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Disability types and children's schooling in Africa

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Abstract

The Sustainable Development Goals (SDGs) set up by the United Nations include an overarching principle of "leaving no one behind" and aim for, among other goals, equal access to education for children with disabilities. Our study contributes to the knowledge on the school enrolment of disabled children with different disability types, with a focus here on eight countries in Sub-Saharan Africa. Comparing the situation with children without disabilities as a benchmark, we assess early school enrolment for young children below ten years old, school enrolment for older children aged 10–17 years old, and the dropout rates of children from school. We perform our analysis as a natural experiment where different types of disabilities are considered as random treatments, which allows us to assume that the average deviation in certain school performance indicators from the average for non-disabled children is a result of the disability type, specifically vision, hearing, walking, intellectual capacity, and multi-disability.

Our study finds that, compared with non-disabled children, children with vision and hearing disabilities do not lag behind in school enrolment. In contrast, children with walking disability have a higher risk of starting school late. Children with intellectual disabilities are less likely to enrol in school, less likely to remain enrolled, and more likely to drop out than *their counterfactual peers. Children with multiple disabilities tend to experience the most severe challenges in enrolling at school, both at a young age and later. However, once enrolled in school, children with multiple disabilities are not more likely to drop out earlier than other children.*

Based on the first and probably the only large-scale application to date of the standard Washington Group Child function module as a disability measurement tool, our study is the first comprehensive multi-country study of disabled children's schooling in Sub-Saharan Africa based on recent nationally representative data.

Highlights

- We compare school enrolment between disabled and non-disabled children in eight Sub-Saharan African countries.
- Children with vision and hearing disabilities do not lag behind other children in school enrolment.
- Children with walking disabilities are more likely to be late school starters.
- Children with intellectual disabilities are less likely to enrol in school and are more likely to be late starters or to drop out of school.
- Children with multiple disabilities tend to experience the most severe challenges with school enrolment.

Key words

Children with disability, disability types, disability effects on schooling, SDG, Sub-Saharan Africa

JEL codes

I24: Education and Inequality

1. Introduction

For several decades, researchers have considered the critical role of disability on poverty, unequal access to social services and socioeconomic disparities (Elwan, 1999; Baynton, 2013). Unequal access to schooling among children with disabilities is a fundamental aspect that needs to be addressed to break the vicious circle between poverty and disability (Singal, 2011). The importance of education was emphasized as early as 1948, when the Universal Declaration of Human Rights recognized education as a fundamental human right (Assembly, 1948). However, education for children with disabilities did not attract much attention until the late 1990s, and the first legally binding instrument was not until 2006, with the United Nations Convention on the Rights of Persons with Disabilities (UNCRPD), promoting inclusive education for children with disabilities (UN, 2006). Since then, many international agreements and protocols have been established that have included rights for disabled persons[1], including the United Nations' 2030 Agenda for Sustainable Development Goals (SDGs) (UN, 2015).

The core principles of the SDGs include “leaving no one behind” and taking a “human rights-based approach”. Guaranteeing the equal access of persons with disabilities to education and other social services is crucial to meeting these SDG principles. To measure the performance of countries and stakeholders in relation to the SDGs in relation to disabled children's access to education, there is an urgent need to develop knowledge- and evidence-based monitoring systems to track the variations in children's schooling and how these are related to the children's disability status. However, a recent report from the International Centre for Evidence in Disability (ICED) concluded that there was still little evidence of and information on the educational outcomes of people with disabilities in developing countries (Kuper et al., 2018). Further, the quality of what evidence is currently available is also poor.

In 2018, Sub-Saharan Africa (SSA) surpassed Central and Southern Asia as the region with the largest out-of-school population, comprising 38 per cent of the global total (UNESCO

2020). This study focuses on the SSA region and aims to answer: 1) whether and how much children with disabilities differ from their peers without disabilities in terms of school enrolment, and 2) whether and to what extent there are heterogeneous disability effects on children's school enrolment according to their disability type. We aim to provide evidence of the existence of heterogeneous disability effects by disability type, including disabilities in vision, hearing, walking, intellectual capacity, and multi-disabilities.

There are a number of challenges performing studies on disabled children's schooling, including the limited data availability, diversified conceptual models of disability (Hedlund, 2009), and limited and inconsistent use of various measurement tools to classify children with disabilities. Earlier studies comparing the school performance of children with disabilities often relied on incompatible disability definitions and measurements and many suffered from data quality issues (Filmer, 2008; UNESCO, 2018; Gottlieb et al., 2009). Mizunoya et al. (2018) and Luo et al. (2020) deliberately selected data that had been gathered in surveys that had adopted the Washington Group Short Set on Functioning as a tool to identify people with functional difficulties (WG, 2020). However, many survey sources had modified the standard questions to varying degrees, which made direct comparisons questionable.

The Washington Group on Disability Statistics (WG), a group established under the United Nations Statistical Commission, has developed several question sets for measuring disabilities since 2001, including the WG Short Set on Functioning (WG-SS), WG Short Set Enhanced (WG-SSE), WG Extended Set on Functioning (WG-ES), WG and UNICEF (United Nations Children's Fund) Child Functioning Module (WG-CFM) for children aged 2–4, and WG-CFM for children aged 5–17 (WG, 2020). The WG-SS has so far been the most widely used tool for measuring disability and to date, the only WG tool used in education studies for children with disabilities. However, the WG-SS is designed for the general population and it is considered to underestimate the disability prevalence in childhood (Groce & Mont, 2017; WG, 2020). In contrast, the WG-CFM includes several important functional domains, such as learning, memory and concentration, reflecting several key aspects and challenges that arise during child development.

Our study is based on Multiple Indicator Cluster Surveys (MICS), household surveys implemented by countries under a programme developed by the United Nations Children's Fund to provide internationally comparable data on the situation of children and women. Specifically, our study is based on the sixth round of the MICS, which adopted the WG-CFM (UNICEF, 2017). Since 2017, about 70 countries and regions have completed or have planned surveys utilizing the sixth round of the MICS WG-CGM survey tools. The sixth round of MICS is one of the few large-scale surveys that include WG disability measurement tools and is the first, and probably the only, large-scale application of the WG-CFM measurement tool across countries to date. As all the sixth-round MICS surveys follow the WG-CFM closely, it is possible to compare children's school enrolment across disability types.

