

Measuring child vulnerability to poverty: Material and psychosocial deprivation[☆]

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ABSTRACT

The analysis and measurement of what makes children vulnerable to falling into or remaining in poverty is key to ensure equality of opportunities across children, as well as fostering the sustainability of the societal well-being for future generations. This study aims at analysing the child vulnerability to poverty as a broader concept than child poverty because, besides the material deprivation, it also considers the psychosocial deprivation as a result of the relationships of children with their closest environments. We propose to address this issue by means of a multidimensional fuzzy approach. Following the 1989 United Nations Convention on the Rights of the Child, we measure the propensity to be deprived in six dimensions of material deprivation and four of psychosocial deprivation in 32 countries. We use the International Survey of Children's Well-Being (wave 2016–2019), in which 10-years-old children are the respondents. Our study finds that whereas children in developed countries experience more psychosocial than material deprivation, in developing countries there is no clear pattern. Based on the above evidence, we would argue that material and psychosocial deprivation do not go hand in hand and their joint analysis represents a promising tool for a better understanding of children well-being to plan more effective policy measures.

1. Introduction

The concept of sustainable development considers that environmental, social, and economic elements and their interrelations are important. This implies the commitment to satisfy the needs of present generations without compromising the well-being of future generations. In this setting, the study of child vulnerability to poverty, that is what makes children vulnerable to falling into or remaining in poverty, is of great importance to foster the sustainable development of a territory. The intergenerational cycle of poverty or exclusion helps us to understand why growing up in poverty can have a lasting impact on children, as well as on the current and future societal well-being. Poor children are more likely to become poor adults because they will suffer more illnesses and suffer material and psychosocial deprivations that are necessary for their physical, mental, emotional, and intellectual development, and

drop out of school early. In the future, when they become adults, it is more unlikely that they have the employability skills necessary for the present and future job markets [1,2]. This sequence of circumstances can lead to increases in social and economic inequalities, as well as lower social mobility [3–5]. Additionally, several studies highlighted the adverse linkage between poverty and environmental degradation [6, 7].

In the international sphere, the 2030 Sustainable Development Goals (SDG) represents a drive for development that is both equitable and sustainable, in social, economic, and environmental terms [8]. Considering the dynamic or intergenerational nature of sustainable development, for a territory to achieve the SDGs it will have to pay attention to meeting the needs of its children [9]. In this vein, the first goal in the Target 1.2 of SDGs focuses on reducing “at least by half the proportion of men, women and children of all ages living in poverty in all its

[☆] The International Survey on Children's Well-Being (ISCWeB) database is freely available. To receive the dataset it is necessary to fill out the form available at the link below, and then the data are sent by email: <https://iscweb.org/the-data/access-our-dataset/>

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dimensions according to national definitions" ([8], p. 19). Probably, it is the first time that a global development initiative explicitly highlighted the fight against multidimensional child poverty as one of its targets [10]. But attention to children goes beyond the first goal since addressing child vulnerability to poverty has also positive linkages with outcomes across a range of SDGs. For instance, combating child poverty implies addressing multiple ways of deprivation related to personal subsistence, like nutrition (SDG 2), or access to services and utilities such as health and clean water (SDGs 3 and 6). Fostering quality education for children (SDG 4) is key for breaking the intergenerational cycle of exclusion, as well as offering them the possibility of having best labor chances (SDG 8) and greater choice about cleaner and more sustainable living conditions (SDGs 7 and 12).

In short, analysing what makes children vulnerable to falling into or remaining in poverty is a key step to combat child poverty and to ensure equality of opportunities across children, as well as fostering the sustainability of the societal well-being for future generations [10,11].

The present article focuses on studying child vulnerability to falling into or remaining in poverty as a broader concept than child poverty (defined in terms of relative deprivation), because it additionally considers the interpersonal relationships of children with their closest environments (parents and family, peers, teachers, and neighborhoods). The quality and quantity of these relationships overlay the psychosocial deprivation of children that could intensify or counteract vulnerability to poverty. The predominant idea is that living in the environment of material and psychosocial deprivation undermines their health, social competence, and ability to succeed in school and in life [2,12–14]. However, there are also situations in which the closest environment provides the care, protection and participation that helps children who suffer material deprivation to move forward, and to be more resilient (see Ref. [14–19]). Many studies along this line underline that the psychosocial dimension must be considered in the multidimensional analysis of poverty (see Ref. [13,20,21]). Nevertheless, this is not a general practice, largely due to the scarcity of suitable databases. This article is an attempt to fill this gap. The data and methodology adopted in this paper enable us to measure both domains of child vulnerability to poverty in a large range of countries. In the common framework in which different policymakers could and do act for improving child well-being, one can argue the relevance of this analysis that adds new knowledge in what is going on in children's lives and what is important to them in a comparative perspective.

More specifically, we have relied on the International Survey of Children's Well-Being, carried out in 32 countries or territories¹ around the world in which 10-years-old children are the respondents. This dataset is cross-sectional; the third wave, with which we worked, was compiled during 2016–2019. This dataset together with the methodology of Betti et al. [22] allows us to measure the presence of deprivation in both material and psychosocial dimensions that children experience at the time of the survey. This status may indicate their vulnerability at that time and, consequently, predict the risk or predisposition of falling into or remaining in poverty the rest of their childhood and adulthood. More importantly, we are able to perform a comparative analysis of various categories of countries to answer the question: Do material and psychosocial deprivation run together so that children in developing countries experience more material deprivation, and also more psychosocial deprivation?

It is important to highlight the three pillars on which our approach is grounded. Firstly, in our dataset, children are the respondents so that we have the information to study objective aspects of material deprivation

in their daily lives, education or housing; additionally, the subjective aspects to study the psychosocial deprivations related to how they perceive the quality and quantity of their relationships with parents and family; at school, with friends and in neighbourhood. The importance of children's perspective on their living standards is stressed by the UNCRC [23]. Further, several studies have observed that children and their parents may assess their perceptions of necessities differently [24–26]; thus, children's opinion is crucial to develop an accurate study on their actual vulnerability to falling into or remaining in poverty.

Secondly, based on the idea that the best way to study child poverty is to rely on child-specific deprivation indicators [27–31], we follow the UNCRC in the selection of several dimensions of both material and psychosocial deprivations. The inclusion of psychosocial deprivation from the intimate environments, where children develop their lives, is a novel aspect of our study in comparison to other well-known approaches.

Thirdly, we understand that concepts such as deprivation or vulnerability are very fluid; as for an example when we study vulnerability among children, we are measuring degrees of vulnerabilities, or we provide a measure of proximity to the concept. For this reason, we work with the multidimensional and fuzzy approach of Betti et al. [22] in the empirical strategy. More specifically, from the information provided by children, we measure the children's propensity to be deprived of, in each of the studied dimensions by building a fuzzy index at a country level.

In summary, the three main objectives of this article are: first, proposing a new and broader concept of child vulnerability to poverty; second, building indexes of deprivation in material and psychosocial dimensions of childhood at country level, based on the utilization of fuzzy logic techniques; and thirdly, analysing the relationship between material and psychosocial deprivation of children living in countries with different socioeconomic backgrounds.

This paper is structured as follows. In Section 2, we review the most influential approaches to study the multidimensional child poverty. Our analytical approach and hypothesis are presented in Section 3, where we also define the concept of child vulnerability to poverty and justify the adoption of both material and psychosocial deprivation indicators. The dataset and variables used in the analysis, as well as the methods applied to measure material and psychosocial deprivations are explained in Section 4. Section 5 presents the main results of the analysis. Conclusions are drawn in Section 6. Finally, in Section 7, we discuss about the implications of the study for conceptualisations of deprivation in childhood and the main implications for public policies to foster a sustainable development.

2. Background

Two approaches to address the multidimensional child poverty are generally considered as the most influential in the official spheres. The first is the "Bristol Indicators" methodology, developed in 2003 by UNICEF, the University of Bristol and the London School of Economics. It will be referred to as UNICEF from now onwards. The second approach is the Oxford Poverty and Human Development Initiative (OPHI), a research group at the University of Oxford (the United Kingdom), founded in 2007, and directed by Sabina Alkire, has had a widespread implementation in the developing countries.

These approaches have some similarities and differences, which are reviewed below. From a theoretical point of view, both UNICEF and OPHI agree that the one-dimensional monetary approach to estimate child poverty has serious drawbacks. Although having a family income adequate for meeting basic material needs is essential for a child's well-being, using income as the only predictor of child deprivation might be misleading. Monetary poverty and multidimensional poverty are distinct constructs and cannot serve as a proxy for one another [19,32]. Within this framework, the focus is on the access to food, housing amenities, education or health, not mere income.

