The Prevalence of Significant Cognitive Delay among 3-4-Year-Old Children Growing Up in Low- and Middle-Income Countries: Results from 126 Nationally Representative Surveys Undertaken in 73 Countries

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# Abstract

**Background**: We sought to: (1) update estimates of the prevalence of SCD among nationally representative samples of young children overall, and in upper-middle, lower-middle and low-income countries; (2) investigate whether variation in prevalence between countries was systematically associated with national wealth and other country characteristics; (3) investigate the stability of prevalence estimates over time; (4) examine the correlation between SCD and 2019 Global Burden of Disease estimates on the prevalence of the impairment of developmental intellectual disability under 5 years of age ; and (5) investigate the extent to which risk of SCD within countries varies with child age and gender, maternal education and household wealth.

**Methods**: Secondary analysis of data collected in 126 nationally representative Multiple Cluster Indicators Surveys (MICS) conducted under the supervision of UNICEF in 73 countries involving a total of 396,596 3-4-year-old children.

**Results**: The overall prevalence of SCD was 9.7% (95%CI 8.6%-10.9%). Between-country variation in prevalence was strongly related to national wealth, the Human Development Index, the Human Inequality-adjusted Development Index and the Multidimensional Poverty Index, but not income inequality. In the 46 countries in which more than one survey was available prevalence estimates were reasonably stable over time (r=0.80, p<0.001). There were strong independent associations between increased risk of cognitive delay and younger child age, lower levels of maternal education and lower levels of household wealth (but not male gender). There was only a weak association across countries between the estimated prevalence of SCD and Global Burden of Disease estimates of the under 5 prevalence of the impairment of developmental intellectual disability.

**Conclusions**: UNICEF’s MICS data is readily (and freely) available to researchers and provides a cost- effective opportunity for researchers who are concerned about better understanding the situation of young children growing up in the world’s LMICs with a marked loss of developmental potential in areas of cognition and learning.

**Keywords:** Cognitive delay, intellectual disability, prevention, low- and middle-income countries, young children

# Introduction

Intellectual disability research has been criticised for primarily addressing the situation of people with intellectual disability living in high-income countries (Emerson *et al.* 2007). Little is known about such basic issues as the prevalence of intellectual disability or the life experiences of people with intellectual disabilities living in low- and middle-income countries (LMICs). For example, a WHO commissioned review of the prevalence of intellectual disabilities identified 26 studies that used robust regional, provincial or national sampling frames (Maulik *et al.* 2011). All but one of these were undertaken in high-income countries. More recently the Global Burden of Disease Study (GBDS) has modelled the prevalence of intellectual disabilities for most of the world’s countries (Olusanya *et al.* 2020, Global Research on Developmental Disabilities Collaborators 2018). GBDS estimates are derived from complex modelling of data extracted from listed ‘inputs’ (primarily studies reporting the prevalence of intellectual disability). The 2019 modelling of intellectual disability was based on 51 cited inputs. Of these, 36 (71%) were studies undertaken in high-income countries, with the remaining studies undertaken in middle-income countries, none of which used sampling frames capable of generating robust national estimates. No listed studies were undertaken in low-income countries.

However, the available evidence on between-country variation in exposure to established determinants of intellectual disability (e.g., undernutrition, infectious disease, poverty) suggests that the incidence and probably prevalence of intellectual disability is likely to be much higher in LMICs and especially so in low-income countries (Black *et al.* 2017, Walker *et al.* 2007, Walker *et al.* 2011, Durkin *et al.* 2007). Although methodologically limited, the sparse evidence that was available until recently on prevalence does support this hypothesis (Maulik et al. 2011, Durkin et al. 2007, Durkin 2002, Arora *et al.* 2018).

One possible approach to addressing this bias in intellectual disability research is for researchers to make greater use of data collected by UN Agencies and national governments as they monitor progress toward the achievement of the UN’s Sustainable Development Goals (<https://sdgs.un.org/#goal_section>). In addition, greater use could be made by researchers of data generated in the attempt to estimate the global and regional ‘burdens’ of health conditions and impairments, including intellectual disability. With regard to the latter strategy, Olusanya and colleagues have used data from the 2017 Global Burden of Disease Study (GBDS) to estimate the global and regional prevalence of intellectual (and other) disabilities for age 0-19 (Olusanya et al. 2020) and data from the 2017 GBDS to estimate the global and regional prevalence of intellectual disabilities for children under the age of 5 (Global Research on Developmental Disabilities Collaborators 2018). In the 2018 study, they estimated a global prevalence of intellectual disability of 2.0% (95%CI 1.6%-2.4%) with lower than average estimates in Latin America and the Caribbean (1.1% (1.0-1.3)), Southeast Asia, East Asia, and Oceania (1.2% (1.0-1.5)), North America (1.4% (1.3-1.6)), Western Europe (1.5% (1.4-1.6)) and Central and Eastern Europe and Central Asia (1.6% (1.3-1.8)) and higher estimates in sub-Saharan Africa (2.3% (1.8-2.9)), South Asia (2.5% (2.0-3.1)) and North Africa and the Middle East (2.6% (2.1-3.2)).

Particularly relevant among the Sustainable Development Goals is Target 4.2 (by 2030, ensure that all girls and boys have access to quality early childhood development, care and pre-primary education so that they are ready for primary education) and its associated Indicator 4.2.1 (the proportion of children under 5 years of age who are developmentally on track in health, learning and psychosocial wellbeing). Data relevant to this indicator are currently collected as a core component of UNICEF’s Multiple Indicator Cluster Survey programme (MICS). Established in 1995, the programme aims to provide support to LMICs to generate robust country-specific data on the wellbeing of children and mothers (UNICEF 2015, Khan and Hancioglu 2019). MICS data has been used by several research groups who have focused on the loss of developmental potential of young children living in LMICs (Shonkoff and Garner 2012, Grantham-McGregor *et al.* 2007, Engle *et al.* 2007, Walker et al. 2007, Black et al. 2017, Engle *et al.* 2011, Walker et al. 2011, Grantham-McGregor *et al.* 2014). A proportion of this group of young children are likely to have or be at risk of having intellectual disability (McCoy *et al.* 2016).