Disability is a rare phenomenon and even more so for specific types and severity of disability. This makes it challenging to identify how much a particular disability may affect or set back a child's school enrolment and performance when we only have a small sample of children with each type of disability to study. Therefore, most comparison studies to date have merely focused on cross-country comparisons between non-disabled children and disabled children as a catch-all category in different contexts (Filmer, 2008; Mizunoya et al., 2018; UNESCO, 2018). These studies have tended to ignore the considerable heterogeneity in how disability is characterized and its impact on schooling outcomes (Anastasiou & Kauffman, 2011). Among the comparison studies in the literature, Luo et al. (2020) were one of the first to explore the disability gaps in school enrolment and school completion rates by considering the heterogeneity by disability type and gender. Although they deliberately selected eight national censuses between 2006 and 2012 that applied the WG-SS, most the censuses only used part of the standard questions. Therefore, the disability groups they reported on were less comprehensive than intended by the WG-SS.

In the present study, we use school enrolment as a simple school performance indicator for school performance. Following the work of David Card, Joshua Angrist, and Guido Imbens, who are 2021 Nobel Prize winners in economics, we frame our analysis in the form of a natural experiment where disabilities are considered as random treatments. We aim to measure the impacts/causal effects of various disability types on children's school enrolment rate before and after the age of ten, as well on the children's school dropout rate. While school enrolment is a crude indicator of school performance, it is the best available at this scale.

We first inspect the heterogeneity and frequency of the disability types across countries. After that, we check the school enrolment and dropout rates according to five disability types (vision, hearing, walking, intellectual, and multiple disabilities) with an aim to investigate the potentially heterogeneous mechanisms that may influence the schooling of children with various disabilities. Our study findings indicate that classifying the disability types of children can be an essential first step in studying the disability effects on education and can provide a sound basis for developing policies to promote the education of disabled children.

2. Concepts, measurement and research framework

2.1 Disability concepts and measurement tools

Several conceptual disability models have been introduced over the past decades, including the medical model (Marks, 1997), the social model (Oliver, 2013) and the human rights model (Degener, 2017). However, these models have diversified interpretations of the disability problems (Hedlund, 2009). The social model is the foundation of the UN convention (UNCRPD) for classifying disability types and has been adopted by several disability measurement tools. It interprets disability as a consequence of man-made conditions and emphasizes society's organization and adaptation as critical to improving the performance and participation of persons with disabilities. The World Health Organization (WHO) developed the International Classification of Functioning, Disability and Health (ICF) as a framework for measuring health and disability. The ICF adopted a biopsychosocial model, which attempts to integrate the medical and social models and emphasizes the dynamic interaction between health conditions and individual and environmental factors.

The Multiple Indicator Cluster Surveys (MICS) conducted by UNICEF generate data on globally agreed indicators on the well-being of children and women related to the Millennium Development Goals (MDGs) and SDGs in developing countries. The task of the Washington Group (WG) established in 2001 was to develop standardized instruments for persons with disabilities and to collect high-quality disability data that are internationally comparable The question sets in the WG-CFM follow conceptually both the biopsychosocial model of disability and ICF standards, focusing on functional outcomes.

To date, there is no widely acknowledged categorization of disability types because the wide range of disability conditions is often associated with different functional challenges. Table 1 lists several widely adopted disability measurement tools. Several disability types with the WG measures have been constructed with the same survey questions and scale levels. However, these are generally not directly comparable with other measurement tools, and none of them is obviously superior to other tools.

Table 1
Disability measurement tools[2].

Tools	Number of questions	Disability types	Scales
WG-SS	6	Vision, hearing, mobility, communication, remembering and concentrating, self-care.	Four-level severity scale: "No difficulty", "Some difficulty", "A lot of difficulty", and "Cannot do at all".
WG-SSE	12	Vision, hearing, mobility, communication, remembering and concentrating, self-care, upper body, anxiety, depression.	Four-level severity scale: "No difficulty", "Some difficulty", "A lot of difficulty", and "Cannot do at all". (Five-level scale for anxiety and depression)
WG-ES	37	Vision, hearing, mobility, communication, remembering and concentrating, self-care, upper body, anxiety, depression, pain, fatigue.	Four-level severity scale: "No difficulty", "Some difficulty", "A lot of difficulty", and "Cannot do at all".
WG-CFM (Aged 2–4)	16	Vision, hearing, mobility, communication, dexterity, learning, playing, controlling behaviour.	Four-level severity scale: "No difficulty", "Some difficulty", "A lot of difficulty", and "Cannot do at all".
WG-CFM (Aged 5–17)	24	Vision, hearing, mobility, communication, remembering, concentrating, self-care, learning, accepting change, controlling behaviour, making friends, anxiety, depression.	Four-severity-scale: "No difficulty", "Some difficulty", "A lot of difficulty", and "Cannot do at all". (Five-scale for anxiety and depression)
Model Disability Survey (MDS)	48	Vision, hearing, mobility, communication, self-care, hand and arm use, pain, energy and drive, breathing, affect (depression and anxiety), interpersonal relationships, handling stress, cognition, household tasks, community and citizenship participation, caring for others, work and schooling.	Five-level severity scale 1 (None)–5 (Extreme)
Disability Screening Questions (DSQ)	34	Vision, hearing, mobility, flexibility, dexterity, pain, learning developmental memory, mental health-related, other/unknown.	Four-level severity scale: "No difficulty", "Some difficulty", "A lot of difficulty", and "Cannot do at all". Five-level frequency scale: “Never", "Rarely", "Sometimes", "Often", "Always".
Ten Question (TQ) (Aged 2–9)	10	Vision, hearing, mobility, cognitive, speech, epilepsy.	None

Different categorizations of disability types have been reported in various studies, with low international comparability and external validity (Filmer, 2008; UNESCO, 2018). Although several disability measurement tools, such as WG-SS, MDS and DSQ, are widely applied by individual surveys or censuses, they are often revised by including different sub-categories or severity scales of disability types during the implementation in order to meet the studies’ own limitations, requirements or goals (Singal et al., 2020). The challenges of achieving comparability also lie in the diversified sub-categories and the subtle differences among the same disability types. For example, the deaf or blind are often included in the category of hearing or vision disabilities in many studies but may be defined as stand-alone categories in some other studies (Wager et al., 2005) or defined together with multiple disability as a low incidence disability (Schifter, 2016). Due to the typical limitation in the sample size, hearing, vision and physical disabilities may even be merged as one broad sensory category in some studies (Schifter, 2016). However, other studies have defined hearing and vision disabilities as sensory disabilities but left physical disabilities as separate (Trani et al., 2012; Bakhshi et al., 2017). The case of mental or intellectual disability is more complicated and may contain heterogeneous disability sub-categories.

