable is, more likely the child is to be less poor or move to higher level. With categorical variables, a positive coefficient implies that the child at current group is more probable to be less poor or move to higher level than the one at base group. All the results are ceteris paribus.

The result suggests that the gender of the child has no statistically significant impact on his/her probability of falling in a multidimensional poverty level (p-value < 0.05) at a level of 5%. The age group is statistically significant with p-value < 0.001 and has the same coefficient for both sub-models since it does not violate the underlying assumption. As the coefficients are positive, children in the older group are more likely to be partially poor and non-poor than multidimensionally poor. Children from 6 to 17 years have 0.561 unit higher in log-odds of falling at a higher level of being less poor, compared to children below six years old.

With the same logic, variables ethnicity, urban/rural and gender of the head are proved to have a significant impact on the probability of falling in partial poverty and/or multidimensional poverty (all p-values < 0.05). Kinh and Hoa children, children living in urban areas and in female-headed families are more likely to fall in higher level or to be better off. The bigger coefficients and odds-ratios are, the impact of the variable is stronger.

Both household size and square of household size significantly contribute to the probability of falling poverty at both M1 and M2. The different signs of coefficient between two variables indicate an inverted U-shaped relationship between the household size and the likelihood of being poor and partially poor exists, ceteris paribus. The more family members in a household, the more probable it is that a child will be less poor, but there is a peak of the number of members. After that point, more family members cause a higher probability of falling in poverty or partial poverty.

The impact of the region is much stronger on the probability of being poor in M1 than in M2. In M1, living in the other regions than Red river delta statistically raises the likelihood of being poor (p-value < 0.001). Compared to Red river delta, living in Northern highlands has the highest probability of being considered poor (with 1.989 unit increase in the log-odds), followed by Central highlands (1.925), Mekong river delta (1.909), Southcentral coast (1.634) and Southeast region (1.388). In M2, living in other regions (p-value < 0.05), except for Southeast region (p-value >0.05), than Red river delta statistically reduces the likelihood of being non-poor.

The age of the head has the significant inverted U-shaped impact on the probability that a child could be multidimensionally poor. The p-value of the age of the head is lower than 0.05 and the sign of its coefficient and its square's coefficient is opposite. When the head is one year older, a 0.05 unit is expected increase in log odds of falling in better conditions for the child. However, the downward trend is not apparent since the coefficient of the squared age of the head (-0.0003) is approximately 0.

The higher education level of the head statistically increases the probability a child lives in better and less poor conditions (all p-values < 0.001). Compared to the head not completing primary school in M1, it is expected 0.542, 1.138, 2.125, and 2.857 units increased in log odds of being above the multidimensionally poor level for the child when the head finished primary, secondary, high school and higher education, respectively. This impact is even more substantial on the probability of being above partially poor level (M2), exclusively for primary-completed and higher-educated household heads.

The marital status of the head in the household is proved to influence significantly the likelihood of being poor, partially poor or non-poor of a child. Children whose family head is single is more likely to live in lower conditions in term of multidimensional poverty than those having the family head whose marital status is married, divorced, or separated. Noticeably, marital status as being widowed is insignificant (p-value = 0.366) in M1 but significant in M2 (p-value = 0. 012). There is no difference in the likelihood of a child being poor when the head is single or widowed while it is more likely that a child would be non-poor than partially poor and poor when staying with a widowed head instead of a single head.

Last, the relationship between the child and the head is statistically significant in M1 (p-value <0.05). It implies children having the household head as grandparents or other people are more likely to be at better levels than in multidimensional poverty, compared to children living the head as parents. However, this relationship has nothing to do with the probability that a child is non-poor or in poorer conditions when p-value (0.272) in M2 is greater than 0.05 or 0.1.

CHAPTER 5 DISCUSSION OF THE FINDINGS

5.1 Discussion of the results

This chapter will discuss the results of demographics, the dimensions constructing nonmonetary poverty, the distinct features of children in multidimensional poverty groups, and the determinants of child poverty.

The descriptive results show a manifest gender imbalance. According to the study's estimation, more than four million excess Vietnamese men are considered "leftover" and cannot find a woman to get married. The wide disparity between boys and girls is confirmed in the reports about sex imbalance in Vietnamese children by GSO & UNFPA Vietnam (2016a), Nguyen (2015) and UNICEF (2018). The sex ratio at birth in Vietnam in 2014 is around 112 boys per 100 girls, while the average biological figure is 104 or 105 per 100 (GSO & UNFPA Vietnam, 2016a) . It means, in one million people, around 16500 "missing girls" are not given birth each year. It is probably partly a result of the unfair preference of Vietnamese parents towards sons over daughters, which has been deep-rooted in the subconsciousness of many households. In the countries characterized by patrilocal and patrilineal kinship, the role of males in the family as descendants, and their manifest responsibility to provide care to parents lead to the fact that many families would want to have at least one boy. Besides, policies and family planning to impede the overpopulation in the 1960s accompanied by the economic Open-door reform [2] in the late 1980s directly affected the prenatal and gender-biased sex selection in Vietnam. If this issue persists and worsens, it will influence family planning, social security, labor force structure, and women empowerment progress in Vietnam.

The data also shows that year-of-birth selection highly links to traditional conceptions. The analyzed results of children born in the period between 1998 and 2016 indicate the number of children born in the years 2002, 2007, and 2012 is exceptionally high. In Asian lunar almanac, these years are known as the year of the "golden goat," "golden pig," and "golden dragon," respectively. In traditional belief, golden animals will bring families fortunes in terms of health, intellect, money, and finance. Children born in these years hold the expectations of their family to become successful and wealthy when growing up. The phenomenon of year-of-birth selection is common in China or Singapore (where the Chinese origin people are the majority). It is conceivable that Vietnam and China share many cultural values and customs. Superstitions

[2] It also was known as the "Doi moi" reform. The reform aimed to change the centrally planned economy to market economy.

about the year of birth can lead to the birth-ratio distortion (Horng et al., 2015). However, children born in lucky years have to compete for school places or jobs more fiercely. An abnormal excess of hundreds of thousands of children in lucky years can burden the public social service provision or impact the quality and efficiency of school and healthcare systems (Li et al., 2018).