In 2009 (Round 4 of MICS; MICS4) UNICEF introduced the Early Child Development Index (ECDI) as a core component of MICS data collection to identify the proportion of three and four-year-old children who were developmentally ‘on track’. Data from the ECDI collected in MICS4-6 have been used to identify three and four-year-old children who are showing signs of significant cognitive delay (SCD) as a possible proxy indicator for risk of intellectual disability. This has been used to estimate the potential impact of a range of preventative interventions on the global prevalence of SCD (Emerson *et al.* 2018), to investigate aspects of the health and healthcare received by young children with SCD (Emerson and Savage 2017, Emerson *et al.* 2020, Savage and Emerson 2016) and to assess the validity of an indicator of functional limitations in learning introduced in MICS6 (Emerson and Llewellyn 2021 ).

The aims of the present paper were to: (1) update estimates of the prevalence of SCD among nationally representative samples of young children overall, and in upper-middle, lower-middle and low-income countries; (2) investigate whether variation in prevalence between countries was systematically associated with national wealth and other country characteristics; (3) investigate the stability of prevalence estimates over time; (4) examine the correlation between SCD and 2019 Global Burden of Disease estimates on the prevalence of the impairment of developmental intellectual disability under 5 years of age (Olusanya et al. 2020); and (5) investigate the extent to which risk of SCD within countries varies with child age and gender, maternal education and household wealth. Aims (3) and (4) relate to the psychometric properties of the measure of SCD in relation to reliability (aim 3) and validity (aim 4).

# Method

We undertook secondary analysis of nationally representative data collected in Rounds 4 (2009-2013), 5 (2013-16) and 6 (2017 ongoing) of MICS (UNICEF 2015) and from 2011 onwards in the USAID funded Demographic and Heath Surveys Programme (DHS: <https://www.dhsprogram.com>). Following approval by UNICEF, MICS data were downloaded from <http://mics.unicef.org/>. At the end of the download period (1 February 2022), data from 108 nationally representative surveys were available for 64 LMICs. Similarly, following approval from the DHS programme, data from DHS surveys that included the ECDI were downloaded from <https://www.dhsprogram.com/data/available-datasets.cfm>. At the end of the download period, data from an additional 18 nationally representative surveys were available including for 9 LMICs not covered by MICS.

Both survey programs contain several questionnaire modules. Data used in the present paper were extracted from the MICS household module, the MICS module applied to all children under five living in the household, the DHS household module and the DHS module applied to women aged 15-49. Both survey programmes used cluster sampling methods to derive samples representative of the national population of mothers and young children. Specific details of the sampling and ethical review procedures used in each country are available in country specific reports freely available at <http://mics.unicef.org/> (for MICS) and <https://dhsprogram.com/> (for DHS). The median survey response rate for children under 5 was 96.1% (interquartile range 93.0%-97.8%).

## Identification of children with SCD

The MICS child under five module contained ECDI, a ten-item scale based on milestones that children are expected to achieve by ages 3 and 4 (UNICEF 2014). The ECDI was also included as an optional component of the DHS women’s module. The ECDI contains four domains: literacy-numeracy, physical, social emotional, and learning. ECDI data were collected on children in the age range 36-59 months. We used all five items from the literacy-numeracy and learning domains to identify children with SCD. All items are based on key informant (primarily maternal) report with simple binary (yes/no) response options.

* *Literacy-numeracy:* Can the child: (1) identify/name at least ten letters of the alphabet; (2) read at least four simple, popular words; (3) name and recognize the symbols of all numbers from 1 to 10?
* *Learning*: Can the child: (4) follow simple directions on how to do something correctly; (5) when given something to do, do it independently?

ECDI guidance treats the literacy-numeracy and learning domains as separate entities with children being recorded as developmentally ‘on track’ for literacy-numeracy if they pass at least one item and as ‘on track’ for learning if they pass both items (Gil *et al.* 2020). Previously, McCoy and colleagues used ECDI guidance on the *learning* domain to identify children with cognitive delay (McCoy et al. 2016). They reported an overall prevalence across 35 LMICs of 14.6% of 3-4 year old children not being ‘on track’ in the cognitive domain. However, as the five items from the two domains demonstrated an acceptable degree of internal consistency (median country level alpha=0.65, inter-quartile range 0.57-0.66), we used the approach developed by Emerson et. al. (2018) to identify children with SCD , defined as the reported inability to complete all five items. ECDI data were missing for <1% of children.

## Country Characteristics

We collected four measures of country characteristics that have been related to variations in child development, health and wellbeing.