The sixth round of MICS applied the same survey questions, definitions, concepts and methodologies for the statistics for persons with disabilities following the WG-CFM standard. The sixth round of MICS data have the outstanding advantage of combining large-scale and nationally representative samples with the standard WG-CFM disability measurement tool; thus facilitating a more comprehensive comparison of heterogeneities across disability types than what has been possible before.

The MICS WG-CFM data also have limitations. First, the wide range of disability conditions is nearly impossible to cover entirely in a single survey measurement tool. The question sets in WG-CFM only capture a part of the functional difficulties; albeit they include the most common functional problems. Second, as a multi-indicator survey, MICS include a limited number of crucial school performance indicators, similar to what is done in many other large-scale surveys (Singal et al., 2020; Lamichhane & Kawakatsu, 2015). There are limitations with utilizing school enrolment since this cannot fully reflect children's school performance and school quality. However, the discrepancies in school enrolment and its heterogeneity are also crucial and may indicate a divergent inclusion of disabled children in school and can be instructive for future studies and assessment of the SDGs.

2.2 Research framework

Among our key research questions is: Why and how do various types of disabilities affect school enrolment and school performance differently? Obviously, children with vision disabilities are particularly hindered from receiving information through vision, thus restricting their reading capability, cognitive and language development, and involvement in physical activities and social interactions (Bigelow, 1990; Rogers & Puchalski, 1984, 1988). The main challenge for children with hearing disabilities is also language-related, primarily spoken language. Earlier studies demonstrated such children face challenges in grammar development, reading and writing skills, and participation in social activities (Lederberg, Schick & Spencer, 2012; Bess, Dood-Murphy & Parker, 1998). Children with hearing impairment experience particular challenges in communication with others.

Unlike vision and hearing disabilities, children with walking disabilities are typically constrained by their difficulties in travelling to school or moving around in school. This may limit their school attendance and cause frequent absence and early dropout from school at a later stage (Tedla et al., 2015). Intellectual (cognitive or mental) disability is probably the most complex disability type and can include a wide range of limitations in cognitive ability, behavioural functions, mental retardation or disorder, which may affect the children's communication, attention, social, self-regulation or adaptive skills, as well as logic and reasoning, language processing, or depression and anxiety. Children facing these challenges may have difficulties in school adaptation, which may constrain their school attendance (McIntyre et al., 2006).

It is evident from the above examples that the mechanisms of how disability affects school enrolment are heterogeneous. With one type of disability, subjects may be able to compensate by substitution, i.e. by using some of their other senses more cleverly. Such substitution, however, may be harder or impossible for subjects with multiple disabilities. In that case, such subjects face even more substantial challenges, with earlier studies reporting that the combined effect of co-occurring disabilities was not merely additive but tended to be multiplicative (Marschark et al., 2015).

Different factors can be crucial for the schooling of children with different disabilities. For instance, a language-rich environment with consistent linguistic input at a young age is critical for children with vision or hearing disabilities to help them develop their language skills (Lederberg, Schick & Spencer, 2012). In contrast, the school infrastructure, children's access to assistant equipment and parents' support are essential for school participation by children with walking disabilities (Piškur et al., 2012). Teachers' experiences, skills and knowledge as well as the class environment can be important for the involvement of children with intellectual disabilities (McIntyre et al., 2006).

The critical school performance variable used in our analysis is school enrolment. Late enrolment is quite common in most SSA countries for young-age children. Filmer (2008) suggested that the schooling gap between children with and without disabilities starts at grade one. Young children who never attended school from early on, such as from grade one, might still have an opportunity to start school later, but older children who are not yet in school are unlikely to ever start school (Bommier & Lambert, 2000; Van der Berg, 2020). On the other hand, children who manage to start school also have a high risk of school dropout in SSA countries (Momo et al., 2019). Therefore, we chose three school performance indicators to assess the different challenges for children with disability to enrol in school.

We first define an age cut-off for starting school. Children under the age cut-off and not yet enrolled in school are considered under the category "Young Not-Enrolled" (YoungNE), representing the risk of a late school start-up. In contrast, children above the age cut-off are considered under the category Older Never-Enrolled (OlderNE), representing a risk of them never attending school at all. The third school performance indicator evaluates the risk of school dropout (Dropout), defined as a child who was enrolled in school before but is not continuing in school despite them not having yet completed compulsory junior high school[3].

To answer the overarching research question as to the evidence of the disability effects on children's school performance and of the heterogeneous disability effects by disability type, we aim to test the following hypotheses based on the three school performance indicators:

Hypothesis 1: Children with vision disabilities do not have challenges in a) early school enrolment and b) school enrolment at older age, but have a higher risk of c) dropping out than children without disabilities. Most vision-disabled children in our national representative sample have some vision capability, while blind children are pretty rare. This hypothesis builds on the assumption that children with limited vision capability may not be particularly hindered from starting school but may face problems with writing and reading, which affects their school performance and development.

Hypothesis 2: Children with hearing disabilities do not have challenges in a) early school enrolment and b) school enrolment at older age, but have a higher risk of c) dropping out than children without disabilities. This hypothesis builds on the assumption that children with limited hearing capability may not be constrained in school start-up but are restricted in their ability to communicate (listen and interact) and in other language-related development during school learning and adaptation.

Hypothesis 3: Children with walking disabilities have a higher risk of failing in a) early school enrolment and in b) school enrolment at older age, but are not more likely to c) drop out if they can attend school. This hypothesis builds on the assumption that children with walking disabilities are highly dependent on the distance to school, school infrastructure and transportation facilities for their school start-up. As long as it is feasible for them to start school, they should not be more likely to drop out than the children without disabilities.