The study also shows a tendency to have a lower proportion of children in the regions that are more socially developed with more vibrant economic activities. Among six economic regions, Red river delta and Southeast are the most urbanized and industrialized while the Northern mountains and Central highlands are the least developed. Nearly 76% of total labors in Red river delta and 87.6% in Southeast work in the industry, construction, and service in 2018, respectively. Whereas, the vast majority of Northern (59.2%) and Central highlands (72%) labors remain in agricultural, forestry, and fishery sectors (GSO, 2019). Hanoi-the capital and the economic hub-Hochiminh city locate in Red river delta and Southeast, respectively. Northern highlands and Central highlands share the common features of rugged terrain and the high proportion of ethnic minorities in the population. On average, there is a child in every three people in these two most impoverished regions, while this ratio is less than 1 to 4 in the most advanced ones. The progress of urbanization is proved to contribute to the fall in fertility rate in Vietnam in two recent decades (Dang & Rogers, 2015; GSO & UNFPA Vietnam, 2016b). When the income increases, the number of children wanted decreases because of the higher opportunity cost of child-bearing and raising a woman bares. Furthermore, child quality is in favor of many families in cities instead of child quantity when they want to have fewer children to increase their investment in them.

Despite the economic advance and industrialization over the past 25 years, family structure seemingly has not significantly changed. Not until 1990s has Vietnam basically achieved the universalization of primary education. In 2000s, Vietnam achieved the literacy rate higher than 90% population. In combination with the relatively high average age of the heads (~47 years old and more than 40% born in and before the 1960s), it explains why not so many of them have higher education qualifications or even graduate from high school. The vast majority of households are male-headed and relatively big which indicates that the traditional extended family model remains its influence. Additionally, a large number of family heads being grandparents of children partly implies that three generations live together in many families. However, this situation suggests that many children may not live with parents who migrate internally to the cities for work and send money back home. According to Internal Migration in Vietnam(GSO & UNFPA Vietnam, 2016b), more than 50% of internal migrants have children, but only 17.5% of them have children go with them.

The results record remarkable progress in children's access to education and healthcare. Particularly, high percentages of children attend school at all levels (84%) and are covered by at least one type of health insurance (95%). Children in poor households, ethnic minorities, and in remote areas are the beneficiaries of many tuition fee waivers and subsidy programs and policies (namely Decision 85/2010/QD-TTg, Decision 12/2013/QĐ-TTg, Decision 36/2013/QĐ-TTg). Besides, all children are entitled to free tuition at public primary schools. These descriptive results relatively resemble the data of (UNICEF, 2019). UNICEF (2019) reported the adjusted net rate of attendance for children at all school levels, specifically that for primary school-age children is 98% while for high school age youth is only 71%. It is necessary to remind that the education access is underestimated since education of the head is used as the proxy for that of children under 6. Children dropping out in the past 12 months at the time of investigation does not necessarily mean they have not ever accessed education services. Free health insurance is also applied to households in outlying areas and children under six years old. Importantly, health insurance is compulsory for children as students (Decision 959/QĐ-BHXH).

There is a contrasting picture of electricity access versus sanitation in children's households. While the percentage of national-grid electricity is above 90% of households, these rates for clean tap water, standardly clean toilets, and safe waste management are much lower. Over 300 thousands more children have access to tap water in 2016, compared to the results of previous VHLSS in 2014. The effectiveness of clean water access programs is also recognized in the successive and remarkable decline in the under-five mortality rate from 51.4 over 1000 children in 1990 to 21.1 in 2017 (UNICEF, 2019). Nevertheless, the level and efficiency of the implementation of programs and policies are not really high when comparing to the under-five mortality rate of countries in the region such as Thailand and Malaysia which all have the rates below 10 in 2017(UNICEF, 2019), and to the progress of electricity provision to Vietnamese population. Statistics on the use of clean water and hygienic toilets meet many challenges, especially the data about safely managed services in Vietnam is still missed, even on the UNICEF database (2020). Only data of percentages of the population using at least basic water and hygiene services are reported, 84% and 95%, respectively. In this study, the definition and identification of standardly clean water and toilet used at each household from VHLSS 2016 remain limitations (UNDP Vietnam, 2018). However, these estimated rates assist in assessing the actual situation about children's safe water and amenity access more precisely.

Seemingly, there is a contradiction in the means to access information. Despite the high rates of electricity access as well as tv/radio and telephone at home, those for computer owning and the internet are much smaller. This result corresponds to the report by MIC (2017) that over 6.8 million households, equivalent to 27.3%, have an internet connection at home. However, it can be explained through three main reasons. First, a computer is not really (easily) affordable and not an essential equipment, especially for many rural households with an average monthly income of less than 420 USD. Indeed, 80% of households in the study not having a computer are in rural areas. Second, with the fact that the majority of heads, who are usually the decision-maker in the family, are middle-aged or older, achieved low education levels. They might find a computer not easy to use and do not have a demand for it. Finally, with the development of telecommunication, a mobile phone connected with 3G or 4G will be the best replacement for a computer, especially if it carries more benefits when it helps get access to the internet and is available at a lower price to their income. A household having at least a computer will probably install the internet at home.

The study shows different pictures of food security between children with varying household income levels. The distribution of ratios of calorie intake and food expenditure share is relatively dispersive. While many children remain undernourished (i.e., face the shortage of food and economic vulnerability), some others are exposed to the high probability of obesity. National nutrition programs and strategies annually achieve a gradual decline in the proportion of underweight and stunning children from 19.9% and 32.6% in 2008 to 13.8% and 24.3% in 2016 (NIN, 2017). More than one-fourth of children in the study having the calorie intake ratio to the standard lower than one somehow reflects the situation of undernutrition among children. The correspondence between the study's result and the report by NIN (2017) can also be found in overweight children. Dimension food security partly does a good job of the proxy for BMI indicators, which are not recorded in VHLSS. Nevertheless, it is worth reminding that due to the limitation of the data, the food security dimension fails to capture the dietary diversity and the intra-household inequality in terms of food consumption.

The study finds five principal dimensions (social security, food security, living conditions, and information access) of nonmonetary poverty in children. The results are considered to condense and capture factors that can affect the well-being of one Vietnamese child. There are some changes from the expected literature when (1) school attendance and health insurance together explain the social security of a child, and (2) two indicators television/ratio and telephone belong to the living conditions instead of information access. First, a child usually benefits from education and health policies and programs simultaneously. When going to school, children generally participate (and have to participate) in health insurance programs. Second, owning a telephone or a television in a Vietnamese household becomes popular among the population; thus, their role in a family is seen as essential durables and material resources (Bradley & Putnick, 2012) to serve the living comforts. Their purpose of information provision and communications is undeniable. However, to the extent of development of households, other means of communications such as books, internet and computer become more significant to the demand of learning resources of the technologically advanced generations in Vietnam.