1. National wealth: Given the commonly reported association between child wellbeing and national wealth in LMICS (World Health Organization 2008), we used World Bank 2015 country income classifications as upper-middle income, lower-middle income and low-income (World Bank 2021c). These classifications are based on per capita Gross National Income (pcGNI; expressed as current US$ rates) using the World Bank’s Atlas Method. We also downloaded 2015 Atlas Method pcGNI from the World Bank website between April and December 2021 (World Bank 2021b, World Bank 2021a). These data were available for all 73 countries.
2. Income inequality: Level of income inequality has been associated with variations in health and wellbeing, including among children, in higher income countries (Pickett and Wilkinson 2007). The World Bank GINI Index, a measure of income inequality, for 2015 or, if not available, the most recent year since 2010 was downloaded from the World Bank website between April and December 2021. These data were available for 65 countries.
3. Human Development Index (HDI): The composite HDI integrates three dimensions of human development: life expectancy at birth; mean years of schooling and expected years of schooling; and gross national income per capita (United Nations Development Programme 2016, Anand and Sen 1994). The HDI is the geometric mean of normalized indices for each of the three dimensions. The HDI is also available in a form which adjusts the HDI for inequality in the distribution of each dimension across the population; the Inequality-adjusted Human Development Index (IHDI). It is computed as a geometric mean of inequality-adjusted dimensional indices. The IHDI equals the HDI when there is no inequality across the population but falls below the HDI as inequality rises. HDI and IHDI data for 2015 were taken from the 2016 Human Development Report (United Nations Development Programme 2016). HDI data were available for 71 countries, IHDI data were available for 65 countries.
4. The Multidimensional Poverty Index (MPI): The MPI identifies multiple deprivations at the household level in education, health and standard of living (United Nations Development Programme 2019, Alkire and Santos 2010). These data were taken from the 2019 Global Multidimensional Poverty Index Report (United Nations Development Programme 2019), and were available for 62 countries.

## 2019 Global Burden of Disease Estimates of the Prevalence of the Impairment of Developmental Intellectual Disability

Global Burden of Disease Survey (GBDS) country level estimates for 2019 for the impairment of ‘developmental intellectual disability’ for the 1-4 year age band were downloaded from [http://ghdx.healthdata.org/gbd-results-tool on 2nd December 2021](http://ghdx.healthdata.org/gbd-results-tool). In addition, global estimates and estimates for the World Bank categories of high-income. Upper-middle income, lower- middle income and low-income were downloaded. These data are updates of the data used by Olusanya and colleagues (Olusanya et al. 2020, Global Research on Developmental Disabilities Collaborators 2018); they were available for 71 countries. GBDS estimates at country and regional levels for a wide range of impairments are derived by complex statistical modelling based on selected ‘inputs’ in the case of developmental intellectual disability the estimates were derived primarily from published scientific papers reporting on the prevalence of intellectual disability. Details of the modelling techniques have been fully reported elsewhere (Olusanya et al. 2020, GBD 2017 Disease and Injury Incidence and Prevalence Collaborators 2018, GBD 2017 Child and Adolescent Health Collaborators 2019).

## Household Wealth

Relative household wealth has been shown to be associated with variation in child development as measured by the ECDI (Gil et al. 2020). MICS data includes a within-country wealth index for each household. To construct the wealth index, principal components analysis is performed by using information on the ownership of consumer goods, dwelling characteristics, water and sanitation, and other characteristics that are related to the household’s wealth, to generate weights for each item. Each household is assigned a wealth score based on the assets owned by that household weighted by factor scores. The wealth index is assumed to capture underlying long-term wealth through information on the household assets (Rutstein 2008, Rutstein and Johnson 2004, Howe *et al.* 2012). These data were split into quintiles and were available for all surveys. Data were missing for 0.2% of children.

## Maternal Education

Level of maternal education has been shown to be associated with variation in child development as measured by the ECDI (Gil et al. 2020). The highest level of education received by the child’s mother was recorded using country-specific categories. These data were available for all countries. Data were missing for 1.0% of children. We recoded these data into a three-category measure: (1) no education; (2) primary education; (3) receipt of secondary or higher-level education.

## Approach to Analysis

Research question #1 was addressed with simple bivariate descriptive statistics to estimate the prevalence of SCD (with 95% confidence intervals) among 3/4-year-old children for each survey and pooled estimates for each World Bank country income classification group. Research question #2 was addressed with Spearman’s non-parametric correlation coefficients to examine the association between country characteristics and country prevalence of SCD. In countries for which more than one survey was undertaken, we used estimates from the survey closest to 2015.

Research question #3 was addressed in the 46 countries for which more than one survey was undertaken, by comparing estimates from the earliest and most recent survey to determine the stability of estimates over time. We used Pearson’s parametric correlation coefficients to estimate the strength of association between prevalence estimates generated in the two surveys and a paired samples t-test to evaluate the statistical significance of changes in prevalence over time. Research question #4 was addressed by using Pearson’s parametric correlation coefficients to estimate the strength of association between prevalence estimates for SCD and GBD 2019 estimates for the prevalence of the impairment of developmental intellectual disability. In countries for which more than one MICS survey was undertaken, we used estimates from the most recent survey. In addition, for each World Bank country income classification group we calculated mean prevalence of for SCD and mean GBDS 2019 estimates for the prevalence of the impairment of developmental intellectual disability for the participating countries. Research question #5 was addressed by using mixed effects multilevel multivariate modelling (to address the clustering of observation by countries) to estimate prevalence ratios of the risk of SCD by child age and gender, maternal education and household wealth quintile overall and by World Bank country income classification group.

All analyses were undertaken in Stata 16.1 using the svy commands to take account of the within-country clustering of observations. Multilevel modelling was undertaken using the mepoisson command. UNICEF’s country-specific child-level weights were used to take account of biases in sampling frames and household and individual level non-response. For pooled analyses we recalibrated the country specific weights to take account of between country differences in the child sampling fraction based on UNICEF’s 2015 estimates of the population of children under the age of 5 years (UNICEF 2016). Given the small amount of missing data, complete case analysis was undertaken.

# Results

The total sample included information on the prevalence of SCD on 396,596 3-4-year-old children in 126 surveys undertaken in 73 countries (81,295 children in 27 upper middle-income countries, 196,026 in 30 lower middle-income countries and 119,275 in 16 low-income countries).