Hypothesis 4: Children with intellectual disabilities are not particularly hindered in a) early school enrolment and b) school enrolment at older age, but are more likely to c) drop out than children without disabilities. This hypothesis builds on the assumption that such children may have difficulties in school adaptation due to their cognitive and behavioural function limitations, which can constrain their school progress.

Hypothesis 5: Children with multiple disabilities lag more behind in school performance (all indicators) than children with a single disability. This hypothesis builds on the assumption that having multiple disabilities makes it harder for the children to compensate or substitute by developing their other senses compared to singly disabled children.

We assess these hypotheses based on the pooled data from the eight SSA countries to ensure we have a large enough sample size for each disability type.

3. Data and descriptive analysis

3.1. Data

For the sample set, eight SSA countries (DR Congo, Gambia, Ghana, Lesotho, Sierra Leone, Togo, Tunisia, Zimbabwe) were selected that had conducted MICS surveys in 2017–2019 (Table 2). The MICS children survey instrument comprises 26 questions from WG-CFM with four severity scales, and interviews with one selected child aged 5–17 from each survey household[4]. The questions relate to 13 functional difficulties (Table 1). Severe disability refers to those with a lot of functional difficulties or no function at all. This paper prescribes vision disability as severe difficulty in vision even with glasses or contact lenses, hearing disability as severe difficulty in hearing even with a hearing aid, walking disability as severe difficulty in walking 500 metres on level ground without equipment or assistance, and intellectual or cognitive disability as severe difficulties in self-care, communication, learning, remembering or concentrating on activities that the child enjoys doing. Finally, those who reported more than one co-occurring severe functional difficulty are categorized as having multiple disabilities. The total sample size is 32,248, consisting of 29,218 (90.6%) non-disabled children and 3026 (9.4%) disabled children[5].

3.2. Descriptive statistics

Table 2 shows that the sample sizes for the specific severe disability types for the individual countries are small, especially for the severe vision and hearing disability types. This limited sample size constrains our ability to estimate the countries' disability effects on the school performance indicators accurately. We can see from the table that the share of children with disabilities varies from 16.3% in Ghana (highest) to 5.6% in Gambia (lowest). Our data, however, do not allow us to investigate the reasons for this variation.

Table 2
Sample size by country[6]

	No difficulty	Seeing disability	Hearing disability	Walking disability	Cognitive disability	Multi disability	Total
DR Congo	6629 (92.5)	17 (0.2)	16 (0.2)	124 (1.7)	313 (4.4)	67 (0.9)	7166 (100.0)
Gambia	3280 (94.4)	15 (0.4)	6 (0.2)	43 (1.2)	113 (3.3)	18 (0.5)	3475 (100.0)
Ghana	3937 (83.7)	32 (0.7)	16 (0.3)	56 (1.2)	613 (13.0)	48 (1.0)	4702 (100.0)
Lesotho	3114 (93.2)	61 (1.8)	24 (0.7)	13 (0.4)	107 (3.2)	24 (0.7)	3343 (100.0)
Sierra Leone	5008 (92.0)	10 (0.2)	11 (0.2)	137 (2.5)	215 (4.0)	63 (1.2)	5444 (100.0)
Togo	1925 (86.8)	44 (2.0)	18 (0.8)	15 (0.7)	196 (8.8)	20 (0.9)	2218 (100.0)
Tunisia	2042 (89.4)	39 (1.7)	6 (0.3)	39 (1.7)	122 (5.3)	35 (1.5)	2283 (100.0)
Zimbabwe	3283 (90.9)	30 (0.8)	20 (0.6)	10 (0.3)	240 (6.6)	30 (0.8)	3613 (100.0)
Total	29218 (90.6)	248 (0.8)	117 (0.4)	437 (1.4)	1919 (6.0)	305 (1.0)	32244 (100.0)

Note: Number in parenthesis is the percentage of the total column sum

In our sample of first-grade children, 51.8 per cent are six years old, 5.9 per cent are nine years old, and only 2.7 per cent are ten years old (see Appendix 1 for details). Therefore, we set the age cut-off for classifying the first two school performance indicators (young and older group) at age ten, under which each age group comprises over 5 per cent of the first-grade students. The results for the three school performance indicators among the children with different disability types are presented in Figure 1. The descriptive data indicate that young children under age ten with walking disabilities and the older group of children with intellectual disabilities have specific challenges in terms of school enrolment. Moreover, children with multiple disabilities have a much lower school enrolment rate in both the young and older age groups than children with a single disability. At the same time, children with multiple and intellectual disabilities have the highest risk of school dropout. These findings generally align with our Hypotheses 3, 4 and 5. On the other hand, surprisingly, children with vision and hearing disabilities have higher school enrolment and lower dropout than non-disabled children, which does not support our Hypotheses 1 and 2.

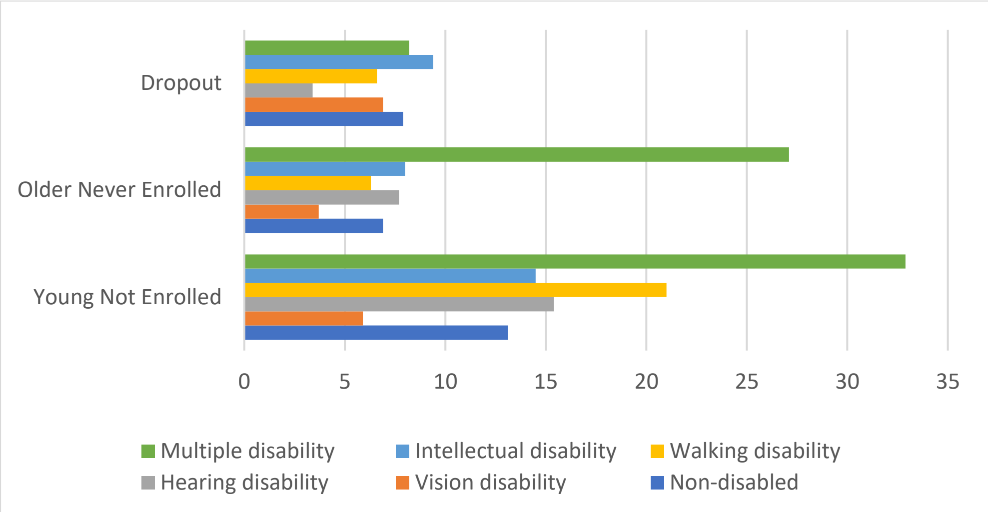

Figure 1. School performance indicators for children with different disabilities (%)

Note: Young Not Enrolled is calculated as the % of the total number of young children; the rate of Older Never Enrolled is calculated as the % of the total number of older children; the dropout rate is calculated as the % all the children who have ever been enrolled in school.