The data reports that the majority of children are multidimensionally poor and shows distinct poverty features between children's groups. Notably, more than 75% of children being deprived of at least one dimension provides a different picture to the monetary measure, at which only 21% of children are poor in terms of average household income. It implies multidimensional child poverty in Vietnam is relatively prevalent and remains a huge issue. Still, many children are not living in an environment which enables them to develop physically and psychologically comprehensively. Two types of severe multidimensional poverty are characterized by either acute food insecurity or social insecurity. Children in these types are also deprived of at least one more dimension. The study finds that they mainly locate in Northern highlands and Central highlands. In these regions, the economy is the most backward among six regions with a high dependency on agriculture and no industrial zones. The terrain is rugged and featured by midlands or steep mountains, while the primary and crucial infrastructure and transportation systems are not well-developed and well-connected. Additionally, above 76% of ethnic minority children are residing in these two regions. Many ethnic minorities use their own languages; thus, they confront a challenge to learn the official national Vietnamese. The majority of illiterate people are also in these two regions (GSO, 2018). These elements impede the development of regional economy and limit opportunities for enhancing households' income, and prevent marginalized children from access of education and other public services even when they are the beneficiaries of many development policies and subsidies.

The probability of falling in multidimensional poverty has nothing to do with the gender of children. However, it does not imply the non-existence of gender inequality in children. Connecting with the phenomenon of gender imbalance in the descriptive results, children meet gender inequality before but after birth. The gender of a child is already chosen before they are born, but afterward, there is no longer gender-based discrimination in treatment and care given to the child in the household. Gender inequality stems from and still lies in the awareness of many Vietnamese parents. The sub-index Health and Survival in the Gender Gap Index of Vietnam rank 138th out of 144 countries in 2016, hence makes the enormous contribution worsening gender inequality (WEF, 2016).

There is a tendency for multidimensional poverty to decrease following the increasing age of children. Younger children, especially below six, are more likely to be vulnerable and multidimensionally poor. Mothers of children below 6 have to dedicate more time and effort to them in their early years than their school ages. On the one hand, mother's employment is associated with less and low-quality time spent for children and negatively affects child health (Brauner-Otto et al., 2019), nutrition status (Popkin & Solon, 1976), child behaviors and vocabulary reception (Berger et al., 2008) in first five years. On the other hand, in the postnatal period, mothers have to stay at home for few months. Many of them might not have or lose opportunities to improve their earnings and household income, compared to the time they are at work. In Vietnam, there are many inadequacies in policies and social supports for parents of younger children and on maternity leave. Not until 2013 was maternity leave extended from 4 months to 6 months for mothers (Article 57/Labor Law 2012). No child allowance is provided to parents of children below six by the government, except free healthcare. The salary the mother receives during maternity leave is low and only applicable when both or one of the parents pay health insurance (Law on Social Insurance No. 58/2014/QH13). Whereas, around 79% of people at working age work in the informal sector (including both agricultural and non-agricultural workers) and 98% of them do not obtain any kind of insurance in 2016. This percentage in women is even higher (ILO, 2018). There is always a tradeoff between income and childcare for working mothers and their small children.

We found that geographical location is one of the elements conditioning the multidimensional child poverty. Children living in Red river delta and southeast regions are more likely to escape from extreme poverty and be non-poor. This situation conforms with many results in previous studies (Mahadevan & Hoang, 2016). Additionally, their probability of being non-poor is higher than the likelihood to simply move from multidimensionally poor to partially poor, compared to children in other regions. It emphasizes the advantages of living in the most advanced and urbanized places. After these children escape from social insecurity and food security, it becomes easier for them to end the information access poverty. In these regions, job opportunities are numerous and varied, living standards and conveniences are greater. Aforementioned, socioeconomic development Northern highlands, Central highlands, and Mekong river delta meets tons of challenges. Particularly, Mekong river delta is featured by the crisscross network of numerous rivers and canals while the road network is weak and underdeveloped. Between children in Red river delta and Southeast, there is a difference in the probability of being poor but the probability of being non-poor. Red river delta with Hanoi capital is the political and academic center of the country. With the long-established tradition of studiousness remains in many provinces, parents usually attach much importance to and invest more heavily in the children's education. Thus, children in this region are less likely to face social insecurity than those in the Southeast. However, the economic activities in the Southeast are more vibrant and developed. The income per capita in the Southeast, especially in Hochiminh city, is highest in the country.

The gender of the household head impacts the children's probability of escaping poverty. Children in female-headed households seem to be better off and more likely to escape from multidimensional and partial poverty than in male-headed families. This finding conforms to the descriptive results of the poverty group by gender of the head. When women are the head, the proportion of non-poor children is higher, and that of multidimensionally poor children is lower. Children in these families probably receive more care and better conditions. However, the hugely disproportionate number of women being the head indicates that men are more likely to receive the power in the family under the influence of tradition and culture.

The findings also provide reliable evidence about the role of education to combat poverty. Education of the head has a strong effect on the probability of escaping multidimensional poverty. This effect is even much more substantial on the likelihood to move out of partial poverty of a child. A vast difference can be made between the household head with no qualification and the one obtaining the university education. When the children live with a low-educated head, the extreme poverty escape is more complicated and takes more time than that of partial poverty.

It is suggested that multidimensional child poverty is a generations-and-lifestyle-related problem. When the head is the grandparent, children have more probability of overcoming extreme multidimensional poverty. However, parents or grandparents being the head has nothing to do with the case the child is partially poor. First, children probably stay with their grandparents when their parents migrate to other places (externally or internally) for economic incentives. Remittances sent home contribute to cover living expenses, improve living standards, and sometimes are the main income source of their family, especially in the rural area(GSO & UNFPA Vietnam, 2016b). In 2015, 92.4% of households having internal migrants use remittances mostly for daily living expenses, 28% and 26.4% of them dedicated money to education and healthcare, respectively (GSO & UNFPA Vietnam, 2016b) . Hence, additional income may help satisfy the material conditions for left-behind children. In other words, children may not face food and social insecurity or have adequate housing conditions. However, separation from parents and lack of parental care will negatively affect their well-being (Graham & Jordan, 2011), hinder their social and emotional development in the long run (Nguyen, 2016). Second, children live in an extended family at which grandparents are the heads. However, when three generations live together, grandparents might not be the decision-makers on their child's things or their main caregiver as they are usually not major wage-earning adults in the family.

5.2 Policy implications

As all the findings imply, policy recommendations to decline the multidimensional poverty and enhance living standards of Vietnamese children need to focus on the vulnerable and marginalized objects . First, gender equality should be prioritized and is essentially solved through changes in the perception of people towards both girls and women. The role of women in multidimensional child poverty escape suggests the female empowerment. Employment and financial independence will improve their status in the community, the labor market, and their household. Although the percentage of Vietnamese women participating in the labor market is remarkably high in recent years, there is still a huge gap between male and female average wages in the same job or having same education level (WEF, 2016) and a higher number of women working in the informal sector (GSO & ILO, 2018). Hence, possible policies relating "working women" and "financial independence" include (1) increasing women employment and creating more jobs prioritized for women in the formal sector, (2) improving working conditions in fields and industries involving in a large number of female workers, (3) encouraging and imposing strict regulations which require employers to pay the adequate health insurance. Not only babies, small children, but also their mothers should also be considered economically vulnerable and underprivileged. Hence, the government can allocate and provide support in cash and in-kind based on their actual lost income to assist them in child-bearing and child-rearing. Importantly, programs, campaigns, and propagandas on broadcast and media to ease the gender preference in subconsciousness and preconception of both men and women need implementing, such as (1) emphasize women participation in the process of decision making, (2) provide the information about the situation of sex imbalance and offer incentives to give birth to girls.