## Prevalence

In analyses pooled across countries, the overall prevalence of SCD was 11.5% (95%CI 10.9%-12.1%). Prevalence rates varied systematically by World Bank country income classification: 2.6% (2.3%-3.0%) in upper middle-income countries; 10.6% (9.8%-11.4%) in lower middle-income countries; and 20.7% (19.8%-21.8%) in low-income countries. Information on the prevalence of SCD for each survey is presented in Table 1.

*[insert Table 1]*

## Association with Country Characteristics

Between-country variation in prevalence was strongly and significantly associated with national wealth (pcGNI: Spearman’s r = -0.79, p<0.001), country Human Development Index (r = -0.83, p<0.001), country Human Inequality-adjusted Development Index (r = -0.85, p<0.001) and the Multidimensional Poverty Index (r = -0.82, p<0.001), but not income inequality (r = +0.19, n.s). Figure 1 shows the association between country level prevalence and the Human Development Index. The fitted trend line represents a second order polynomial function accounting for 65% of the variance.

*[insert Figure 1]*

## Stability of Prevalence Estimates

Prevalence estimates were relatively stable over time for the 46 countries with multiple surveys (r=0.84, p<0.001). While overall prevalence was marginally greater at Time 2 (8.0% (95%CI 5.6-10.4)) than at Time 1 (7.7% (95%CI 5.5-10.0)), these differences were not statistically significant.

## Association with GBDS Estimate of the Prevalence of the Impairment of Developmental Intellectual Disability

The overall association between SCD and GBDS estimates was weak to moderate (r=+0.34, p<0.01). However, analyses stratified by World Bank country income classification revealed a strong significant association within upper middle-income countries (r=+0.62, p<0.001), but non-significant associations in lower middle-income and low-income countries (r=-0.15, n.s.; r=+0.10, n.s.). Mean country level prevalence for SCD (age 3-4) and GBDS prevalence of the impairment of developmental intellectual disability (age 0-4) by World Bank country income classification are presented in Figure 2 for the 71 countries for which data were available. As can be seen, while the prevalence of SCD showed a clear monotonic increase in prevalence as national wealth reduced, GBD estimates showed only a very weak relationship between World Bank country income classification and the estimated prevalence of the impairment of developmental intellectual disability. Compared with SCD estimates, GBD estimates of the impairment of developmental intellectual disability also showed much weaker associations than SCD with country Human Development Index (r = -0.46, p<0.001), country Human Inequality-adjusted Development Index (r = -0.38, p<0.01) and the Multidimensional Poverty Index (r = +0.30, p<0.05).

## **Predictors of SCD**

The association between within country variation in the risk of SCD by child age, child gender, level of maternal education and household wealth quintile are presented in Table 2. In these multilevel multivariate analyses, overall, lower levels of maternal education and lower levels of household wealth were strongly independently associated with SCD. The association between boy gender and SCD was much weaker, though still statistically significant.

*[insert Table 2]*

# Discussion

## Main findings of this study

Our analysis of 126 nationally representative surveys undertaken in 73 LMICS indicates that: (1) the prevalence of SCD was 2.6% (2.3%-3.0%) in upper middle-income countries, 10.6% (9.8%-11.4%) in lower middle-income countries and 20.7% (19.8%-21.8%) in low-income countries; (2) between-country variation in prevalence was strongly related to national wealth, the Human Development Index, the Human Inequality-adjusted Development Index and the Multidimensional Poverty Index, but not income inequality; (3) the prevalence of SCD was reasonably stable over time; (4) there was only a modest association between the ascertained prevalence of SCD and GDB estimates of the prevalence of the impairment of developmental intellectual disability; and (5) there were strong independent associations between risk of SCD and lower levels of maternal education and lower levels of household wealth, and weaker association with male gender.

## What is already known on this topic

Little is known about the prevalence of intellectual disability in LMICs. We are aware of only one study (Arora et al. 2018) that has been undertaken in a LMIC that has used a sampling frame capable of generating robust national estimates of the prevalence of intellectual disability. Information on the prevalence of SCD as a potential proxy measure of intellectual disability has been previously presented for 51 LMICs (2.7% (2.5–3.0%) in upper-middle-income countries, 10.6% (10.0–11.2%) in lower-middle-income countries and 19.1% (18.4–19.9%) in low-income countries) (Emerson et al. 2018). Information on the prevalence of developmental delay more broadly has been previously presented for 35 LMICs (14.6% overall information not given by World Bank income group; McCoy et al. 2016) and 63 LMICS (learning 2.8% in upper-middle-income countries, 8.7% in lower-middle-income countries and 18.6% in low-income countries; literacy/numeracy 63.4% in upper-middle-income countries, 77.9% in lower-middle-income countries and 87.2% in low-income countries (Gil et al. 2020).

## What this study adds

Our study updates the information presented by Emerson et al. (2018) by including data from an additional 22 countries, evaluating the association between country variation in prevalence and indicators of national capacity (the Human Development Index, the Human Inequality-adjusted Development Index and the Multidimensional Poverty Index), examining the stability of prevalence estimates over time, examining the association between the ascertained prevalence of SCD and GDB estimates of the prevalence of the impairment of developmental intellectual disability, and reporting data on the association between child age and gender, level of maternal education and household wealth and risk of SCD. As such, it contributes to key global research priorities identified by WHO in relation to intellectual disability and developmental delay (Tomlinson *et al.* 2014).