4. Model and estimation strategy

We frame our econometric analysis in the form of a natural experiment. Natural experiments are empirical observational studies in which individuals are exposed to the conditions determined by nature or factors outside the control of the subjects or of the researchers (Rosenzweig, 2000). Although not controlled in the traditional sense of random assignment, a natural experiment resembles a randomized control trial with a clearly defined exposure or random treatment. The assumption is that disability of any kind is a rare phenomenon and is typically not concentrated in certain parts of the population or driven by ecological, economic or social processes. Therefore, a subgroup of the population exposed to a certain treatment (treatment group) should be otherwise similar to those not exposed to the treatment (control group). Based on this assumption (given that it is plausible), causal inferences can be made, where the differences in outcomes may be ascribed to the treatment (Leatherdale, 2019). In our paper, disability and disability types are considered as random treatment variables. Filmer (2008) studied 14 countries and found little evidence to suggest children with disabilities were more likely to live in poorer or richer households. To further inspect our assumption, we regressed each disability type on a set of individual, family, wealth and geographical variables, see Appendix 2. Such analysis also supports our natural experiment assumption[7].

We include all the children classified in one of the five severe disability types in the "treatment" sample and those who did not report any severe or moderate disabilities in the "control" sample. The impacts or causal disability effects of the various disability types on schooling are estimated from the disparities in the rates of the three selected school performance indicators between the "treatment" and "control" sample. We next run regressions with the three indicators (Young Not-Enrolled, Older Never-Enrolled), and Dropout) as dependent variables. The model includes a dummy of disability types D_{ij} as a treatment variable. As proposed by Angrist (2001), a simple ordinary least squares (OLS) approach can be used to measure the causal effects of these limited dependent variables. These models provided unbiased estimates of the average marginal treatment effects in the full sample compared with the non-disabled children as the control group.

$$YoungNE_i = \beta_0 + \beta_{1j}D_{ij} + X_i\beta_2 + u_i \quad (1)$$

$$OlderNE_i = \Upsilon_0 + \Upsilon_{1j}D_{ij} + X_i\Upsilon_2 + v_i \quad (2)$$

$$Dropout_i = \alpha_0 + \alpha_{1j}D_{ij} + X_i\alpha_2 + \varepsilon_i \quad (3)$$

Here, subscript *i* represents each individual child in the sample, *j* indicates the disability type, X_i represents a list of the control variables, and ε_i, u_i and v_i are the error terms. We run models (1)–(3) on the pooled sample from the eight SSA countries. We draw general conclusions for the parts of the SSA region that these countries represent. α_0, β_0 and Υ_0 estimate the average rates of the three school performance indicators (YoungNE, OlderNE, Dropout) for our control group (non-disabled children). α_{1j} is the marginal treatment effect of disability type *j* on dropout., while β_{1j} and Υ_{1j} estimate the marginal disability treatment effects for disability type *j* on children's school enrolment at an earlier and later stage.

We start with a parsimonious specification with the pooled data that includes only the disability types. To inspect the robustness of the findings in the parsimonious model, we run additional models where we stepwise include macro-level (country and urban/ rural dummies) and micro-level (individual and household characteristics) control variables. Ideally, we would have liked to split the samples to more thoroughly investigate the heterogeneities in school performance by the macro variables; however, as shown in Table 2, there were too few observations for some disability types, which limits the statistical power.

The second model includes the macro country dummy, while the third model includes the macro rural–urban divide. Essential micro-level variables, such as gender, number of siblings, and whether children live with their mother and/or father, are introduced in the fourth model. In the fifth model, we assess the robustness of the critical variables to the inclusion of both the macro and essential micro variables.

Finally, in model six, we include additional control variables that are likely endogenous, such as family wealth and parents' education. Disabled children can be affected differently by family wealth or parents' education compared to non-disabled children. While ideally, these variables should have been interacted with the disability types and/or instrumented for, we did not have the statistical power or available instruments to do that. Therefore, we only ran the models without and with these extra controls to assess how that affected the average marginal performance for each disability type.

5. Results

5.1 Disability effect on school enrolment by disability type

The regression models for the three school performance indicators: Young Not-Enrolled (YoungNE), Older Never-Enrolled (OlderNE), and school dropout (Dropout), are presented in Tables 4, 5 and 6. The first regression for each model is a parsimonious model without macro and micro child/family variables. The constant terms in the parsimonious models represent the estimated mean rates for the school performance indicators for the counterfactual non-disabled children. Furthermore, the coefficients on the disability categories represent the deviation from the counterfactual non-disabled children.

Table 4
Regression results for disability effects on Young Not Enrolled[8].

	YoungNE1	YoungNE2	YoungNE3	YoungNE4	YoungNE5	YoungNE6
Disability types (base category: non-disabled)						
Vision disability	-0.072***	-0.004	-0.062*	-0.064**	0.004	0.009
	(0.026)	(0.036)	(0.037)	(0.026)	(0.023)	(0.023)
Hearing disability	0.023	0.059	0.012	0.032	0.057	0.041
	(0.058)	(0.052)	(0.054)	(0.062)	(0.059)	(0.061)
Walking disability	0.079***	0.039*	0.077***	0.080***	0.037	0.045*
	(0.028)	(0.020)	(0.021)	(0.028)	(0.026)	(0.026)
Intellectual disability	0.014	0.034***	0.007	0.014	0.026**	0.024*
	(0.013)	(0.012)	(0.012)	(0.013)	(0.012)	(0.012)
Multiple disabilities	0.198***	0.190***	0.194***	0.200***	0.186***	0.183***
	(0.037)	(0.026)	(0.027)	(0.037)	(0.037)	(0.036)
Control variables (X=included)						
Area (1=rural, 0=urban)			X		X	X
Country dummy (base category: DR Congo)		X			X	X
Gender (1=girl, 0=boy)				X	X	X
Family structure (base category: live together with both mother and father)				X	X	X
Number of siblings				X	X	X
Highest completed educational level of household head (base category: No schooling)						X
Wealth index (base category: first quintile)						X
Constant	0.131***	0.171***	0.072***	0.153***	0.216***	0.432***
Sample size	12859	12859	12738	12738	12738	12706
R2	0.006	0.117	0.018	0.117	0.134	0.166