Second, long-term regional development policies should be designed exclusively and implemented harmoniously in Northern highlands, Central highlands, and Mekong river delta. As features of terrain impede the socio-economic development, infrastructure and transportation system need to be developed to connect residential areas, stimulate economic activities, attract investment in these regions. The infrastructure and transportation system will also facilitate the provision of more social services to households and children, such as schools, medical establishments, and clean water pipes. The appearance of economic activities in these regions will help control the internal migration flows between regions and from rural to urban places. In detail, they provide incentives and job opportunities to rural laborers and discourage them from moving to cities or other regions. However, with high proportions of ethnic minorities people, particularly in Northern highlands and Central highlands, the creation of means and sources of livelihood from them are also crucial since they are underprivileged and their children have the lower starting point to integrate and access to social services and opportunities as Kinh and Hoa people. Hence, more subsidies, financial aid, and free social services are still recommended to keep supporting people and particular beneficiaries (children, ethnic minorities, poor people) in three regions (i.e., to improve education level and community health).

Third, education is also proved as a pivotal means to overcome multidimensional child poverty and escape from the vicious circle of poverty. To increase school attendance of children at older ages or adolescents as well as education levels of population in the long run, after primary education, lower and upper high education at public schools should be soon provided free to them. Attaching importance to higher education, which is a powerful key to block multidimensional poverty from the following generations certainly, is a sustainable solution. To prevent children from dropping out, besides scholarship offer and tuition waiver are aimed at children themselves, paying their parents for letting them go to school is also a potential solution. Child labor is fairly prevailing at poor and extremely impoverished households in rural or mountainous and remote areas or among ethnic minority (UNICEF, 2018; UNICEF Vietnam, 2015). The subsidy should be based on the parents' income and compensate for the loss of child contribution to family income when they go to school. Family planning is recommended to apply in these marginalized households to ensure the opportunity to access education for all children. Multidimensionally poor children usually live in quiverful families, which causes the issue that not all children have opportunities to go to school due to the restricted family budget. Hence, the incentive provision of having two children, propaganda, and distribution of contraceptive methods, gender and reproduction education are possible solutions that can be carried out directly by local authorities and through television programs on media. Last, social programs need to be organized to educate the public, raise the awareness of treatment towards underprivileged people, and involve children in community policies to assist them in easing their deprivations and disadvantages.

5.3 Contributions and limitations

The study has made certain contributions to both theory and practice. The study condensed the five concrete dimensions of nonmonetary poverty in Vietnamese children from 18 conditions essential to children’s development and well-being. Hence, the study also built the first comprehensive framework to examine child poverty in Vietnam. It can be used as a potential reference to measure nonmonetary poverty in children in subsequent studies in other contexts. The study found four groups of nonmonetary poor children, which can be utilized to map child poverty and help understand the situation of child poverty in Vietnam. It shows that the majority of Vietnamese children are deprived of at least one dimension. The research results provide policy makers with some guidelines to design and implement direct strategies to address child poverty based on regions, areas, demographic and deprivation characteristics and track the efficiency and effectiveness of poverty reduction policies.

However, some limitations are existing in the study. The study fails to capture the intra-household inequality in many indicators regarding food security, shelter, and living conditions. The use of proxies for many indicators can lead to unwanted biases and underestimation of actual deprivations. With children's right approach, more deprivations can be introduced to consider and examine child poverty. These limitations are simultaneously the basis to continue to develop a better framework measuring child poverty.

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APPENDIX

Table 1. Age and year of birth of children

Age of child	Year of birth	Frequency	Percent (%)
0	2015-2016	475	4.9
1	2014-2015	501	5.17
2	2013-2014	527	5.44
3	2012-2013	598	6.17
4	2011-2012	628	6.48
5	2010-2011	507	5.23
6	2009-2010	494	5.1
7	2008-2009	547	5.64
8	2007-2008	534	5.51
9	2006-2007	588	6.07
10	2005-2006	548	5.65
11	2004-2005	556	5.74
12	2003-2004	575	5.93
13	2002-2003	541	5.58
14	2001-2002	499	5.15
15	2000-2001	534	5.51
16	1999-2000	553	5.71
17	1998-1999	488	5.03

Table 2. Demographic description of children

Variable	**Composition**	**Frequency** (sample)	**Proportion** (%) (sample)
Gender	Female	4,707	48.56
	Male	4,986	51.44
Age group	0-5	3236	33.38
	6-17	6457	66.62
Region	Red river delta	1,881	19.41
	Northern highlands	2,069	21.35
	South central coast	2,185	22.54
	Central highlands	926	9.55
	Southeast	1,065	10.99
	Mekong river delta	1,567	16.17
Ethnicity	Minorities	2,344	24.18
	Kinh & Hoa	7,349	75.82
Rural/Urban	Rural	6,931	71.51
	Urban	2,762	28.49
Gender of the head	Female	1,856	19.15
	Male	7,837	80.85
Education of the head	No qualification	2,337	24.11
	Primary school	2,563	26.44
	Secondary school	2,777	28.65

Variable	Composition	Frequency (sample)	Proportion (%) (sample)
	High school	1,284	13.25
	Higher education	732	7.55
Marital status of the head	Single	73	0.75
	Married	8,449	87.17
	Widowed	950	9.8
	Divorced	164	1.69
	Separated	57	0.59
Relationship with the head	Child	6,768	69.82
	Grandchild & others	2,925	28.57