¹ We refer to territories because in some cases, such as the United Kingdom, the database does not provide information for the entire country, but for the territories of England and Wales. For the sake of clarity, we write only "countries" throughout the document. The list of the 32 countries studied can be checked in the Appendix (Table A1).

In this vein, UNICEF follows the human rights approach of the Convention on the Rights of the Child (UNCRC) [23]. The underlying idea is that the deprivation of a right that constitutes poverty is what makes the child poor. More specifically, the rights that constitute poverty are associated to some material deprivation [28,31,33–35]. For instance, the article 28 of the UNCRC recognizes the right of the child to education; a child who does not have a place at home to do homework or who does not have school materials to follow classes adequately will not be able to achieve the right to education. On the other hand, OPHI's theoretical approach is broader and holds that child poverty should be measured in terms of unmet basic needs, child rights, and the capabilities or real freedoms that people have to lead lives, they have reasons to value [36,37]. The capability approach [38,39] provides the underlying assumption for this.

From the methodological point of view, both approaches use information from household surveys that include children-specific items and rely on headcount ratio measurements with various strategies. Specifically, UNICEF calculates the headcount ratio following the union criterion (see Ref. [40]); and OPHI has developed the Alkire-Foster method or multidimensional poverty index (MPI) that is equal to the headcount ratio, multiplied by the intensity of deprivation [41].

Based on the idea that children can experience deprivations not necessarily related to the parents' ones [24,35,42], both approaches agree that children-specific items in the dataset are required for the measurement of child deprivation. However, the judgments about children's circumstances and situations are made based on adults' accounts. In other words, the children's opinions and perceptions about their own living standards are not taken into consideration.

Nevertheless, the main difference between both approaches arises from the question of whether an independent (from the whole population) measurement of child poverty is needed. UNICEF advocates for a specific measure of child poverty, whereas OPHI advocates that no distinction should be made between the two: one for children and the other for the population as a whole. More specifically, UNICEF follows the life-course approach –age-specific indicators for each stage of life. The idea is that children's needs of a one-year-old are quite different from those of a 10-year-old (for example, the vaccinations needed in the first months of life to guarantee the right to health). This fact impacts heavily how poverty is experienced by children of different age groups even within the same household [31,33]. On the contrary, OPHI measures deprivations at the household level, therefore assuming that all children living in the same household share the same condition (poor/non-poor). In this setting, poverty among children is usually measured as the share of children living in poor households (see Ref. [36,37]).

The theoretical frameworks of each of these two initiatives, together with the position on the suitability of a specific poverty index for children, guide the selection of indicators and dimensions of child deprivation of UNICEF and OPHI (see the comparisons in Ref. [28,40,43]).

3. Analytical approach and hypothesis

In line with UNICEF, our proposal based on the UNCRC stresses that children have the rights to survival, development, protection and participation [23]. However, the empirical applications of UNICEF approach have focused only on the survival and development rights, rooted in the identification of indicators of material deprivation. Depending on the availability of data (or countries studied) and the age of children, most of the studies consider indicators of housing, education, health, nutrition, sanitation and access to information (see for instance Ref. [28,31]). Other studies also take leisure into account in the developing countries [34], as well as in the context of the European Union and high-income countries [40,44,45].

Our main hypothesis is that these dimensions highlight an incomplete diagnosis of children's vulnerability to poverty, because they do not provide information on children's rights to protection and

participation as contemplated in the UNCRC. In this setting, we consider the material deprivations that could impede children achieve the rights of provision, survival and development, but also the psychosocial deprivations that might hamper them achieve the rights of protection and participation. Thus, both deprivations lead them to be more vulnerable to falling into or remaining in poverty during the rest of their childhood and adulthood.

Table 1 presents a summary of the UNCRC, grouped by categories of rights and dimensions, as well as the differentiation we propose between material and psychosocial deprivation.

To address the study of child vulnerability to poverty, we define vulnerability to falling into or remaining in poverty as composed of two macro domains, namely material and psychosocial deprivation.

3.1. Defining child vulnerability to poverty

Fineman [46], p. 142) defines human vulnerability in a broad sense as “the continuous susceptibility to change in both our bodily and social well-being that all human beings experience”. In turn, the degree of vulnerability is determined by the combination of sensitivity or fragility to suffer a change or harm, and the capacity to cope and adapt, or be resilient [47,48]. More specifically, resilience can mitigate the vulnerability since it provides people with the means to recover from harm, and to bounce back from life setbacks [46].

The terms poverty and vulnerability to falling into or remaining in poverty, have different implications (see Ref. [47,49–51]). Poverty is identified with the material deprivation or the lack of economic-material resources that have negative social consequences. On the other hand, a person can be considered vulnerable to fall into poverty if he/she faces a current risk of becoming poor, or remaining poor in the future. In this vein, our study goes one step further, and we hypothesize that child vulnerability to poverty is a broader concept that encompasses not only the material but also the psychosocial deprivation, and suggest that those, who experience them in childhood might manifest negative effects later in life [12,13,19,52]. That is, we also consider the relational wealth of children with people in their closest environments. The quantity and, more importantly, the quality of these interpersonal relationships with family, teachers, peers and neighborhoods determine whether children fulfill the rights to be protected and to be heard; consequently, whether children feel more resilient and less vulnerable to falling into or remaining in poverty. The importance of this comprehensive approach is that analysing what makes children vulnerable to poverty is a key step to combat child poverty, to prevent that poor children become poor adults, as well as fostering the sustainability of

Table 1

Rights recognized for children around the world in the United Nations Convention on the Rights of the Child of 1989.

	Categories	Dimensions (number of articles of the United Nations CRC)
Material deprivation	Provision - Survival and development	Housing (27)
		Education (28)
Psychosocial deprivation	Protection	Health care, water and sanitation (24 and 25),
		Nutrition and clothing (27),
	Participation	Access to information (13 and 17),
		Leisure (31)
	Participation	Protecting the child from all forms of violence, negligent treatment or maltreatment (19),
		Being heard in all matters affecting the children (12),
	Participation	Freedom of expression (13),
		Freedom of thought (14),
	Participation	Freedom of association (15)

Note. Adapted from the United Nations [23] Convention on the rights of the child, the General Assembly resolution 44/25.

societal well-being for future generations.

Taking the approach of the UNCRC (Table 1) as a starting point as well as the contribution of Fineman [46], p. 146), who identified five types of resources or assets that social institutions can provide to foster the resilience, we identify the two macro domains to reduce the child vulnerability to poverty: material and psychosocial. In our approach, the child vulnerability to poverty is a construct, determined firstly by the availability of physical resources (housing, food, entertainment, etc.), and human resources (education, health care, etc.) to achieve the rights of provision, survival and development. Secondly, it is also determined by the availability of social, ecological and existential (culture, religion, etc.) resources that give children a sense of belonging and community and allow them to see meaning and beauty in their existence. These resources, in turn, provide children with the protection and participation rights. The lack of physical and human resources constitutes material deprivation and the lack (or low quality) of social, ecological and existential resources constitutes psychosocial deprivation. The first type of resources is provided mainly by the family, and also by the public sector (depending on the development of the Welfare State of each country), and the second, largely by the family, teachers, peers and neighborhoods.

The combination of material and psychosocial deprivation will determine the vulnerability of children to falling into or remaining in poverty, since the lack of them can have long-term adverse consequences [12,13,53]. Bearing this in mind, Fig. 1 illustrates our approach to study the child vulnerability to poverty, focusing on both macro-domains.

3.2. Advantages of the proposal

The combination of material and psychosocial deprivation measures to analyse the vulnerability of children to poverty has various remarkable advantages. Firstly, unlike the bulk of the empirical evidence on multidimensional child poverty (as reviewed in the previous section), we present a more comprehensive study of child vulnerability to poverty, as we consider all categories of rights, recognized around the world in the UNCRC of 1989 (see Table 1). We also include relational wealth indicators that allow us to study psychosocial deprivation considering the opinion of children regarding interpersonal relationships that matter most to them. In this way we reflect on the multidimensionality of child vulnerability to poverty, encompassing both its

objective and subjective elements.