Significance levels: * p<0.10; ** p<0.05; *** p<0.01. Cluster robust standard errors are in parentheses.
Note: Young Not-Enrolled (YoungNE) is calculated as a proportion of the total number of young children.
YoungNE: 1=Not in school, 0= In school

The estimated average rate of Young Not-Enrolled (YoungNE) for the non-disabled children in the parsimonious model is 13.1% (Table 4), indicating that late school enrolment among young children in SSA countries is common. The coefficients on the disability types for the YoungNE rate shows that there was no significant adverse disability effect for children with vision or hearing disabilities. Actually, the school enrolment among young children (YoungNE) with vision disability is even significantly higher than for the non-disabled children in the models without control variables.

Young children with walking disabilities are about eight percentage points less likely to attend school, according to the model without additional controls. With the introduction of macro country controls, this effect is reduced to about half. On the other hand, the disability effect is robust to the introduction of macro urban/rural control and micro controls. When the additional controls on household wealth and parents' education are included, the walking disability effect becomes significant and increases to 4.5 percentage points.

The intellectual disability effect is insignificant in the parsimonious model. However, this effect becomes larger and significant after controlling for the macro country dummy. It remains significant with an around 2.5 percentage points higher likelihood of such children not attending school than for non-disabled children when adding the macro and micro controls. Finally, children with multiple disabilities are most affected in their school enrolment and are close to 20 percentage points less likely to attend school than their counterfactual non-disabled children. This finding is robust with the introduction of the macro and micro controls.

Table 5 presents the results for the school enrolment of the Older Never-Enrolled (OlderNE) children. In the parsimonious model before introducing the controls, the OlderNE rate for the non-disabled children is 6.9% (Table 5), representing the average rate of not enrolling in school among the older children in these SSA countries. Unexpectedly, in the parsimonious model, the OlderNE rate for children with vision disability is significantly lower than that for the counterfactual non-disabled children. However, this effect becomes insignificant after controlling for the macro controls. For the older children with hearing and walking disabilities, their school enrolment rates are not significantly different from their peers without disabilities. These findings are robust to the inclusion of the macro and micro controls.

Table 5
Regression results for the disability effects on the Older Never-In-School rate[9].

	OlderNE1	OlderNE2	OlderNE3	OlderNE4	OlderNE5	OlderNE6
Disability types (base category: non-disabled)						
Vision disability	-0.032**	0.008	-0.027	-0.026*	0.015	0.018
	(0.014)	(0.020)	(0.020)	(0.014)	(0.013)	(0.014)
Hearing disability	0.008	0.037	-0.003	0.012	0.029	0.031
	(0.030)	(0.028)	(0.029)	(0.031)	(0.029)	(0.030)
Walking disability	-0.006	-0.022	-0.005	-0.006	-0.022	-0.022
	(0.020)	(0.019)	(0.019)	(0.020)	(0.021)	(0.020)
Intellectual disability	0.012	0.033***	0.013	0.012	0.032***	0.036***
	(0.009)	(0.008)	(0.008)	(0.009)	(0.008)	(0.008)
Multiple disabilities	0.202***	0.214***	0.204***	0.205***	0.216***	0.214***
	(0.038)	(0.021)	(0.021)	(0.038)	(0.038)	(0.037)
Control variables (X=included)						
Area (1=rural, 0=urban)			X		X	X
Country dummy (base category: DR Congo)		X			X	X
Gender (1=girl, 0=boy)				X	X	X
Family structure (base category: live together with both mother and father)				X	X	X
Number of siblings				X	X	X
Highest completed educational level of household head (base category: No schooling)						X
Wealth index (base category: first quintile)						X
Constant	0.069***	0.028***	0.039***	0.016**	0.011	0.144***
Sample size	19385	19385	19169	19169	19169	19124
R2	0.005	0.084	0.010	0.085	0.087	0.110

Significance levels: * p<0.10; ** p<0.05; *** p<0.01.
Note: The rate of Older Never-Enrolled (OlderNE) is calculated as a proportion of the total number of older children.
OlderNE: 1=Not in school, 0= In school

Again, the estimated intellectual disability effect for the older children is insignificant but becomes larger and significant after including the macro controls. The disability effect stays in the interval of a 3.2–3.6 percentage points higher likelihood of not attending school than the non-disabled children in the alternative model specifications with the macro and micro controls included. The multiple disability effect for the older group is significant, and they are about 20 percentage points less likely to enrol in school than their counterfactual children, close to the younger group. This finding is also robust to the inclusion of additional controls.

Table 6 presents the results for model 3 based on the dropout rate. The estimated average school dropout rate for the counterfactual non-disabled children in the SSA countries is 8.7% for children aged 6–17. The coefficients on the disability categories suggest there is no adverse disability effect on the school dropout rate for children with vision, hearing and walking disabilities in the models without control variables. In fact, children with hearing disabilities have an even lower dropout rate than the non-disabled children by 4.9 percentage points. These findings are all robust when introducing various controls.

Table 6
Regression results for the disability effects on the dropout rate.