The weak and statistically insignificant correlations between the ascertained prevalence of SCD and GDB estimates of the prevalence of the impairment of developmental intellectual disability raises questions about the validity of one of the two approaches to estimating risk of intellectual disability. Exact correspondence between the two approaches would not be expected due to differences in age-range (under five vs. three to four years) and SCD being (at best) only a proxy indicator for risk of intellectual disability. However, if ascertained SCD is a valid proxy indicator for risk of intellectual disability and if the GBD estimates are valid, we would expect at least a modest correlation between the two approaches when examining country-level variation in prevalence in lower-middle income and low-income countries (as was seen in upper-middle income countries). If GBD estimates are accepted as a ‘gold standard’, these results cast serious doubt on the viability of using SCD as a proxy indicator for risk of the impairment of developmental intellectual disability. On the other hand, if ascertained SCD is considered a potentially valid proxy indicator for risk of intellectual disability, the results in this paper cast serious doubt on the validity of GBD estimates for the impairment of developmental intellectual disability in lower-middle income and low-income countries.

## Limitations of this study

The primary limitation of our study lies in the unknown validity of our measure of SCD as a potential proxy indicator for risk of intellectual disability. Some weak circumstantial evidence of the potential validity of the measure is provided by: (1) the strength and direction of association between SCD and two well-established correlates of intellectual disability (parental level of education, household wealth); (2) prevalence rates in upper-middle income countries that are similar to expected rates of intellectual disability in childhood in high-income countries; and (3) variation in prevalence rates associated with national wealth in a direction that would be expected for intellectual disability (Maulik et al. 2011, Durkin et al. 2007) and developmental delay in general (Gil et al. 2020, McCoy et al. 2016). Additional limitations include the non-random selection of countries participating in the MICS and DHS survey programmes and possible biases arising from differences between countries in such areas as the social desirability of particular responses and different meanings and understanding of terms used in data collection in different cultures and languages.

## Future Research

Future research is required to determine the extent to which SCD at age 3/4 is predictive of intellectual disability in later childhood. In addition, future research is needed to clarify the relationship between ascertained SCD and the GBD estimates of the prevalence of the impairment of developmental intellectual disability, particularly in lower-middle and low-income countries. At present it is not possible to assess the accuracy of GBD estimates in LMICs given that only one study (not included in the 2019 inputs) has been published using robust sampling frames in an LMIC (Arora et al. 2018).

UNICEF’s MICS data is readily (and freely) available to researchers and provides a very cost effective opportunity for researchers (including intellectual disability researchers) who are concerned about better understanding the cognitive developmental delay among young children growing up in the world’s LMICs (Gil et al. 2020, McCoy et al. 2016). In addition, given concerns about the sensitivity of current ECDI items for detecting developmental delay, a revised and extended 20-item version of the ECDI (ECDI 2030) has been developed (<https://data.unicef.org/resources/early-childhood-development-index-2030-ecdi2030/>). The ECDI 2030 contains 10-items in the ‘learning’ domain and its incorporation in future rounds of MICS surveys is likely to provide a much more robust basis for identifying young children at risk of intellectual disability.