Secondly, this approach may explain why the material deprivation might have unequal impacts on children, when they live within different family and community contexts (different grade of psychosocial deprivation-relational wealth). Notwithstanding that the material deprivation can have negative effects on the relationships between children and their parents and also worsen the school climate and their interaction with peers (see the review in Ref. [12,54]; Thompson, 2014), it is also observed that in difficult environments for children, such as families affected by forced displacement due to terrorist violence or situations of financial distress, the psychosocial support of those closest to them is key to overcome such situations (see Ref. [15,18,55]). The explanation is that during life-adversities, the proximity of attachment figures (parents, teachers, relatives or caregivers) for children has protective effects [16,17]. Various psychological theories and studies highlight that the positive emotions experienced by children in parental, school and peer relations are positively associated with the development of resilience to stressful events (see the review in Ref. [56], chapter 24; [55]). More specifically, Thompson [14] concludes that the warm and nurturing relationships between children and their closest adults can act as buffer, and reverse the neurobiological stress response, experienced by the children living in poverty. Likewise, studies show that in low-income contexts, parents' roles in making connection and offering protection are crucial in preventing health risks [57], which further promote safe and nurturing environments for children [58]. Therefore, the quantity and quality of relationships with their closest people could mediate that children shake off the negative effects of material deprivation and overcome the situation of poverty in the future or, on the contrary, that they remain in that status.

Thirdly, our approach allows considering situations in which increases in family income can have detrimental effects on children. This can be the scenario if the higher income is due to parents working long hours; consequently, this could lead to disregarding the right to care and protection of children (see Ref. [19,27,29]). A similar situation occurs when parents emigrate to earn a higher income for the family, but leave their children behind, worsening their well-being [59]. In such situations there would be an increase in psychosocial deprivation—understood as a worsening of wealth in relationships with parents and household members, which in turn would make children more vulnerable to falling into or remaining in poverty (for example, through worsening school performance and increasing the risk of dropping out of school).

4. Data and method

4.1. Dataset

The data used for the empirical analysis of the theoretical concept are derived from the Children's Worlds Study, a cross-sectional International Survey on Children's Well-Being (ISCWeB), supported by Jacobs Foundation. ISCWeB is the first global study of childhood from a child's perspective. The ISCWeB project aspires to improve children's well-being (i.e., reducing children's deprivation). It aims at collecting solid and representative data on children's lives and daily activities, time use, self-perceptions and evaluations of their well-being in 32 countries across four continents. The questionnaire is self-administered and comprises eight life domains and aspects of life: the home and the people children live with; money and things children have; relationships with friends and other people; the area where children live; school; health; time management and leisure time; self. Each participating country selects a representative sample of at least 1000 children in each of three school year groups – around the ages of 8, 10 and/or 12.

For the purposes of this study, we focus on the third wave of the ISCWeB, carried out between 2016 and 2019. The third wave provides the closest information to our study on a larger number of children and countries. Specifically, we have focused on 10-year-old children because

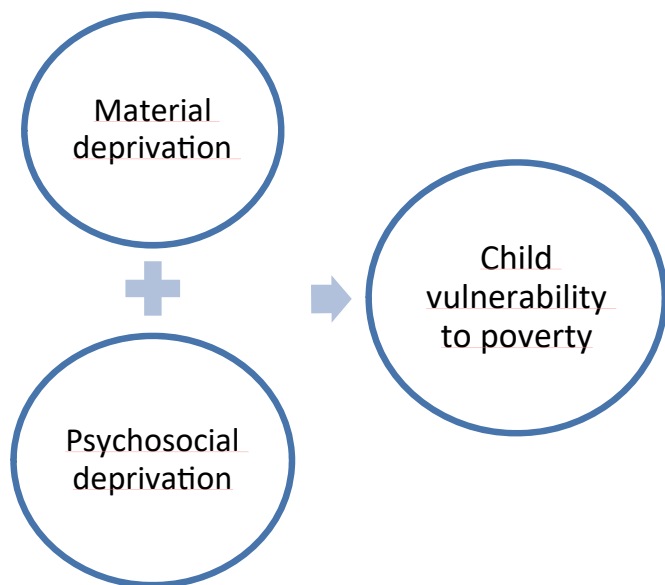


Fig. 1. Material and psychosocial deprivation as determinants of child vulnerability to poverty.

the surveys of the youngest children (8 years of age) include a smaller number of questions of interest to our study, and in the surveys of 12-year-old children the representation of countries is smaller than in surveys of 10-year-olds. For the 10-year-old group there is a wide range of available items that can be used for measuring material and psychosocial deprivation at this age in 32 countries. In order to reduce the number of missing values arising from the multidimensional approach, we took certain precautions. Firstly, the missing data were imputed using a multivariate approach by chained equations [60,61]. Secondly, to preserve the richness of information in some countries, we also prefer to include countries where some of the selected indicators have not been collected. The total number of observations is 46,343. Table A1 in Appendix summarizes the number of available observations for each of the 32 countries involved in this analysis.

4.2. Indicators for measuring material deprivation

The selection of the items of material deprivation is guided by the approach of the UNCRC. In order to identify the indicators of material deprivation, as Abdu and Delamonica [27] explained, the direction of the analysis is not the (monetary) poverty of the child, which explains why they do not have (for instance) a place at home for studying (the right to be educated being violated), but rather the opposite. A child who does not have a place in his/her home to study (regardless of her family's monetary resources) is poor, because education deprivations make the child poor ("constitutes" being poor). Thus, the material deprivations make children poor.

Bearing this idea in mind, the concept of child vulnerability to poverty as discussed in the previous section, the empirical applications in this field, the available information in our data, as well as a list of common indicators of material deprivation provided by the project MODA (Multidimensional Overlapping Deprivation Analysis) of UNICEF in its Web (<https://www.unicef-irc.org/research/multidimensional-child-poverty/>), we selected 19 indicators grouped into six dimensions of child material deprivation (see Table 2). Following a life-course approach, MODA establishes separate indicators and dimensions for different age groups. As our survey has been answered by 10-year-old children, we selected the 5-14-year-old group of MODA.

Table A1 in Appendix summarizes the number of dimensions of material deprivations that has been computed for each of the 32 countries involved in this analysis.

4.3. Indicators for measuring psychosocial deprivation

As our readings suggest, the incorporation of specific indicators of psychosocial deprivation in terms of children's relational-wealth is not extensively explored in the empirical studies of child poverty and/or child vulnerability to poverty. Overall, relational wealth is referred to human relations that are more frequent, and more important to people. That is to say, it focuses on trusting interpersonal relationships that take place between the closest people, who know each other [62]. In the case of children, this special kind of relationships are developed in the setting of the nuclear family, school, with friends, and in the closest community. In contexts where resources are scarce, the quality and depth of these interpersonal relationships might aggravate the negative effects of material deprivation [13] or, alternatively, can have protective effects to foster the resilience of children to such stressful situations [14,16,17, 55].

To select indicators that allow measuring the psychosocial privation of children, we have followed the proposals of Li et al. [54], and Rojas [62]. Psychosocial deprivation would be a proxy for children's perception of the extent to which their closest environment does not allow them possessing the fundamental rights of the UNCRC related to protection and participation (see Table 1). Table 3 illustrates the selected indicators of psychosocial deprivation in the four environments, considered closer to children.

Table 2

Selected items for measuring material deprivation from the International Survey of Children's World.

Survey questions (No. in the survey)		Dimension
How many bathrooms (rooms with a bath/shower or both) are in your home? (19)	Categorical variable (0,1,2 or more)	Housing
Do you have your own bed? (21)	Binary variable (no, yes)	Education
Is there a place in your home where you can study? (22)	Binary variables (no, yes)	
Do you have the equipment/things you need for school? (64)		
Do you have the equipment/things you need for sports and hobbies? (64)		
Do you have enough money for school trips and activities? (64)		Water and sanitation
Does your home have running water? (24b)	Binary variables (no, yes)	
Does your home have a toilet that flushes? (24b)		Access to information
Does your family have at home: (49)	Binary variables (no, yes)	
A computer (including laptops and tablets)		
A television		
A radio		
A telephone (landline or mobile)		Leisure
Access to the internet at home		
In the last 12 months, how many times did you travel away on a holiday with your family? (56)	Categorical variable (0,1,2,3 or more)	
How much do you agree with this sentence: in my area there are enough places to play, and have a good time (37)	Categorical variable Likert scale at five level (1 = I do not agree, 5 = I totally agree)	Nutrition and clothing
Do you have pocket money? (64)	Binary variable (no, yes)	
Do you have enough food to eat each day? (63)	Categorical variable (Never, sometimes, often, always)	
Do you have clothes in good conditions? (64)	Binary variable (no, yes)	
Do you have two pairs of shoes in good condition? (64)	Binary variable (no, yes)	

Psychosocial deprivation, containing explorative and confirmatory factor analysis, has been displayed in the four dimensions to support the poor empirical evidence on this subject in literature. The cut-off value for Cronbach's alpha, which denotes good internal consistency of the scale, is in average 0.60 or higher; thus, the four dimensions scales identified, reveal a good global internal consistency in almost all the countries. The overall assessment of this theoretical framework is confirmed by the Confirmatory Factor Analysis (CFA), as reported in Table A2 in Appendix.