Table 3. Indicator compositions

Indicator	Categories	Proportion % (Freq.) (sample)	95%CI of Prop (%) (population)
School attainment	No	15.62 (1514)	[13.48÷15.28]
	Yes	84.38 (8179)	[84.72÷86.51]
Health insurance	No	5.04 (489)	[4.23÷ 5.45]
	Yes	94.96 (9204)	[94.55÷95.77]
Lighting source	Gas/oil lamps	1.2 (116)	[0.60÷1.63]
	Battery or generator	1.2 (116)	[0.62÷1.73]
	National-grid electricity	97.61 (9461)	[97.06÷98.61]
Water supply	Unprotected source	16.56 (1605)	[14.23÷16.94]
	Protected source	48.18 (4570)	[45.51÷49.06]
	Tap water	35.26 (3418)	[35.59÷38.80]
Toilet	To environment	7.07 (685)	[4.85÷6.72]
	Unimproved unsanitary toilet	15.76 (1528)	[12.45÷14.81]
	Improved unsanitary toilet	12.08 (1171)	[11.26÷13.52]
	Flush sanitary toilet	65.09 (6309)	[66.76÷69.92]
Waste management	Dumping in a nearby site	10.95 (1061)	[8.01÷10.23]
	Dumping into lakes, rivers	7.49 (726)	[6.20÷7.95]
	Land-till burial	34.53 (3347)	[30.31÷33.61]
	Somebody else collects	47.03 (4559)	[50.27÷53.66]
Pole material	Poor-quality wood/bamboo	7.76 (752)	[6.04÷7.98]
	Iron/steel/good wood	13.46 (1305)	[10.07÷12.13]
	Bricks/stones	42.8 (4149)	[42.51÷45.87]
	Reinforcement concrete	35.97 (3487)	[36.18÷39.46]
Wall material	Bamboo/hardboards	3.52 (341)	[2.56÷4.03]
	Calcareous soil/straw	1.71 (166)	[1.02÷1.81]
	Wood/metal	15.24 (1477)	[11.55÷13.76]
	Bricks/stones	76.58 (7423)	[78.19÷81.00]
	Reinforcement concrete	2.95 (286)	[2.60÷3.86]
Roofing	Leave/straw	1.67 (162)	[1.12÷1.95]
	Root slabs	52.2 (5060)	[46.84÷49.86]
	Tiles	25.05 (2428)	[24.39÷27.21]

Indicator	Categories	Proportion % (Freq.) (sample)	95%CI of Prop (%) (population)
	Reinforcement concrete	21.08 (2043)	[22.99÷25.85]
House type	Temporary and others	7.1 (688)	[5.43÷7.15]
	Semi-permanent house	61.44 (5955)	[57.17÷60.47]
	House (shared kitchen, bathroom)	10.66 (1033)	[10.42÷12.82]
	House (private kitchen, bathroom)	20.33 (1971)	[21.46÷24.20]
	Villas	0.47 (46)	[0.35÷0.92]
Internet access	No	73.17 (7092)	[68.96÷71.96]
	Yes	26.83 (2601)	[28.04÷31.04]
Telephone	No	5.95 (577)	[4.28÷5.88]
	Yes	94.05 (9116)	[94.12÷95.72]
Computer	No	78.12 (7572)	[74.96÷77.75]
	Yes	21.88 (2121)	[22.25÷25.04]
Tv/radio	No	8.26 (801)	[6.27÷8.16]
	Yes	91.74 (8892)	[91.84÷93.73]

Table 4. Descriptive statistics ratio of calorie intake ratio, food expenditure share and mean area

Variable	Mean	Std. Dev.	Min	Max	95% CI of mean
Calorie intake ration	1.276	0.008	0.280384	4.724647	[1.260÷ 1.292]
Food expenditure share	0.409	0.005	0.02951	3.189959	[0.400÷0.417]
Mean living area	18.841	0.207	0	170	[18.434÷19.247]

Table 5. Number of books

Number	Frequency	Percent
0	5,020	51.79
1	62	0.64
2	335	3.46
3	365	3.77
4	288	2.97
5	653	6.74
6	333	3.44
7	145	1.5
8	143	1.48
9	26	0.27
10	2,323	23.97
Total	9,693	100

Table 6. Eigenvalues after factor analysis

Factor	Eigenvalue	Difference	Proportion	Cumulative

Factor1	4.83085	3.37626	0.2684	0.2684
Factor2	1.45459	0.17227	0.0808	0.3492
Factor3	1.28232	0.12122	0.0712	0.4204
Factor4	1.1611	0.13821	0.0645	0.4849
Factor5	**1.02289**	**0.10467**	**0.0568**	**0.5418**
Factor6	0.91822	0.04461	0.051	0.5928
Factor7	0.87361	0.05763	0.0485	0.6413
Factor8	0.81598	0.03979	0.0453	0.6866
Factor9	0.77619	0.03809	0.0431	0.7298
Factor10	0.73811	0.01735	0.041	0.7708
Factor11	0.72076	0.01935	0.04	0.8108
Factor12	0.70141	0.10451	0.039	0.8498
Factor13	0.5969	0.01491	0.0332	0.8829
Factor14	0.58199	0.11687	0.0323	0.9153
Factor15	0.46512	0.04568	0.0258	0.9411
Factor16	0.41944	0.06165	0.0233	0.9644
Factor17	0.35779	0.07506	0.0199	0.9843
Factor18	0.28273	.	0.0157	1

Table 7. Kaiser-Meyer-Olkin measure of sampling adequacy

Indicators	**KMO**
School attendance	0.8326
Books	0.9322
Health insurance	0.6235
Food spending	0.9048
Calorie intake	0.8561
Lighting source	0.8254
Water supply	0.8955
Toilet	0.92
Waste management	0.9251
Pole material	0.8538
Wall material	0.8533
Roofing	0.7606
Living area	0.9086
House type	0.8136
Internet	0.8315
Telephone	0.9107
Computer	0.8116
Tv/radio	0.859
Overall	0.8588

Table 8. Rotated factor loadings and unique variances

Variable	Shelter	Information access	Living conditions	food security	Social security	Uniqueness
school	0.072	0.162	0.124	0.035	**0.725**	0.426
books	0.134	**0.505**	0.180	0.083	0.199	0.648
insurance	0.042	-0.014	-0.048	-0.004	**0.787**	0.377
food_share	0.139	0.083	0.158	**0.630**	0.050	0.549
kcals_ratio	0.035	0.117	-0.030	**0.823**	-0.012	0.307
lighting_a	0.049	-0.039	**0.697**	0.027	0.002	0.510
water_b	0.038	**0.484**	**0.308**	0.250	-0.064	0.603
toilet_d	**0.361**	**0.360**	**0.507**	0.209	0.077	0.434
waste_c	**0.354**	**0.301**	**0.354**	0.234	0.023	0.603
pole_a	**0.604**	0.219	**0.388**	0.208	-0.032	0.392
wall_a	**0.561**	0.085	**0.432**	0.246	-0.038	0.430
roof_a	**0.817**	0.000	-0.015	0.055	0.113	0.316
area_mean	**0.472**	**0.394**	0.079	-0.162	0.062	0.586
housetype_a	**0.825**	0.257	0.049	0.063	0.062	0.243
internet	0.175	**0.784**	0.029	0.100	0.009	0.344
d_telephone	0.060	0.135	**0.526**	-0.002	0.043	0.700
d_computer	0.128	**0.802**	0.009	0.033	0.053	0.337
d_tvradio	0.080	0.084	**0.733**	0.051	0.037	0.445