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| **Table 1: Estimates of country-specific prevalence of significant cognitive delay (% SCD) (126 surveys, 73 countries)**  |
| --- |
| Country | World Bank Region | pcGNI (2015) | Year of survey | Survey  | Sample sizea | Response rateb | % with SCD | 95% CIs |
| *27 Upper Middle-Income Countries, 45 surveys*  |
| Trinidad & Tobago | Latin America & Caribbean | 19,130 | 2011 | MICS | 521 | 90.7% | 0.6% | 0.2-1.7 |
| Argentina | Latin America & Caribbean | 12,600 | 2011/122019/20 | MICSMICS | 3,4922,691 | 70.7%81.8% | 0.8%1.0% | 0.5-1.60.6-1.7 |
| Panama | Latin America & Caribbean | 11,740 | 2013 | MICS | 2,275 | 96.9% | 3.1% | 2.2-4.3 |
| Kazakhstan | Europe & Central Asia | 11,420 | 2010/11 | MICS | 1,820 | 97.8% | 2.0% | 1.3-3.2 |
|  |  |  | 2015 | MICS | 2,193 | 98.5% | 1.0% | 0.7-1.7 |
| Costa Rica | Latin America & Caribbean | 10,400 | 2011 | MICS | 912 | 88.1% | 0.1% | 0.1-0.9 |
|  |  |  | 2018 | MICS | 1,541 | 86.9% | 0.6% | 0.2-1.5 |
| Mexico | Latin America & Caribbean | 10,170 | 2015 | MICS | 3,338 | 92.0% | 0.7% | 0.5-1.1 |
| Georgia | Europe & Central Asia | 9,820 | 2018 | MICS | 1,097 | 84.7% | 0.9% | 0.4-1.9 |
| Suriname | Latin America & Caribbean | 8,890 | 2010 | MICS | 1,234 | 83.0% | 1.5% | 0.9-2.5 |
|  |  |  | 2018 | MICS | 1,772 | 82.1% | 1.9% | 1.4-2.6 |
| Saint Lucia | Latin America & Caribbean | 7,850 | 2012 | MICS | 122 | 92.6% | 0.4% | 0.1-2.6 |
| Maldives | South Asia | 7,650 | 2016/17 | DHS | 1,264 | 84.0% | 0.8% | 0.5-1.4 |
| Cuba  | Latin America & Caribbean | 7,230 | 2014 | MICS | 2,150 | 97.2% | 1.3% | 0.6-3.1 |
|  |  |  | 2019 | MICS | 2,309 | 98.5% | 1.1% | 0.7-1.8 |
| Montenegro | Europe & Central Asia | 7,250 | 2013 | MICS | 630 | 84.3% | 0.8% | 0.3-2.4 |
|  |  |  | 2018/19 | MICS | 484 | 60.7% | 1.2% | 0.3-4.5 |
| Turkmenistan | Europe & Central Asia | 7,030 | 2015/16 | MICS | 1,492 | 97.6% | 2.0% | 1.3-3.0 |
|  |  |  | 2019 | MICS | 1,571 | 97.0% | 0.9% | 0.5-1.6 |
| Belarus | Europe & Central Asia | 6,720 | 2012 | MICS | 1,400 | 97.4% | 0.1% | 0.0-0.6 |
|  |  |  | 2019 | MICS | 1,506 | 96.0% | 0.4% | 0.2-1.0 |
| Dominican Republic  | Latin America & Caribbean | 6,580 | 20142019 | MICSMICS | 7,6533,418 | 95.0%99.0% | 1.5%2.0% | 1.1-2.01.4-3.0 |
| Serbia | Europe & Central Asia | 5,960 | 2010 | MICS | 1,342 | 93.3% | 0.3% | 0.1-0.8 |
|  |  |  | 2014 | MICS | 1,168 | 87.3% | 0.2% | 0.1-0.7 |
|  |  |  | 2019 | MICS | 759 | 79.5% | 0.0% | 0.0-0.5 |
| Iraq | Middle East & North Africa | 5,940 | 2011 | MICS | 13,485 | 98.9% | 7.9% | 7.3-8.6 |
|  |  |  | 2018 | MICS | 6,987 | 99.1% | 7.4% | 6.4-8.6 |
| Thailand  | South Asia | 5,710 | 2012/13 | MICS | 4,155 | 98.1% | 0.8% | 0.5-1.3 |
|  |  |  | 2015/16 | MICS | 5,528 | 97.0% | 0.3% | 0.2-0.7 |
|  |  |  | 2019 | MICS | 5,766 | 94.0% | 0.4% | 0.2-0.6 |
| Paraguay | Latin America & Caribbean | 5,620 | 2016 | MICS | 1,807 | 93.5% | 2.4% | 1.5-3.8 |
| Tuvalu | East Asia & Pacific | 5,440 | 2019/20 | MICS | 183 | 97.7% | 2.2% | 1.7-3.0 |
| Bosnia & Herzegovina | Europe & Central Asia | 5,210 | 2011/12 | MICS | 1,004 | 89.9% | 0.2% | 0.0-0.7 |
| North Macedonia | Europe & Central Asia | 5,110 | 2011 | MICS | 537 | 89.9% | 0.6% | 0.2-1.8 |
|  |  |  | 2018-19 | MICS | 644 | 90.0% | 1.3% | 0.5-2.9 |
| Algeria  | Middle East & North Africa | 4,850 | 2012/13 | MICS | 5,279 | 95.5% | 6.2% | 5.4-7.1 |
|  |  |  | 2018 | MICS | 6,140 | 94.5% | 6.5% | 5.5-7.7 |
| Jamaica  | Latin America & Caribbean | 4,710 | 2011 | MICS | 641 | 93.9% | 0.5% | 0.2-1.4 |
| Tonga  | East Asia & Pacific | 4,520 | 2019 | MICS | 578 | 96.0% | 1.6% | 0.5-5.2 |
| Belize  | Latin America & Caribbean | 4,420 | 2011 | MICS | 766 | 94.3% | 1.0% | 0.4-2.1 |
|  |  |  | 2015/16 | MICS | 1,088 | 90.3% | 2.2% | 1.3-3.7 |
| Guyana | Latin America & Caribbean | 4,130 | 20142019/20 | MICSMICS | 1,2711,195 | 88.6%90.1% | 1.8%2.1% | 0.9-3.71.3-3.5 |
| *30 Lower Middle-Income Countries, 50 surveys*  |
| Eswantini  | Sub-Saharan Africa | 4,000 | 2010 | MICS | 1,065 | 93.0% | 5.1% | 3.8-6.9 |
|  |  |  | 2014 | MICS | 1,058 | 96.4% | 3.8% | 2.7-5.1 |
| Kosovo  | Europe & Central Asia | 3,980 | 2013/14 | MICS | 633 | 86.4% | 1.7% | 0.9-3.2 |
|  |  |  | 2019/20 | MICS | 619 | 78.2% | 0.8% | 0.3-1.9 |
| Tunisia  | Middle East & North Africa | 3,960 | 2011/12 | MICS | 1,134 | 97.0% | 4.4% | 3.1-6.1 |
|  |  |  | 2018 | MICS | 1,497 | 96.3% | 4.1% | 3.2-5.2 |
| Samoa | East Asia & Pacific  | 3,960 | 2019/20 | MICS | 1,040 | 94.3% | 4.3% | 3.2-5.9 |
| Jordan | Middle East & North Africa | 3,950 | 20122017/18 | DHSDHS | 4,1162,129 | 94.0%97.1% | 6.8%9.8% | 5.7-8.27.9-12.0 |
| Mongolia  | Europe & Central Asia | 3,820 | 2010 | MICS | 1,317 | 94.2% |  0.7% | 0.4-1.3 |
|  |  |  | 2013/14 | MICS | 2,258 | 97.2% |  1.3% | 0.9-1.8 |
|  |  |  | 2018 | MICS | 2,563 | 95.5% |  2.1% | 1.4-3.2 |
| Palestine  | Middle East & North Africa | 3,670 | 2010 | MICS | 3,882 | 90.7% |  5.3% | 4.6-6.0 |
|  |  |  | 2014 | MICS | 3,170 | 95.1% |  4.8% | 4.0-5.7 |
|  |  |  | 2019/20 | MICS | 2,407 | 94.7% | 4.3% | 3.4-5.5 |
| Kiribati | East Asia & Pacific | 3,460 | 2018/19 | MICS | 843 | 98.2% |  1.0% | 0.5-2.2 |