Table A1 in Appendix summarizes the number of dimensions of psychosocial deprivations that has been computed for each of the 32 countries involved in this analysis.

4.4. Method: the fuzzy approach

Most of the items used in multidimensional poverty approaches are categorical variables on ordinal scale. Therefore, if a certain item x_j is categorical, then its values can be assigned with the numerical values (for instance, the item "My friends are usually nice to me": 1- do not agree, ..., 5 = I totally agree; the item "Does your family have a computer at home?": 0 = no, 1 = yes. Thus, suppose that categorical items are arranged in such a way that higher value is considered as lower poverty risk. Let x_{jmin} be the lowest value of x_j so each children i with $x_j = x_{jmin}$ is undoubtedly considered as deprived in such an item and x_{jmax} be the highest value of x_j so each children i with $x_j = x_{jmax}$ is undoubtedly considered as not deprived. Children i with $x_{jmin} < x_j < x_{jmax}$

Table 3
Selected items for measuring psychosocial deprivation from the International Survey of Children's World.

Survey questions (No. in the survey)		Dimension
How much do you agree with each of these sentences? (12)		
There are people in my family who care about me	Categorical variables	Family
If I have a problem, people in my family will help me	Likert scale at five level (1 = I do not agree, 5 = I totally agree)	
We have a good time together in my family		
My parent(s) listen to me and take what I say into account		
My parents and I make decisions about my life together		
How much do you agree with each of these sentences? (33)		
My teachers care about me	Categorical variables	Teacher-school
If I have a problem at school, my teachers will help me	Likert scale at five level (1 = I do not agree, 5 = I totally agree)	
My teachers listen to me, and take what I say into account		
If I have a problem at school, other children will help me		
How much do you agree with each of these sentences? (26)		
I have enough friends	Categorical variables	Friends
My friends are usually nice to me	Likert scale at five level (1 = I do not agree, 5 = I totally agree)	
If I have a problem, I have a friend who will support me		
How much do you agree with each of these sentences about your local area? (37)		
If I have a problem there are people in my local area who will help me	Categorical variables	Community
Adults in my local area are kind to children	Likert scale at five level (1 = I do not agree, 5 = I totally agree)	
In my local area, I have opportunities to participate in decisions about things that are important to children		
Adults in my area listen to children, and take them seriously		

are considered as partly deprived. Following the proposal of multidimensional and fuzzy approach of Betti et al. [22] for measuring quality of life, the membership function for children i and the item j to the set of deprived children is defined as follows:

$$\mu_j(x_{ij}) = 1 - \frac{F(x_{ij}) - F(x_{jmin})}{F(x_{jmax}) - F(x_{jmin})}, j = 1, \dots, J, i = 1, \dots, n, \quad (1)$$

where $F(\cdot)$ is the cumulative density function of item x_j .

When the item assumes its minimum level (high level of deprivation), we have that $F(x_{ij}) = F(x_{jmin})$, and therefore, $1 - \mu_j(x_{ij})$ is equal to one. Instead, when the item assumes its maximum level (lowest level of deprivation) the numerator of Eq. (1) is equal to the denominator, and therefore, $1 - \mu_j(x_{ij})$ is equal to zero.

Thus, the membership function ranges between 0 (not deprived) to 1 (most deprived) and values between 0 and 1 indicate intermediate degrees of deprivation.

Let also be d ($d = 1, \dots, D$) one of the possible dimensions that characterize a particular aspect of deprivation (see Tables 2 and 3). The overall membership function of multidimensional deprivation for i -th observational unit in the d -th dimension is then derived by computing the weighted average across the items holding to dimension d , namely:

$$\mu_d(i) = \frac{\sum_j w_{(d)j} \mu_j(x_{ij})}{\sum_j w_{(d)j}}, \quad (2)$$

where $w_{(d)j}$ is the weight assigned to the j -th item in the d -th dimension and it is computed as $w_{(d)j} = w_{(d)j}^a * w_{(d)j}^b$ according to the approach proposed by Betti and Verma [63]. Following this weighting system, within each identified dimension d , the weight w_j to attribute to each single

item j is computed as the product of two components that take into account both the dispersion of the item (e.g., the weight should rise as the corresponding item becomes more widely distributed) in the d -th dimension ($w_{(d)j}^a$), and its correlation ($w_{(d)j}^b$) with the other indicators in the same dimension d (e.g. weighting should minimize redundancy, thereby reducing the impact of items that exhibit high correlation). In summary, it is a weighting system based on the statistical characteristics of the data that is very common in socio-economic literature (see among others, [64–68]). Concerning the aggregation method (e.g., arithmetic mean) used in Equation (2), we are aware that weights used in additive methods are substitution rates instead of importance coefficients (i.e., the intrinsic nature of additive methods implies a compensatory logic). However, our analysis aligns with most of the empirical studies in this context that are based on such assumption [69].

Finally, it is also possible to construct a fuzzy multidimensional index μ_d that measures the degree of deprivation in dimension d of the entire children population. This overall fuzzy index μ_d is defined as the average value of individual values of overall multidimensional functions defined by (2), across the population, as follows:

$$\mu_d = \frac{1}{n} \sum_{i=1}^n \mu_d(i) \quad (3)$$

As values of μ_d increase from 0 to 1, the deprivation of i -th children for the corresponding dimension increases. In order to detect differences among countries in fuzzy indices (μ_d), we used empirical 95 % confidence intervals [70] supported by the Kruskal-Wallis (KW) non-parametric test [71,72]. In addition, Dunn's test with Holm-Sidak adjustment [73] was performed to pairwise multiple-comparisons. Dunn's test is also known as Dunn's post hoc test because it is performed after conducting a non-parametric analysis of variance (i.e., Kruskal-Wallis test) in order to detect which groups significantly differ to each other while controlling the risk of making erroneous conclusions due to multiple testing. These no-parametric tests are very attractive in this context because the assumption of normality is not required.

5. Results

To answer our main research question, namely "Do children in developing countries perceive more material deprivation and/or psychosocial deprivation than children in developed countries?" we use graphical visualizations and the Dunn's test introduced in section 4.4. Figs. 2–11 present the empirical 95 % confidence intervals of the overall fuzzy readiness index μ_d for each dimension of the respective macro-domain by country. The overlap or lack thereof of these intervals allows us to understand how different the vulnerability distributions are for each dimension in various countries. When two confidence intervals do not overlap, we can infer that high levels of deprivation in one country are, on average, lower than the low levels of deprivation in another country.

The values of the fuzzy indexes estimated for each dimension of deprivation at country level -or membership functions- and the intervals are also reported in Tables A3 and A4 in Appendix. The p-values of Dunn's test are included in Tables A5-A14 in Appendix.

In Table 4 we summarize the main results of these analyses. For example, four groups of countries with statistically different average levels of material deprivation in housing can be identified. The first group, which registers the highest level of deprivation in housing (between 0.3244 and 0.3848) includes Sri Lanka, South Africa, and Nepal. The second group, with housing deprivation values between 0.2422 and 0.2792, incorporates Indonesia, Algeria, and Vietnam. The third group is formed by Malta, Brazil and Albania and they register average deprivation values in housing between 0.1515 and 0.2001. Finally, a fourth group is composed of the rest of the countries for which information on housing deprivation is available, and which registers the lowest values for this type of deprivation. By repeating this analysis in all the