Table 9. Descriptive statistics of dimensions

Dimensions	Observations	Mean	Std. Deviation	Min	Max
Social security	9,693	0	0.775	-3.372	0.326
Food security	9,693	0	0.789	-6.518	1.281
Shelter	9,693	0	0.740	-2.214	2.895
Living conditions	9,693	0	0.636	-4.069	0.464
Information access	9,693	0	0.787	-0.632	1.719

Table 10 Within-group variance related indices and Pseudo-F tests

Number of groups (k)	WSS	log(WSS)	μ_k^2	PRE	Pseudo-F
1	27087.441	10.207	0.000	.	.
2	20060.905	9.907	0.259	0.259	3394.371
3	16253.571	9.696	0.400	0.190	3229.450
4	**12694.337**	**9.449**	**0.531**	**0.219**	**3661.863**
5	11150.416	9.319	0.588	0.122	3461.707
6	9994.777	9.210	0.631	0.104	3313.263
7	9103.351	9.116	0.664	0.089	3189.190
8	8425.833	9.039	0.689	0.074	3064.346
9	7877.303	8.972	0.709	0.065	2952.009
10	7713.606	8.951	0.715	0.021	2702.250

Number of groups (k)	WSS	log(WSS)	μ_k^2	PRE	Pseudo-F
11	7344.896	8.902	0.729	0.048	2602.451
12	7086.636	8.866	0.738	0.035	2483.905
13	6467.890	8.775	0.761	0.087	2571.643
14	6773.299	8.821	0.750	-0.047	2232.983
15	6645.393	8.802	0.755	0.019	2126.480
16	5776.681	8.662	0.787	0.131	2379.962
17	5738.420	8.655	0.788	0.007	2249.891
18	5687.503	8.646	0.790	0.009	2141.376
19	5628.266	8.636	0.792	0.010	2049.142
20	5242.476	8.565	0.806	0.069	2121.400

Table 11. Descriptive statistics of four poverty groups by dimension (k = 4)

Group (number of children)	Statistics	Social security	Food security	Shelter	Living conditions	Information access
Group 1	Mean	***0.083***	***-1.111***	***-0.774***	***-0.843***	***-0.534***
Poor type 1 (1576)	SD	0.517	0.966	0.614	1.001	0.227
	Min	-2.051	-6.518	-2.214	-4.069	-0.632
	Max	0.326	0.759	1.549	0.464	1.142
Group 2	Mean	***-1.573***	***0.110***	***-0.222***	***-0.029***	***-0.370***
Poor type 2 (1415)	SD	0.889	0.591	0.597	0.475	0.475
	Min	-3.372	-4.386	-2.214	-3.927	-0.632
	Max	-0.995	1.146	2.093	0.464	1.719
Group 3	Mean	***0.326***	***0.198***	***0.056***	***0.130***	***-0.337***
Partially-poor (4392)	SD	0.000	0.505	0.576	0.329	0.330
	Min	0.326	-1.808	-1.823	-2.109	-0.632
	Max	0.326	1.281	2.004	0.464	0.873
Group 4	Mean	***0.286***	***0.314***	***0.557***	***0.346***	***1.231***
Non-poor (2310)	SD	0.229	0.504	0.660	0.186	0.454
	Min	-2.051	-2.062	-1.625	-1.044	0.215
	Max	0.326	1.263	2.895	0.464	1.719

Table 12 Distribution of poverty groups by demographic characteristics (k =4) (percentage of sample)

Group (number of children)	Poor type 1 (1,576)	Poor type 2 (1,415)	Partial-poor (4,392)	Non-poor (2,310)
Gender	**Freq.(%)**	**Freq.(%)**	**Freq.(%)**	**Freq.(%)**

Group (number of children)	Poor type 1 (1,576)	Poor type 2 (1,415)	Partial-poor (4,392)	Non-poor (2,310)
Male	793 (15.90)	768 (15.40)	2,255 (45.23)	1,170(23.47)
Female	783 (16.63)	647 (13.75)	2,137 (45.40)	1,140(24.22)
Age group				
0-5	514 (27.04)	768 (23.73)	1,284 (39.68)	670 (20.70)
6-17	1,062 (16.45)	647 (10.02)	3,108 (48.13)	1,640 (25.4)
Region				
Red river delta	37 (1.97)	135 (7.18)	1,017 (54.07)	692 (36.79)
Northern highlands	870 (42.05)	236 (11.41)	673 (32.53)	290 (14.02)
Southcentral coast	277 (12.68)	289 (13.23)	1,131(51.76)	488 (22.33)
Central highlands	203 (21.92)	203 (21.92)	372 (40.17)	148 (15.98)
Southeast region	46 (4.32)	176 (16.53)	436 (40.94)	407 (38.22)
Mekong river delta	143 (9.13)	376 (23.99)	763 (48.69)	285 (18.19)
Ethnicity				
Minorities	1,130 (48.21)	406 (17.32)	690 (29.44)	118 (5.03)
Kinh & Hoa	446 (6.07)	1,009 (13.73)	3,702 (50.37)	2,192(29.83)
Place				
Rural	1,507 (21.74)	1,121 (16.17)	3,390 (48.91)	913 (13.17)
Urban	69 (2.50)	294 (10.64)	1,002 (36.28)	1,397(50.58)
Gender of the head				
Male	1,359 (17.34)	1,094 (13.96)	3,605 (46.00)	1,779(22.70)
Female	217 (11.69)	321 (17.30)	787 (42.40)	531 (28.61)
Status of the head				
Single	21 (28.77)	13 (17.81)	33 (45.21)	6 (8.22)
Married	1389 (16.44)	1169 (13.84)	3,811 (45.11)	2,080(24.62)
Widowed	140 (14.74)	185 (19.47)	436 (45.89)	189 (19.89)
Divorced	17(10.37)	33 (20.12)	85 (51.83)	29 (17.68)
Separated	9(15.79)	15 (26.06)	27 (47.37)	6 (10.53)
Relationship				
Child	1,261(18.63)	813 (12.01)	3,062 (45.24)	1,632(24.11)
Grandchild/ others	315(10.77)	602 (20.58)	1,330 (45.47)	678 (23.18)
	Mean(SD)	**Mean(SD)**	**Mean(SD)**	**Mean(SD)**
Household size	5.163(1.768)	5.229(1.600)	4.830(1.369)	4.790(1.245)
Age of the head	41.07(11.92)	48.45(12.96)	46.70(12.98)	47.98(12.48)