| El Salvador | Latin America & Caribbean | 3,340 | 2014 | MICS | 2,961 | 88.6% |  1.6% | 1.2-2.2 |
| Nigeria | Sub-Saharan Africa | 2,880 | 2011 | MICS | 9,918 | 96.6% | 15.8% | 14.6-17.1 |
|  |  |  | 2016/17 | MICS | 11,490 | 97.2% | 16.9% | 15.6-18.3 |
| Ukraine | Europe & Central Asia | 2,650 | 2012 | MICS | 1,856 | 94.9% |  0.9% | 0.5-1.5 |
| Moldova | Europe & Central Asia | 2,630 | 2012 | MICS | 719 | 93.8% |  0.2% | 0.1-0.9 |
| Bhutan | South Asia | 2,520 | 2010 | MICS | 2,375 | 95.9% |  4.1% | 3.3-5.2 |
| Congo | Sub-Saharan Africa | 2,410 | 2011/122014/15 | DHSMICS | 2,9363,600 | 98.0%98.5% | 13.1%12.1% | 10.8-15.810.4-13.9 |
| Timor-Leste | East Asia & Pacific | 2,200 | 2016 | DHS | 897 | 97.0% | 27.0% | 23.1-31.2 |
| Honduras | Latin America & Caribbean | 2,060 | 2011/122019 | DHSMICS | 2,9313,615 | 93.2%90.3% | 2.8%3.5% | 2.2-3.52.9-4.2 |
| Lao PDR | South Asia | 1,970 | 2011 | MICS | 4,380 | 97.4% |  5.1% | 4.1-6.2 |
|  |  |  | 2017 | MICS | 4,775 | 98.5% |  2.3% | 1.9-2.8 |
| Vietnam | South Asia | 1,970 | 2010/11 | MICS | 1,408 | 98.4% |  6.3% | 4.9-8.2 |
|  |  |  | 2013/14 | MICS | 1,163 | 98.7% |  3.0% | 2.1-4.3 |
| Ghana | Sub-Saharan Africa | 1,960 | 2011 | MICS | 3,025 | 98.6% |  7.7% | 6.2-9.6 |
|  |  |  | 2017/18 | MICS | 3,661 | 99.2% |  9.7% | 8.4-11.3 |
| Sao Tome & Principe | Sub-Saharan Africa | 1,660 | 2014 | MICS | 808 | 94.8% | 13.3% | 11.0-16.1 |
|  |  |  | 2019 | MICS | 757 | 97.9% | 6.6% | 4.8-9.0 |
| Cote d’Ivoire | Sub-Saharan Africa | 1,480 | 2016 | MICS | 3,669 | 94.8% | 10.7% | 7.4-15.1 |
| Cameroon  | Sub-Saharan Africa | 1,440 | 2014 | MICS | 2,770 | 96.7% | 13.8% | 12.3-15.6 |
| Haiti | Latin America & Caribbean | 1,410 | 2016/17 | DHS | 1,433 | 98.9% | 10.7% | 8.7-13.2 |
| Lesotho  | Sub-Saharan Africa | 1,350 | 2018 | MICS | 1,333 | 87.5% |  3.5% | 2.5-4.9 |
| Senegal | Sub-Saharan Africa | 1,320 | 20172018/19 | DHSDHS | 4,2644,452 | 95.5%96.1% | 13.5%12.6% | 11.6-15.711.0-14.5 |
| Zimbabwe  | Sub-Saharan Africa | 1,280 | 2014 | MICS | 3,857 | 94.5% |  8.7% | 7.6-9.8 |
|  |  |  | 2018/19 | MICS | 2,515 | 96.1% |  8.4% | 7.1-9.9 |
| Mauritania  | Sub-Saharan Africa | 1,260 | 2011 | MICS | 3,509 | 95.9% |  7.3% | 6.2-8.6 |
|  |  |  | 2015 | MICS | 4,349 | 96.9% | 13.2% | 11.4-15.3 |
| Bangladesh  | South Asia | 1,220 | 2012/13 | MICS | 8,572 | 87.9% |  7.6% | 6.8-8.4 |
|  |  |  | 2019 | MICS | 9,446 | 93.0% |  6.1% | 5.6-6.7 |
| Kyrgyz Republic  | Europe & Central Asia | 1,180 | 2014 | MICS | 1,742 | 97.5% |  4.2% | 3.0-5.9 |
|  |  |  | 2018 | MICS | 1,446 | 98.5% |  5.5% | 4.4-6.8 |
| Cambodia | South Asia | 1,030 | 2014 | DHS | 2,596 | 97.6% | 5.6% | 4.5-6.9 |
| *16 Low Income Countries, 31 surveys*  |
| Chad | Sub-Saharan Africa | 880 | 20102014/15 | MICSDHS | 6,7344,163 | 92.0%96.1% | 46.6%36.4% | 44.2-49.133.5-39.4 |
|  |  |  | 2019 | MICS | 9,661 | 99.4% | 20.7% | 19.2-22.4 |
| Benin | Sub-Saharan Africa | 860 | 20142017/18 | MICSDHS | 4,8104,205 | 98.2%98.1% | 15.9%19.6% | 14.4-17.517.5-21.8 |
| Uganda | Sub-Saharan Africa | 830 | 2016 | DHS | 5,017 | 97.0% | 10.5% | 9.3-11.9 |
| Mali | Sub-Saharan Africa | 790 | 2009/10 | MICS | 7,676 | 95.0% |  7.6% | 6.7-8.5 |
|  |  |  | 2015 | MICS | 6,451 | 98.2% | 13.3% | 12.0-14.7 |
| Nepal | South Asia | 780 | 2014 | MICS | 2,224 | 93.0% | 15.4% | 12.5-18.8 |
|  |  |  | 2019 | MICS | 2,894 | 98.4% |  6.9% | 5.8-8.3 |
| Guinea  | Sub-Saharan Africa | 760 | 2016 | MICS | 3,145 | 94.8% | 18.6% | 16.6-20.9 |
| Rwanda | Sub-Saharan Africa | 750 | 2014/152019/20 | DHSDHS | 2,6962,926 | 99.5%99.7% | 11.4%12.8% | 10.0-13.011.4-14.4 |
| Guinea-Bissau | Sub-Saharan Africa | 640 | 2014 | MICS | 2,903 | 97.3% | 11.5% | 10.0-13.3 |
|  |  |  | 2018/19 | MICS | 6,232 | 99.1% | 11.4% | 9.0-13.2 |
| Togo  | Sub-Saharan Africa | 640 | 20102013/14 | MICSDHS | 1,7482,322 | 94.6%97.8% | 16.5%25.0% | 14.5-18.722.4-27.8 |
|  |  |  | 2017 | MICS | 1,995 | 96.4% | 27.3% | 24.3-30.6 |
| The Gambia  | Sub-Saharan Africa | 620 | 2010 | MICS | 3,977 | 98.5% |  4.4% | 3.5-5.5 |
|  |  |  | 2018 | MICS | 4,185 | 96.1% |  3.8% | 3.0-4.8 |
| Sierra Leone  | Sub-Saharan Africa | 550 | 2010 | MICS | 3,616 | 96.2% | 20.5% | 18.7-22.4 |
|  |  |  | 2017 | MICS | 4,718 | 99.6% | 15.9% | 14.9-17.0 |
| Madagascar  | Sub-Saharan Africa | 490 | 2018 | MICS | 5,150 | 94.1% | 13.0% | 11.8-14.3 |
| Congo, DR  | Sub-Saharan Africa | 460 | 20102013/14 | MICSDHS | 3,8882,900 | 97.8%98.6% | 23.5%13.2% | 21.0-26.210.8-16.0 |
|  |  |  | 2017/18 | MICS | 8,582 | 99.8% | 29.3% | 26.6-32.1 |
| Central African Republic  | Sub-Saharan Africa | 400 | 2010 | MICS | 3,687 | 96.0% | 21.4% | 19.4-23.5 |
|  |  |  | 2018/19 | MICS | 3,684 | 96.7% | 32.8% | 30.5-35.3 |
| Malawi | Sub-Saharan Africa | 350 | 2013/14 | MICS | 7,608 | 97.3% | 14.8% | 13.3-16.3 |
|  |  |  | 2019/20 | MICS | 5,921 | 98.0% | 19.0% | 17.3-20.8 |
| Burundi | Sub-Saharan Africa | 260 | 2016/17 | DHS | 4,711 | 98.8% | 31.8% | 29.8-34.0 |
| Notes: SCD = significant cognitive delay; CIs = Confidence intervals; a sample sizes are unweighted and for the population of children with valid SCD datab response rates in MICS are reported for children under 5 in the household. In DHS response rates are reported for women aged 15-49 (the key informants for ECDI data). |