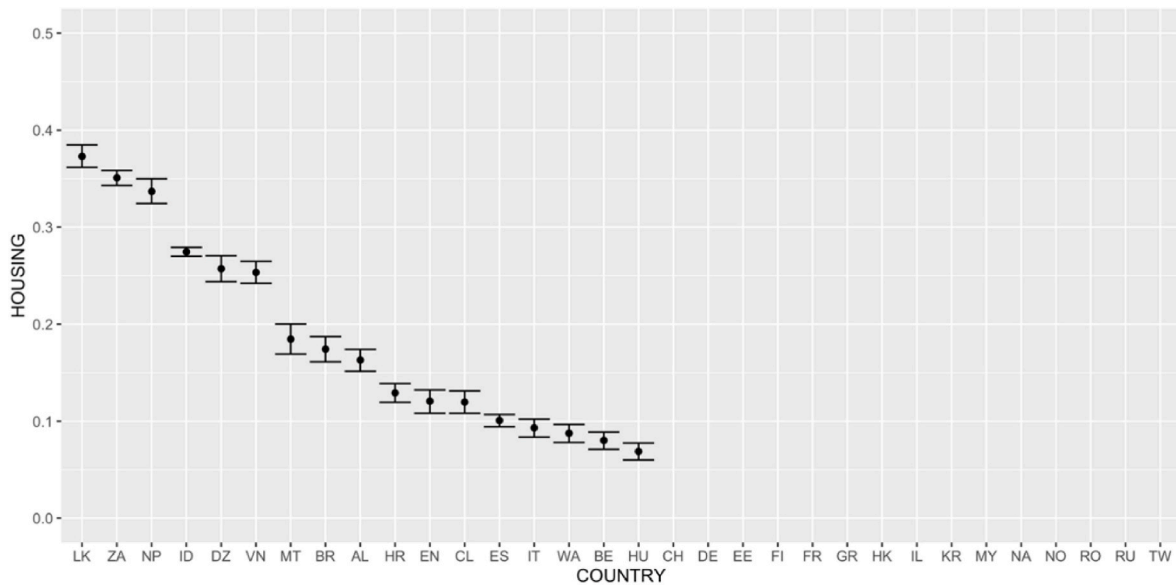


Fig. 2. Empirical confidence intervals (95 %) of the fuzzy index μ_d of material deprivation in housing (17 countries).

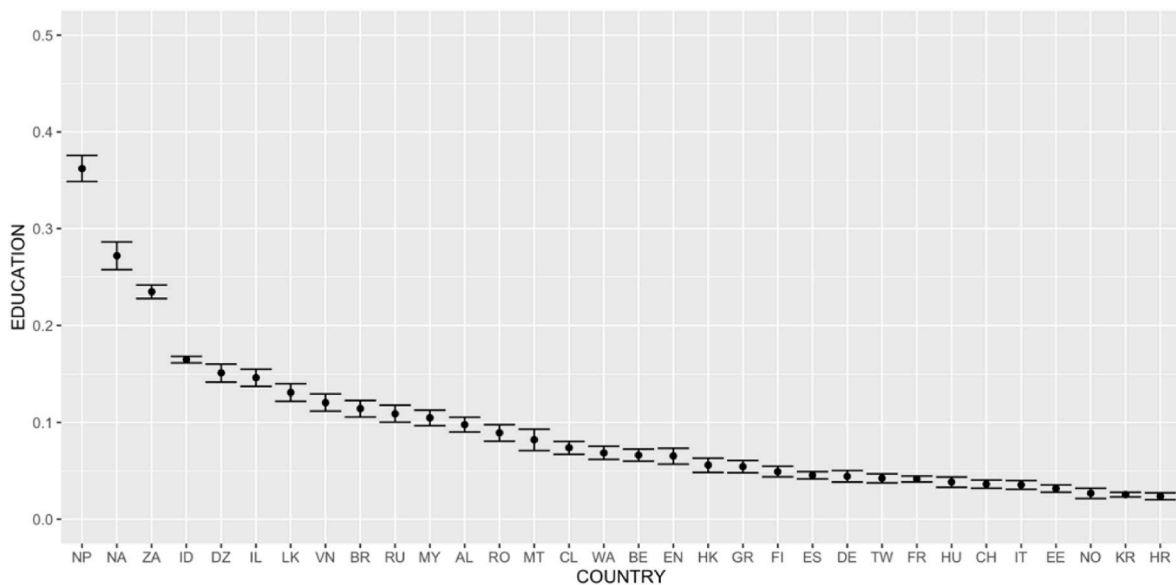


Fig. 3. Empirical confidence intervals (95 %) of the fuzzy index μ_d of material deprivation in education (32 countries).

dimensions of deprivation studied (six of material deprivation and four of psychosocial deprivation), in Table 4 we identify the countries that register the highest and lowest levels of deprivation, respectively. This exercise allows us to show some significant findings from our study that go beyond expectations.

At first glance, our findings highlight that the developing countries are characterized by higher values in all the material dimensions. Among the countries with the highest material deprivation, we find Nepal, Namibia, Zambia, Sri Lanka and Indonesia. However, surprisingly children in developed countries, such as Italy and Spain, report high levels of material deprivation in leisure; children in Belgium and Israel report feeling high levels of deprivation in nutrition and clothing.

Regarding psychosocial deprivation, our finding is quite unexpected. We have information on psychosocial deprivation in the family and school settings for a wide range of countries (respectively, 30 and 29 territories were analysed). Although children in Sri Lanka perceive high levels of material deprivation, they report the lowest levels of

psychosocial deprivation with family and teachers. At the other extreme, children in Malaysia and Brazil report the highest levels of psychosocial deprivation in the contexts of friends and community.

With the purpose of studying more deeply the association between deprivation (material and psychosocial) and the level of development of the countries analysed, we have calculated the Pearson's correlation coefficient between our 10 deprivation indexes and the Productive Capacities Index (PCI) in 2019 (see Table A15).² The results clearly show that the correlation between PCI and each of the six dimensions of material deprivation is negative and very high. This means that, as the

² The PCI is calculated by the UNCTAD as a proxy of the level of development of the countries studied in this paper (see its values in Table A1). The PCI measures the capacity of a country to produce goods and services that enable it to grow and develop. This index ranges between 0 and 100 and synthesizes information from eight dimensions (see: <https://unctadstat.unctad.org/EN/Pci.html>).

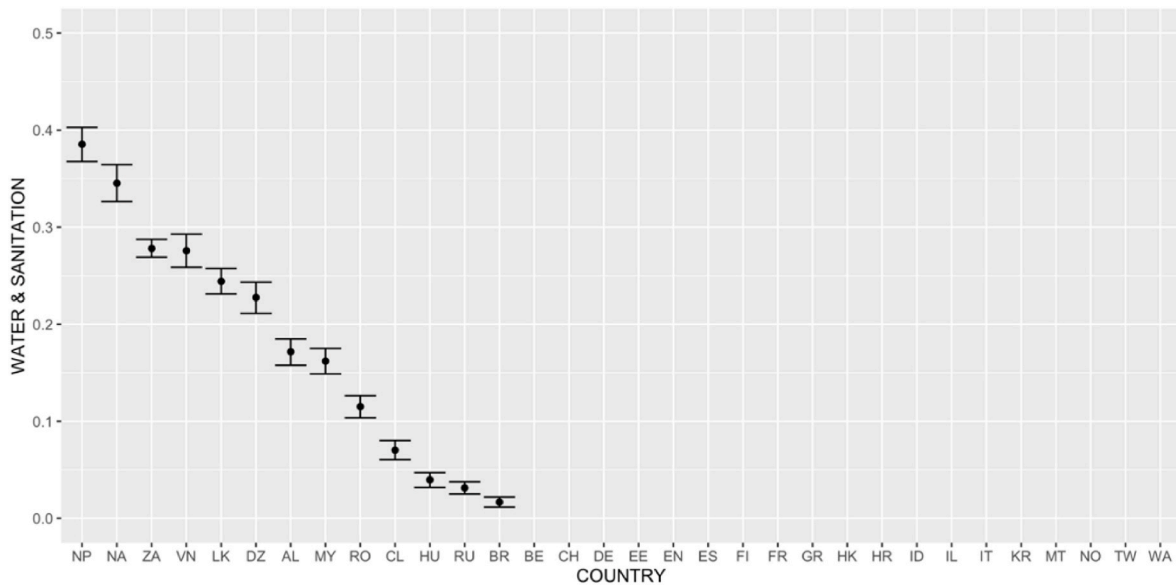


Fig. 4. Empirical confidence intervals (95 %) of the fuzzy index μ_d of material deprivation in water and sanitation (13 countries).