Table 13a. Analysis of variance between poverty groups in “Social security”

Source	SS	df	MS	F	Prob > F
Between groups	4167.008	3	1389.003	8115.74	0
Within groups	1658.265	9689	0.171149		
Total	5825.273	9692	0.601039		

Bartlett's test for equal variances: chi2(2) = 3.1e+03 Prob>chi2 = 0.000

Table 13b. Comparison of social security between groups (Bonferroni)

(Row mean – Col mean)	Poor 1	Poor 2	Partially poor

Poor 2	1.89884		
p-value	0		
Partially poor	1.65539	-0.24344	
p-value	0	0	
Non-poor	1.85892	-0.03992	0.203522
p-value	0	0.001	0

Table 14a. Analysis of variance between poverty groups in "Food security"

Source	**SS**	**df**	**MS**	**F**	**Prob > F**
Between groups	2364.346	3	788.1152	2081.24	0
Within groups	3668.985	9689	0.378675		
Total	6033.331	9692	0.622506		

Bartlett's test for equal variances: chi2(3) = 1.3e+03 Prob>chi2 = 0.000

Table 14b. Comparison of food security between groups (Bonferroni)

(Row mean – Col mean)	**Poor 1**	**Poor 2**	**Partially poor**
Poor 2	0.088406		
p-value	0		
Partially poor	-1.22153	-1.30993	
p-value	0	0	
Non-poor	0.203618	0.115212	1.42514
p-value	0	0	0

Table 15a. Analysis of variance between poverty groups in "Shelter"

Source	SS	df	MS	F	Prob > F
Between groups	1746.682	3	582.227	1583.72	0
Within groups	3562.004	9689	0.368		
Total	5308.686	9692	0.548		

Bartlett's test for equal variances: chi2(3) = 57.7352 Prob>chi2 = 0.000

Table 15b. Comparison of shelter between groups (Bonferroni)

(Row mean – Col mean)	Poor 1	Poor 2	Partially poor
Poor 2	0.278		
p-value	< 0.001		
Partially poor	-0.553	-0.831	
p-value	< 0.001	< 0.001	
Non-poor	0.779	0.501	1.332
p-value	< 0.001	< 0.001	< 0.001

Table 16a. Analysis of variance between poverty groups in "Living conditions"

Source	**SS**	**df**	**MS**	**F**	**Prob > F**

Between groups	1471.367	3	490.4557	1939.85	0
Within groups	2449.683	9689	0.252831		
Total	3921.05	9692	0.404566		

Bartlett's test for equal variances: chi2(3) = 6.3e+03 Prob>chi2 = 0.000Table 16b.

Table 1bb. Comparison of living conditions between groups (Bonferroni)

(Row mean – Col mean)	Poor 1	Poor 2	Partially poor
Poor 2	0.158409		
p-value	0		
Partially poor	-0.81444	-0.97285	
p-value	0	0	
Non-poor	0.374326	0.215917	1.18877
p-value	0	0	0

Table 17a. Analysis of variance between poverty groups in "Information access"

Source	SS	df	MS	F	Prob > F
Between groups	4643.700	3	1547.900	11065.07	0
Within groups	1355.401	9689	0.140		
Total	5999.101	9682	0.619		

Table 17b. Comparison of information access between groups (Bonferroni)

(Row mean – Col mean)	Poor 1	Poor 2	Partially poor
Poor 2	0.034		
p-value	0.019		
Partially poor	-0.164	-0.198	
p-value	< 0.001	< 0.001	
Non-poor	1.602	1.568	1.765
p-value	< 0.001	< 0.001	< 0.001

Table 18 Brant Test of Parallel Regression Assumption

Coefficient	**Y >1**	**Y >2**	**chi-squared**	**p-value**
Gender	-0.041	-0.027	0.03	**0.853**
Age group	0.541	0.440	1.25	**0.264**
Household size	0.428	0.843	8.81	0.003
Square of household size	-0.037	-0.068	6.51	0.011
Region	-0.142	-0.021	27.57	<0.001
Ethnicity	1.930	1.344	25.87	<0.001
Urban	0.888	1.393	28.74	<0.001
Gender of the head	-0.003	0.279	5.87	0.015

Coefficient	**Y >1**	**Y >2**	**chi-squared**	**p-value**
Education of the head	0.700	0.852	14.96	<0.001
Age of the head	0.060	0.042	0.94	**0.331**
Squared age of the head	0.000	0.000	1.58	**0.209**
Status of the head	-0.076	-0.134	0.32	**0.575**
Relationship	0.203	-0.253	9.48	0.002
All	**-**	**-**	***118.7***	***<0.001***

**Approximate likelihood-ratio test of proportionality of odds across response categories:*

chi2(13) = 116.32

Prob > chi2 = 0.0000

Table 19. Result of generalized ordered logit regression (coefficient)

Determinants	**Coef.**	**Std. Err.**	**t**	**P>t**	**[95% Conf. interval]**	
At or below poor level (Y <= 1)						
Gender (base: Male)						
Female	-0.024	0.046	-0.52	0.602	-0.115	0.067
Age group (base: 0-5 years old)						
6-17 years old	0.561	0.059	9.53	0	0.445	0.676
Household size	0.322	0.163	1.98	0.048	0.002	0.641
Sq. household size	-0.029	0.015	-1.95	0.052	-0.058	0.000
Region (base: Red river delta)						
Northern highlands	-1.989	0.213	-9.35	0	-2.406	-1.571
South center coast	-1.634	0.211	-7.73	0	-2.048	-1.219
Central highlands	-1.925	0.231	-8.34	0	-2.378	-1.472
Southern region	-1.388	0.231	-6.01	0	-1.841	-0.935
Mekong river delta	-1.909	0.205	-9.29	0	-2.312	-1.506
Ethnicity (base: Minorities)						
Kinh	1.426	0.117	12.14	0	1.196	1.656
Urban (base: Rural)						
Urban	0.833	0.127	6.57	0	0.584	1.081
Gender of the head (base: male)						
Female	0.371	0.105	3.54	0	0.165	0.576
Education of the head (base: Not finish primary school)						
Primary	0.542	0.099	5.49	0	0.349	0.736
Secondary	1.318	0.109	12.05	0	1.104	1.533
High-school	2.125	0.137	15.55	0	1.857	2.393
Higher education	2.857	0.351	8.14	0	2.169	3.545
Age of the head	0.050	0.015	3.27	0.001	0.020	0.080
Sq. age of the head	0.000	0.000	-2.12	0.034	-0.001	0.000
Marital status of the head (base: Single)						
Married	1.207	0.295	4.09	0	0.628	1.785