|  |
| --- |
| **Table 2: Association (Prevalence Rate Ratio with 95% confidence Intervals) between Child and Family Characteristics and Risk of Significant Cognitive Delay**  |
|  | Overall | Upper-middle Income countries | Lower-middle Income countries | Low Income countries |
| Child gender |
| Boy | 1.07\*\*\*(1.05-1.09) | 1.11\*\*(1.04-1.19) | 1.08\*\*\*(1.04-1.11) | 1.06\*\*\*(1.03-1.09) |
| Girl | 1.0 | 1.0 | 1.0 | 1.0 |
| Highest level of maternal education |
| None | 1.55\*\*\*(1.50-1.60) | 1.61\*\*\*(1.45-1.79) | 1.62\*\*\*(1.54-1.71) | 1.44\*\*\*(1.37-1.50) |
| Primary | 1.30\*\*\*(1.26-1.34) | 1.35\*\*\*(1.24-1.48) | 1.27\*\*\*(1.21-1.34) | 1.24\*\*\*(1.19-1.30) |
| Secondary | 1.0 | 1.0 | 1.0 | 1.0 |
| Household wealth quintile |
| 1 (poorest) | 2.01\*\*\*(1.94-2.09) | 2.62\*\*\*(2.26-3.05) | 2.51\*\*\*(2.31-2.71) | 1.81\*\*\*(1.72-1.90) |
| 2 | 1.75\*\*\*(1.68-1.82) | 1.74\*\*\*(1.49-2.03) | 2.19\*\*\*(2.02-2.37) | 1.64\*\*\*(1.56-1.72) |
| 3 | 1.56\*\*\*(1.50-1.63) | 1.68\*\*\*(1.44-1.97) | 1.86\*\*\*(1.71-2.02) | 1.49\*\*\*(1.42-1.56) |
| 4 | 1.37\*\*\*(1.32-1.43) | 1.54\*\*\*(1.31-1.82) | 1.49\*\*\*(1.36-1.62) | 1.35\*\*\*(1.28-1.41) |
| 5 (wealthiest)  | 1.0 | 1.0 | 1.0 | 1.0 |
| Notes: \* p<0.05, \*\* p<0.01, \*\*\* p<0.001All analyses adjusted for between-group differences in child age. |

Figure 1: Association between country level prevalence of SCD (with 95% confidence intervals) and the Human Development Index

Figure 2: Association between World Bank country income classification and estimated prevalence of SCD (age 3-4) and estimates of the prevalence of the impairment of developmental intellectual disability (DID)