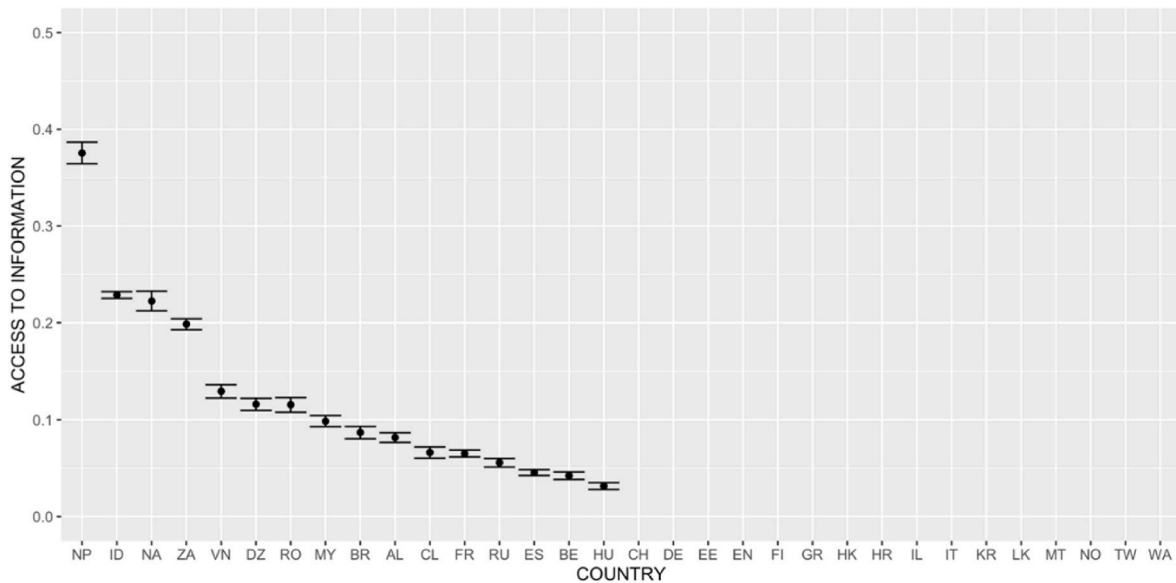


Fig. 5. Empirical confidence intervals (95 %) of the fuzzy index μ_d of material deprivation in access to information (16 countries).

level of development of the countries increases, material deprivation perceived by children decreases. The relationship is quite strong, since the correlations coefficients range between -0.41 and -0.73 (Table A15). On the other hand, there is no clear relationship between the four indexes of the psychosocial deprivation perceived by children and the level of development (PCI) of the countries analysed in this paper. The correlation coefficients reach very low values and, furthermore, with both positive and negative signs (Table A15). Specifically, the two correlations that refer to the dimensions “family” and “friends” are negative but virtually negligible (around -0.05). Likewise, the correlation between the PCI development index and the dimensions “teacher and school” and “community” are positive, registering very low values (0.15 and 0.09, respectively).

6. Conclusions and discussion

Taking as starting point the importance that must be given to meet

the needs of children to promote the sustainable development of a territory [9], we have constructed indexes of deprivation in 10 specific dimensions of childhood for 32 countries. For that, we followed the children’s rights conceptual framework of UNICEF. Our study presents two outstanding contributions.

Firstly, we hypothesize that not only material deprivation makes children vulnerable to falling into or remaining in poverty, but also the psychosocial one. The lack of supportive relationships between children and their closest environment might amplify the effects of material deprivation. Nevertheless, and alternatively, the quality of the interpersonal relationships, could counteract those negative effects that arise in the context of material scarcity by fostering the resilience of children.

Secondly, we worked with children understanding their opinions and perceptions about living standards, instead of considering the adult’s perceptions about the children deprivation. From the empirical point of view, this led us to the treatment of categorical variables measured on an ordinal scale. The applied methodology [22] has allowed us to construct

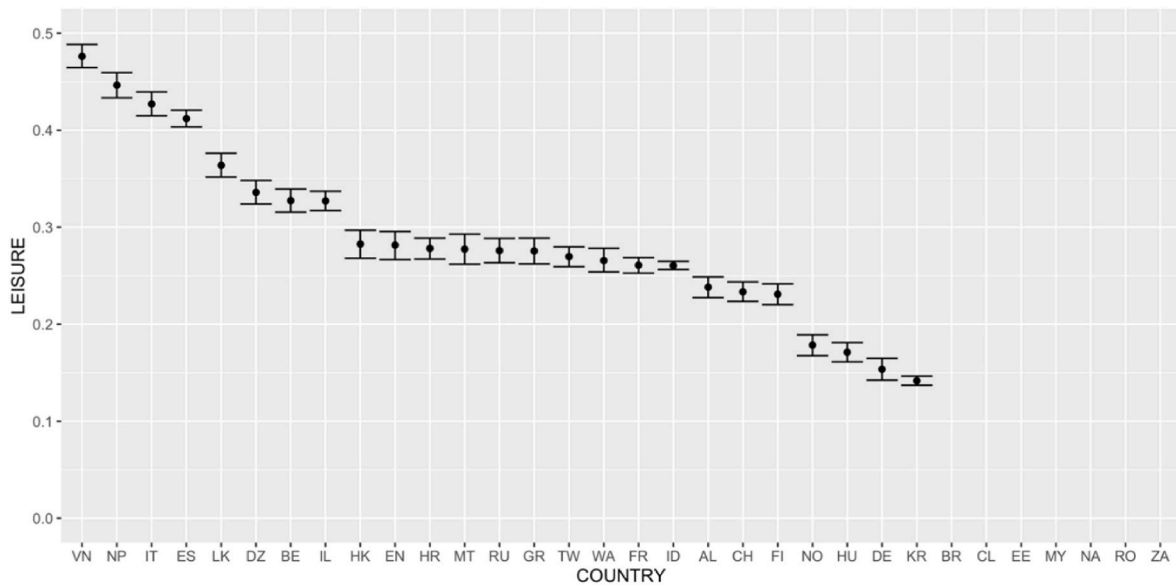


Fig. 6. Empirical confidence intervals (95 %) of the fuzzy index μ_d of material deprivation in leisure (25 countries).

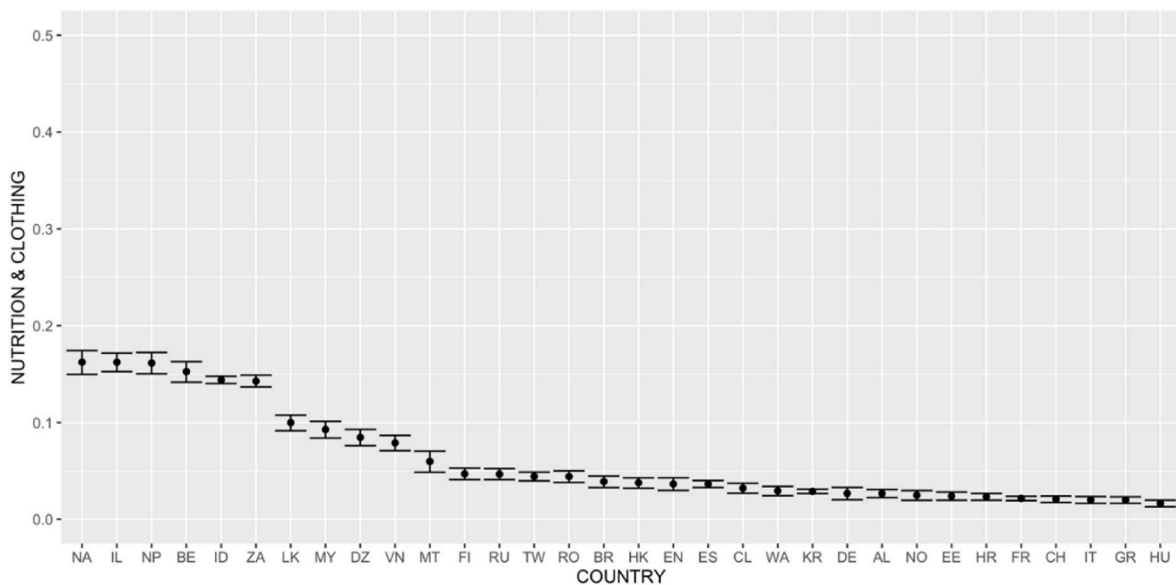


Fig. 7. Empirical confidence intervals (95 %) of the fuzzy index μ_d of material deprivation in nutrition and clothing (32 countries).

six fuzzy indexes of material deprivation, and four fuzzy indexes of psychosocial deprivation for each country.

Based on the results of the fuzzy indexes of deprivation for each of the 32 countries (Tables A3 and A4), it could be stated that children in the developed countries experience more psychosocial than material deprivation, whereas in the developing countries there is not a clear pattern. Focusing on the developed countries, these findings are not surprising because of the welfare state, especially in Europe, which provides a wide range of education and health benefits to promote equal opportunities and prevent children from falling into poverty.