	Dropout1	Dropout2	Dropout3	Dropout4	Dropout5	Dropout6
Disability types (base category: non-disabled)						
Vision disability	-0.015	-0.011	-0.011	-0.008	-0.002	0.002
	(0.017)	(0.018)	(0.018)	(0.017)	(0.017)	(0.017)
Hearing disability	-0.049***	-0.048*	-0.058**	-0.047**	-0.051**	-0.053***
	(0.019)	(0.027)	(0.028)	(0.020)	(0.020)	(0.020)
Walking disability	-0.009	-0.003	-0.009	-0.005	-0.003	-0.002
	(0.013)	(0.015)	(0.015)	(0.014)	(0.013)	(0.013)
Intellectual disability	0.019**	0.029***	0.018***	0.018**	0.026***	0.024***
	(0.008)	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)
Multiple disabilities	0.031	0.036*	0.029	0.032	0.033	0.030
	(0.024)	(0.019)	(0.019)	(0.024)	(0.024)	(0.024)
Control variables (X=included)						
Area (1=rural, 0=urban)			X		X	X
Country dummy (base category: DR Congo)		X			X	X
Gender (1=girl, 0=boy)				X	X	X
Family structure (base category: live together with both mother and father)				X	X	X
Number of siblings				X	X	X
Highest completed educational level of household head (base category: No schooling)						X
Wealth index (base category: first quintile)						X
Constant	0.087***	0.102***	0.058***	0.081***	0.019***	0.107***
Sample size	29132	29132	28802	28802	28802	28730
R2	0.000	0.020	0.010	0.030	0.092	0.102

Significance levels: * p<0.10; ** p<0.05; *** p<0.01.
Note: The dropout rate is calculated as a proportion of all the children who have ever been enrolled in school.
Dropout: 1=drop out of school, 0= In school

The intellectual disability effect on the school dropout rate is significant and about two percentage points higher in the parsimonious model. The disability effect is robust with the micro controls but increases to close to 3 percentage points after introducing the macro country dummy. For children with multiple disabilities, the disability effect is insignificant in the parsimonious model. Still, it becomes significant in second model specifications after controlling for the macro country dummy, and in this case, these children have a 3.6 percentage points higher likelihood of dropping out.

We will now assess our hypotheses one by one by judging the findings across the three tables with the results and the alternative specifications of the controls. Hypothesis H1 states that children with vision disabilities do not have challenges in a) early school enrolment and b) school enrolment at older age, but have a higher risk of c) dropping out than children without disabilities. Our models support Hypotheses H1a and H1b but not H1c, and the conclusions are robust with all the model specifications.

Hypothesis H2 states that children with hearing disabilities do not have challenges in a) early school enrolment and b) school enrolment at older age, but have a higher risk of c) dropping out than children without disabilities. Again, our models support Hypotheses H2a and H2b but not H2c. These findings indicate that compared with the counterfactual non-disabled children, children with vision and hearing disabilities in SSA countries may not face specific challenges in school enrolment. They also do not have a higher risk of school dropout than their counterfactual peers.

Hypothesis H3 states that children with walking disabilities have a higher risk of failing in a) early school enrolment and in b) school enrolment at older age, but are not more likely to c) dropping out if they can attend school. The regression results on the walking disability effect support Hypotheses H3a and H3c but not H3b, indicating that children with walking disabilities are more likely to be late starters in school, but, otherwise, they do not differ from the other children in school enrolment. There are some variations in the late start effect for children with walking disabilities depending on the macro and micro controls. This result may signal there is room for improved school enrolment for such children.

Hypothesis H4 states that children with intellectual disabilities are not mainly hindered in a) early school enrolment and b) school enrolment at older age, but are more likely to c) drop out than children without disabilities. The results, however, were not robust to the inclusion of alternative controls in this case. After including the macro controls, children with intellectual disabilities were found to be less likely to be enrolled in school, and we, therefore, have to reject Hypotheses H4a and H4b. However, Hypothesis H4c is supported, indicating there is a higher risk of school dropout for children with intellectual disabilities.

Finally, Hypothesis H5 states that children with multiple disabilities lag more behind in school performance (all indicators) than children with a single disability. Hypothesis H5 cannot be rejected. The results show that children with multiple disabilities are much less likely to be enrolled in school at a young age and are more likely never to enrol in school than non-disabled children and children with a single disability. However, children with multiple disabilities who have managed to enrol are not much more likely to drop out of school than other children.

6. Discussion and conclusion

Based on the unique MICS survey with national representative data from eight SSA countries, this paper provides evidence about the gaps in school enrolment for children with different disabilities compared to children without disabilities. We assessed the likelihood of school enrolment before and after the age of ten and the possibility of school dropout. We found heterogeneous disability effects in school enrolment and dropout by disability types in the SSA context. Compared with the counterfactual non-disabled children, children with vision and hearing disabilities were found to be not negatively affected in their school enrolment. Despite the potential language-related and communication challenges and constraints for children with vision and hearing disabilities, they were found to have a similar or even higher school enrolment rate than the counterfactual non-disabled children with all three school performance indicators.

The challenges faced by walking-disabled children prevail in school enrolment among the young age group. Although young children with walking disabilities risk not being enrolled in school, this effect does not apply to older walking-disabled children. This means, children with walking disabilities have a higher chance of being enrolled late, but they eventually manage to start school when they grow older. They also do not have a higher risk of school dropout than the non-disabled children. However, our study shows some variations in the walking disability effect of late school start depending on the macro and micro controls. This finding may signal that the local facilities and infrastructure can be crucial for improving the school situation for walking-disabled children.

Children with intellectual disabilities are less likely to enrol or remain enrolled and more likely to drop out than their counterfactual peers. Again, there were variations in the intellectual disability effects on school enrolment when introducing a macro country dummy, suggesting heterogeneous regional effects on school enrolment for children with intellectual disability. Finally, children with multiple disabilities experienced the most severe challenges in school enrolment among all the children with disabilities. When the enrolment rate for children with multiple disabilities was already very low (about 20 percentage points lower than non-disabled children), those who managed to enrol were not much more likely to drop out of school than other children.

The 2030 Agenda for Sustainable Development Goals (SDGs) underlines the overarching theme of "leave no one behind". Equity and inclusion are at the heart of the 2030 SDG Agenda, while disability is associated with an unequal distribution of resources and opportunities. Several earlier multi-country studies have reported huge gaps in school enrolment between children with and without disabilities (Filmer, 2008; UNESCO, 2018; Luo et al., 2020). However, disabilities are often defined in a catch-all category and little effort is paid to compare the disability effects across disability types. The exceptions are the studies by Kuper et al. (2018) and Luo et al. (2020), who reported children with difficulties in seeing or hearing have the least risk of lagging behind in school. They also found children with difficulty in learning, communication, self-care or remembering suffered most from lower school enrolment. Kuper et al. (2018) suggested that there were considerable variations in the school attainment gap for children with physical disabilities in the 30 countries they analysed. The results from these studies are in line with our findings.