Widowed	0.290	0.320	0.9	0.366	-0.338	0.917
Divorced	0.702	0.384	1.83	0.068	-0.052	1.455
Separated	1.033	0.408	2.53	0.011	0.234	1.832
Relationship to the head (base: child)						
Grandchild/others	0.325	0.136	2.39	0.017	0.059	0.591
_cons	-3.110	0.645	-4.82	0	-4.374	-1.845
At or below partially poor level (Y <= 2)						
Gender (base: Male)						
Female	-0.024	0.046	-0.52	0.602	-0.115	0.067
Age group (base: 0-5 years old)						
6-17 years old	0.561	0.059	9.53	0	0.445	0.676
Household size	0.951	0.191	4.99	0	0.577	1.324
Sq. household size	-0.076	0.017	-4.39	0	-0.109	-0.042
Region (base: Red river delta)						
Northern highlands	-0.462	0.141	-3.28	0.001	-0.738	-0.186
South center coast	-0.677	0.141	-4.79	0	-0.954	-0.400
Central highlands	-0.585	0.189	-3.1	0.002	-0.955	-0.215
Southern region	0.285	0.153	1.86	0.063	-0.015	0.586
Mekong river delta	-0.577	0.147	-3.92	0	-0.865	-0.288
Ethnicity (base: Minorities)						
Kinh	1.426	0.117	12.14	0	1.196	1.656
Urban (base: Rural)						
Urban	1.325	0.096	13.74	0	1.136	1.514
Gender of the head (base: male)						
Female	0.371	0.105	3.54	0	0.165	0.576
Education of the head (base: Not finish primary school)						
Primary	0.882	0.138	6.4	0	0.612	1.152
Secondary	1.318	0.109	12.05	0	1.104	1.533
High-school	2.125	0.137	15.55	0	1.857	2.393
Higher education	3.614	0.194	18.65	0	3.234	3.994
Age of the head	0.050	0.015	3.27	0.001	0.020	0.080
Sq. age of the head	0.000	0.000	-2.12	0.034	-0.001	0.000
Marital status of the head (base: Single)						
Married	1.207	0.295	4.09	0	0.628	1.785
Widowed	0.808	0.320	2.53	0.012	0.181	1.436
Divorced	0.702	0.384	1.83	0.068	-0.052	1.455
Separated	1.033	0.408	2.53	0.011	0.234	1.832
Relationship to the head (base: child)						
Grandchild/others	-0.157	0.143	-1.1	0.272	-0.438	0.124
_cons	-9.728	0.720	-13.5	0	-11.141	-8.316

Table 20. Result of generalized ordered logit regression (odds ratio)

Determinants	Odds Ratio	Std. Err.	t	P>t	[95% Confident interval]
At or below poor level (Y <= 1)					

Gender (base: Male)						
Female	0.976	0.045	-0.52	0.602	0.891	1.069
Age group (base: 0-5 years old)						
6-17 years old	1.752	0.103	9.53	0	1.561	1.967
Household size	1.379	0.224	1.98	0.048	1.002	1.898
Sq. household size	0.972	0.014	-1.95	0.052	0.944	1.000
Region (base: Red river delta)						
Northern highlands	0.137	0.029	-9.35	0	0.090	0.208
South center coast	0.195	0.041	-7.73	0	0.129	0.295
Central highlands	0.146	0.034	-8.34	0	0.093	0.229
Southern region	0.250	0.058	-6.01	0	0.159	0.393
Mekong river delta	0.148	0.030	-9.29	0	0.099	0.222
Ethnicity (base: Minorities)						
Kinh	4.162	0.489	12.14	0	3.305	5.240
Urban (base: Rural)						
Urban	2.299	0.291	6.57	0	1.793	2.948
Gender of the head (base: male)						
Female	1.449	0.152	3.54	0	1.180	1.780
Education of the head (base: Not finish primary school)						
Primary	1.720	0.170	5.49	0	1.417	2.087
Secondary	3.738	0.409	12.05	0	3.016	4.632
High-school	8.375	1.144	15.55	0	6.406	10.948
Higher education	17.411	6.108	8.14	0	8.752	34.638
Age of the head	1.051	0.016	3.27	0.001	1.020	1.084
Sq. age of the head	1.000	0.000	-2.12	0.034	0.999	1.000
Marital status of the head (base: Single)						
Married	3.342	0.986	4.09	0	1.874	5.961
Widowed	1.336	0.428	0.9	0.366	0.713	2.502
Divorced	2.018	0.775	1.83	0.068	0.950	4.286
Separated	2.810	1.145	2.53	0.011	1.264	6.249
Relationship to the head (base: child)						
Grandchild/others	1.384	0.188	2.39	0.017	1.061	1.806
_cons	0.045	0.029	-4.82	0	0.013	0.158

At or below partially poor level (Y <= 2)						
Gender (base: Male)						
Female	0.976	0.045	-0.52	0.602	0.891	1.069
Age group (base: 0-5 years old)						
6-17 years old	1.752	0.103	9.53	0	1.561	1.967
Household size	2.587	0.493	4.99	0	1.781	3.759
Sq. household size	0.927	0.016	-4.39	0	0.897	0.959
Region (base: Red river delta)						
Northern highlands	0.630	0.089	-3.28	0.001	0.478	0.831
South center coast	0.508	0.072	-4.79	0	0.385	0.671
Central highlands	0.557	0.105	-3.1	0.002	0.385	0.806
Southern region	1.330	0.204	1.86	0.063	0.985	1.797

Mekong river delta	0.562	0.083	-3.92	0	0.421	0.749
Ethnicity (base: Minorities)						
Kinh	4.162	0.489	12.14	0	3.305	5.240
Urban (base: Rural)						
Urban	3.763	0.363	13.74	0	3.115	4.546
Gender of the head (base: male)						
Female	1.449	0.152	3.54	0	1.180	1.780
Education of the head (base: Not finish primary school)						
Primary	2.416	0.333	6.4	0	1.844	3.166
Secondary	3.738	0.409	12.05	0	3.016	4.632
High-school	8.375	1.144	15.55	0	6.406	10.948
Higher education	37.123	7.195	18.65	0	25.386	54.288
Age of the head	1.051	0.016	3.27	0.001	1.020	1.084
Sq. age of the head	1.000	0.000	-2.12	0.034	0.999	1.000
Marital status of the head (base: Single)						
Married	3.342	0.986	4.09	0	1.874	5.961
Widowed	2.244	0.718	2.53	0.012	1.199	4.202
Divorced	2.018	0.775	1.83	0.068	0.950	4.286
Separated	2.810	1.145	2.53	0.011	1.264	6.249
Relationship to the head (base: child)						
Grandchild/others	0.854	0.122	-1.1	0.272	0.645	1.132
_cons	0.000	0.000	-13.5	0	0.000	0.000