From the comparisons between countries, we can deduce that it is not correct to assume that material and psychosocial deprivation in childhood go hand in hand. Some developing countries, such as Sri Lanka, which have the highest levels of material deprivation, have surprisingly the lowest levels of psychosocial deprivation. This might indicate that in some national contexts, psychosocial dimensions seem to function as protective factors, which mitigate the consequences of

adverse situations, and enable the children to have fulfilling lives despite material deprivation. In contrast, some developed countries present the highest levels in some dimensions of material deprivation (for instance Italy and Spain in leisure, and Belgium and Israel in nutrition and clothing), as well as in psychosocial deprivation in the setting of the family.

Continuing with a comparative analysis across countries, we have identified a high and negative association between the six indexes of material deprivation and the level of development of the countries analysed. Thus, it could be concluded that as the level of development increases, material deprivation perceived by children decreases. However, and in consonance with what was indicated in the previous paragraph, we did not find a clear pattern of association between the four indexes of psychosocial deprivation perceived by children and this level of development.

Likewise, and comparing our findings with the results of the main poverty indicators provided by international organizations for the entire

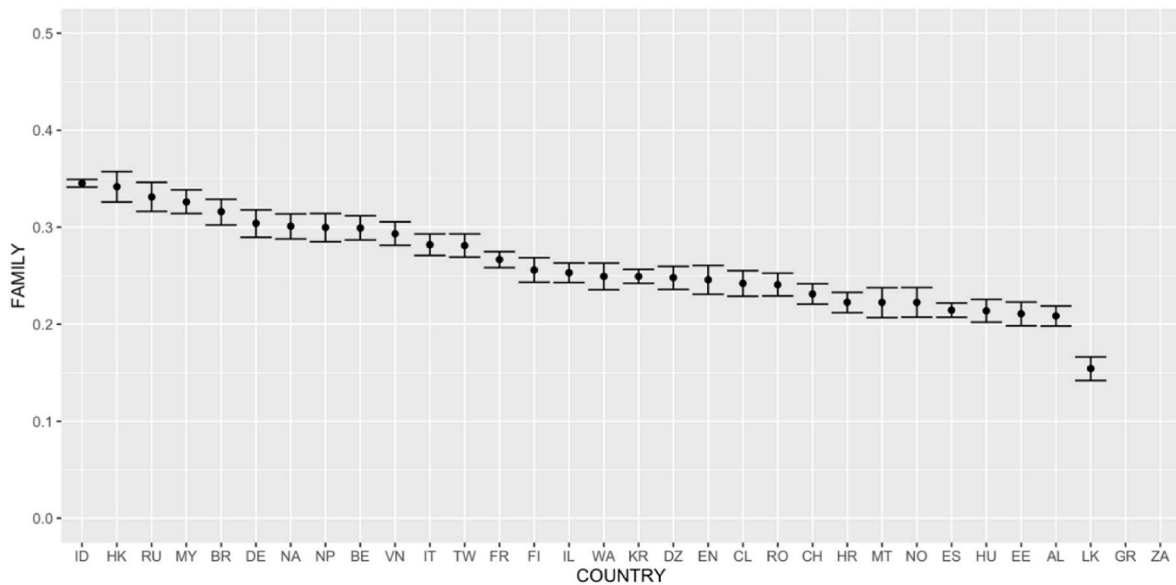


Fig. 8. Empirical confidence intervals (95 %) of the fuzzy index μ_d of psychosocial deprivation in family (30 countries).

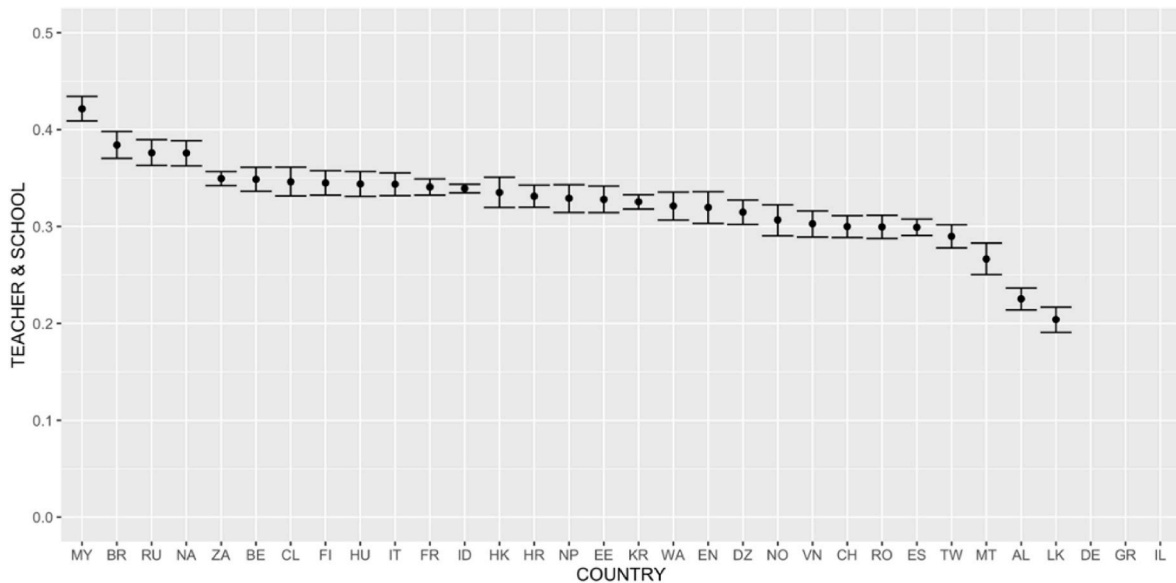


Fig. 9. Empirical confidence intervals (95 %) of the fuzzy index μ_d of psychosocial deprivation with teacher and school (29 countries).

population of a country, some evidence can be stressed. Among the developing countries of our study, Namibia ranked the worst in both the Multidimensional Poverty Index [74] and the Multidimensional Poverty Measure [75]. That is, the population of Namibia registered the highest level of poverty. However, in our study, children in Nepal reported higher levels of deprivation than those in Namibia in education, water and sanitation, and access to information. Within the developed countries of our study, the case of Romania is quite surprising compared to other countries such as Spain and Italy. According to the Multidimensional Poverty Measure for 2019, 4 % of the population in Spain, and 3 % of the population in Italy would be affected by multidimensional poverty, whereas in Romania it would affect only 0.8 % of the population. In contrast, the results of our studies showed that children in Romania reported by far the highest levels of material deprivation in the European Union.

7. Implications of the study for conceptualisations of deprivation in childhood and policy interventions

The primary purpose of this study was to address child vulnerability to falling into or remaining in poverty rather than addressing the narrower concept of child poverty, defined in terms of relative deprivation, by bringing to the fore the role of interpersonal relationships of children with their closest environments (i.e., parents and family, peers, teachers, and neighborhoods). It does so within a broader conceptual framework in which the assumption that material and psychosocial deprivation go hand in hand is highly questioned. The lack of supportive relationships between children and their closest environment may well amplify the effects of material deprivation.

The ground breaking approach of the study is based on the data used since there are very limited studies investigating children’s opinions on their actual vulnerability to falling into or remaining in poverty. On a research level, this study has shown the necessity to investigate further

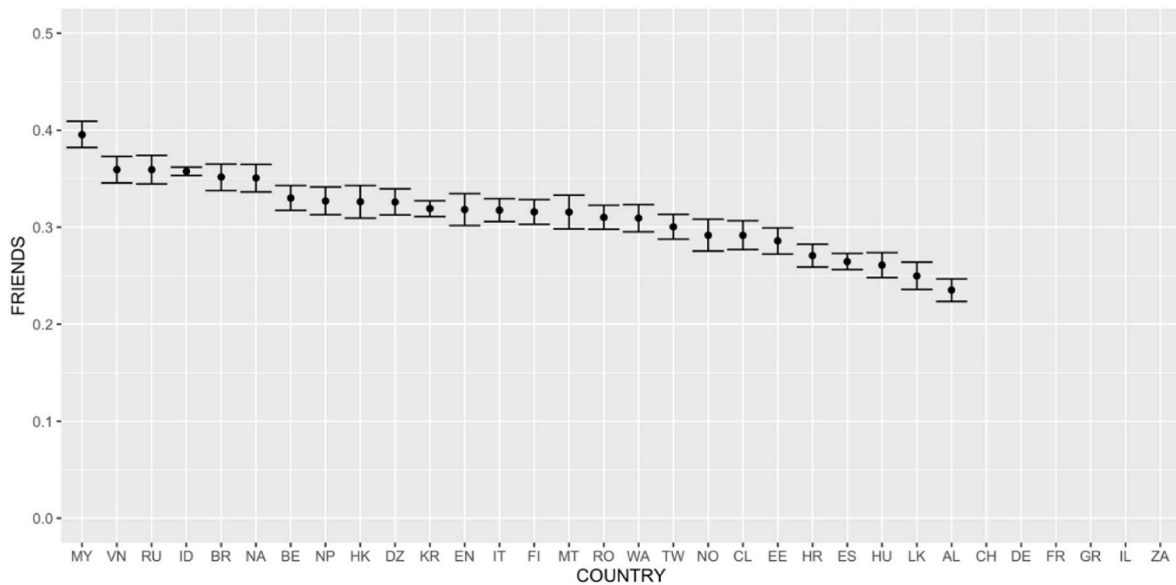


Fig. 10. Empirical confidence intervals (95 %) of the fuzzy index μ_d of psychosocial deprivation with friends (26 countries).

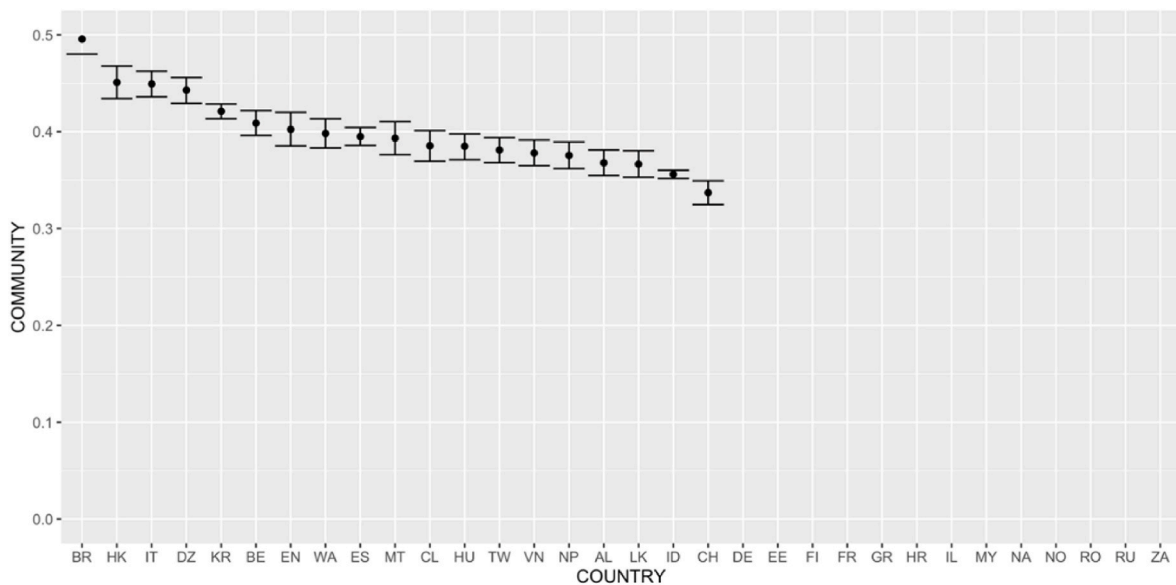


Fig. 11. Empirical confidence intervals (95 %) of the fuzzy index μ_d of psychosocial deprivation in community (19 countries).

the relationship of the triptychon -vulnerability to poverty, material and psychosocial deprivation-, in order to better understand the dynamics that take place especially during early and middle childhood.

The study does not aim to arrive at a definitive set of recommendations for policymakers and those working to combat poverty. Nevertheless, there are some general implications and suggestions that arise from the evidence of the study, which are laid out in this section for further consideration and assessment. Specifically, using the analysis presented, and regardless of the level of economic development of the country, decisions could be made in three directions: 1) the measurement of child poverty with specific indexes, 2) the design of comprehensive programmes to break the cycle of disadvantage of poverty and social exclusion, and 3) the consideration of public policies for reconciling work and family. These three ideas are reviewed below.

First, consistent with the UNICEF's approach, specific measures of child poverty, separate from those of the population as a whole are required. Firstly, because children's deprivations can be different than

parents; poor children are not the same as children living in poor households [27]. Additionally, the measurement must be aligned with the idea that child poverty should be centered on deprivations of child rights, rather on the lack of income. The deprivations that children suffer, directly affect them, independent of any possible causal relationship with their parents' income [29,35]. Secondly, since before the COVID-19 pandemic figures showed a higher incidence of poverty among children worldwide [10,76], it is anticipated that children are also among the most vulnerable groups to experience the negative effects of COVID-19. Overall, the reduction of household income due to the rising unemployment has increased children's material deprivation; and school closures have interrupted their learning process and social interactions [77–80]. Therefore, if policy makers take the national poverty measurements of the entire population as a reference to set targets and monitoring, they would be ignoring the true situation of a large part of the population. Consequently, this will be crucial for the sustainability of the societal well-being of future generations: children

Table 4

Main geographical patters of material and psychosocial deprivation in childhood, 2016–2019.

Material deprivation(n)	The greatest deprivation	The lowest deprivation
Housing(17)	Sri Lanka, South Africa and Nepal	European countries and Chile
Education(32)	Nepal	All (except Nepal, Namibia and South Africa)
Water and sanitation(13)	Nepal and Namibia	Chile, Hungary, Russia and Brazil
Information(16)	Nepal	All (except Nepal, Indonesia, Namibia and South Africa)
Leisure(25)	Vietnam, Nepal, Italy and Spain	Norway, Hungary, Germany and South Korea
Nutrition and clothing(32)	Namibia, Israel, Nepal, Belgium, Indonesia and South Africa	All the rest
Psychosocial deprivation(n)	The greatest deprivation	The lowest deprivation
Family(30)	All except Sri lanka	Sri Lanka
Teacher and school(29)	Malaysia	Sri Lanka and Albania
Friends(26)	Malaysia	All except Malaysia
Community(19)	Brazil	All except Brazil

Note. (n) Number of countries analysed.

and adolescents.

Second, public policies to promote the welfare state have focused mainly on reducing the material deprivation of children. Nevertheless, there is a dire need for policymakers to reconsider and broaden their understanding of the influential conditions of vulnerability to poverty and primarily the role of psychosocial deprivation. The consideration of two macro dimensions of deprivation (material and psychosocial) as determinants of the vulnerability of children to falling into or remaining in poverty helps to explain why children exposed to the same macro-economic shock, for instance COVID-19, have dissimilar capacity of response, because their vulnerability is distinct. For instance, during the pandemic, the results of children's online learning have not only depended on the availability of computers and Internet connections at home, but also on the help and support received by parents, caregivers and teachers [81]. Thus, our study suggests the development of programmes to improve the quality, and depth of the interpersonal relationships of children with their closest environments, as a mechanism to break the cycle of disadvantage of poverty and exclusion. In this vein, policymakers could well develop neighbourhood policies and initiatives that promote the sense of shared responsibility for the conditions of its weakest members and can improve the psychosocial processes of all inhabitants and especially children living under the risk of vulnerability to poverty. This could be realised by reducing the sense of social exclusion and by strengthening the sense of community belonging and solidarity through initiatives that enable daily interactions among its members, supportive measures on housing conditions, advancement of the quality of neighbourhood spaces and by enabling the mobility of its members.

Third, another aspect on which we would like to draw attention are the social protection programmes, whose purpose is to increase the economic resources of households as a mechanism to reduce child poverty (see the review in Ref. [10]). In these cases, fewer material deprivations might have detrimental effects on children since it would mean a reduction or worsening of the quality of relationships between children and their families. Considering the central contribution of families and family policies from around the world to meet the ambitions of the SDGs [21], comprehensive public policies to reduce child vulnerability to poverty should include public policies for reconciling work and family.

To sum up, policymakers dealing with collective choices need tools

to manage the multidimensionality of the child vulnerability to poverty and the relevance of psychosocial factors. The new approach and the indexes of deprivation proposed in this paper can be a support for better-informed decisions and policy formulations and, at the same time, leads to a reflection on the opportunity to evaluate multidimensional children well-being by also taking children as actors for assessing their perceptions of necessities.

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CRediT author statement

Angeles Sánchez: Conceptualization, Methodology, Formal analysis, Writing-Original draft preparation, Writing-Reviewing and Editing, Funding acquisition, Supervision. Antonella D'Agostino: Methodology, Software, Validation, Formal analysis, Visualization, Resources, Data Curation. Caterina Giusti: Methodology, Software, Validation, Formal analysis, Visualization, Resources, Data Curation, Supervision. Antoaneta Potsi: Conceptualization, Writing-Original draft preparation, Writing-Reviewing and Editing, Supervision.

Declaration of competing interest

None.

Data availability

In a footnote in the title we have shared how to access the dataset for free.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.seps.2023.101794>.

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