However, these studies were based on surveys from various sources with different disability measurements and definitions. None of these studies differentiated the multiple disabilities children, who were found to be the most challenging group in our study, from those with a single disability. Also, quite often, the studies include countries spread over wide regions, including Asia, Africa, Latin America and even Europe. To the best of our knowledge, our study is the first comprehensive comparison study focusing on the heterogeneous effects of disabled children's schooling by disability type in Sub-Saharan Africa. Our study is also the first multi-country study that follows the new standard WG-CFM disability measurement with recent nationally representative data.

Our study found that young children with walking disabilities face a challenge to start school and there is a high risk of children with intellectual and multiple disabilities being left out of school in SSA countries. The heterogeneous disability effects among children with diversified disabilities suggest that there is a crucial need to classify children's disability types to allow comparison studies on the disability effects on education, which the current studies have so far overlooked. Distinct local policies and services should be provided to meet the heterogeneous needs of disabled children and to achieve the ultimate goal of "leave no one behind".

It is worth mentioning that most the vision and hearing disabled children in the MICS survey are those with severe difficulties in seeing or hearing but are not blind or deaf. Our study found that vision or hearing disabled children are not particularly hindered from school enrolment, but this situation may not apply to children in more extreme conditions. The intellectually disabled children in this paper include children with severe difficulties in self-care, communication, learning, remembering or concentrating on activities children enjoy doing. Intellectual disability is relatively complicated and related to different heterogeneous disability sub-categories. School enrolment is a crude indicator of children's school performance, which may not fully represent the school challenges faced by children with disabilities. As a national representative survey that is not specially tailored to disability studies, MICS data limit the sample size of disabled children to allow making accurate estimates of the disability effects on school performance indicators at the country level.

In future studies, other school performance indicators should be introduced in the comparison studies that may be crucial for understanding the challenges faced by disabled children, especially children with vision and hearing disabilities. Intellectually disabled children are probably the most heterogeneous disability group who may need more personalized school adjustments among those with a single disability. More work is required to fully understand the different functional challenges among children with intellectual disabilities and probably to break them up into more sub-categories with standard definitions. Critical macro heterogeneous effects on some disability types should also be studied in different local contexts.

7. References

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Appendix 1 Proportion of children in each age group among the first-grade children in each country (%)

Age	DR Congo	Gambia	Ghana	Lesotho	Sierra Leone	Togo	Tunisia	Zimbabwe	All
6	41.8	33.7	39.5	73.3	54.1	60.4	93.5	66.0	51.8
7	28.1	35.6	30.6	18.9	24.6	21.9	5.0	27.2	26.2
8	12.7	16.9	15.2	5.4	9.8	10.4	0.3	5.1	10.8
9	8.6	8.9	7.5	0.6	6.3	4.2	0.3	1.0	5.9
10	4.4	2.7	3.5	0.9	2.4	1.5	0.6	0.8	2.7
11	2.5	0.8	1.8	0.0	1.6	0.8	0.0	0.0	1.3
12	0.7	1.0	0.5	0.0	0.6	0.8	0.0	0.0	0.5
13	0.7	0.2	0.8	0.0	0.7	0.0	0.0	0.0	0.4
14	0.1	0.0	0.3	0.9	0.0	0.0	0.3	0.0	0.1
15	0.2	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.1
16	0.2	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.1
17	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sample size	**1228**	**593**	**792**	**318**	**887**	**260**	**340**	**526**	**4944**
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Note: Numbers in red indicate the age groups that comprise over five per cent of the first-grade students.

Appendix 2 Regression results for estimating the determinant factors of each disability type

	Vision disability (1=yes, 0=no)	Hearing disability (1=yes, 0=no)	Walking disability (1=yes, 0=no)	Intellect disability (1=yes, 0=no)	Multi disability (1=yes, 0=no)
Age	0.000	0.000	-0.001**	-0.003***	-0.001*
Gender (1=girl, 0=boy)	-0.001	0.000	0.004	-0.012**	0.001
Area (1=rural, 0=urban)	0.001	0.001	0.003	0.006	0.000
Gender of household head (1=female, 0=male)	0.000	-0.003	0.005	0.001	-0.002
Highest completed educational level of household head (base category: primary)					
Primary	-0.003	-0.001	0.009*	0.016*	0.003
Lower secondary	0.002	0.001	0.008*	0.013	0.004
Upper secondary	-0.003	-0.001	0.005	0.009	0.004
Higher education	0.000	0.003	0.006	-0.002	0.009
Family structure (base category: live together with both mother and father)					
Only mother	0.006	0.004	-0.006	0.01	0.006
Only father	-0.003	0.000	0.004	0.003	-0.002
None of the parents	0.000	0.003	-0.014	0.001	-0.005
Relationship of the child to the household head (base category: son/daughter of the household head)					
Grandchild	-0.002	0.002	0.009	0.012	0.01
Adopted/ foster/ stepchild	-0.003	-0.005***	0.014	0.023	-0.002
Relative	-0.003	-0.002	0.007	0.014	0.005
Non-relative	-0.006	-0.002	0.017	0.031	0.000
Wealth index (base category: first quintile)					
Second	0.001	0.000	-0.006	0.001	-0.001
Middle	0.001	-0.002	-0.005	-0.004	-0.002
Fourth	0.005	0.001	-0.001	0.000	-0.001
Highest	0.004	-0.003	0.004	-0.014	-0.002
School status of siblings (base category: no sibling)					
All siblings aged 6–17 currently enrolled in school	0.000	0.001	-0.012*	-0.009	-0.004
Some siblings 6–17 not currently enrolled in school	0.002	-0.001	-0.013	-0.021	-0.001
None of sibling currently in school	-0.002	0.001	-0.004	-0.005	-0.001
Number of siblings	0.000	0.000	0.002	0.001	-0.001
Country dummy (base category: DR Congo)					
Gambia	-0.001	-0.002	-0.012*	0.008	-0.003
Ghana	0.000	0.001	-0.010*	0.117***	0.001
Lesotho	0.015***	0.005	-0.020***	-0.015*	-0.005
Sierra Leone	-0.003	-0.001	0.011*	0.003	0.003
Togo	0.016***	0.006*	-0.01	0.059***	0.001
Tunisia	0.015***	0.002	0.000	0.028***	0.005
Zimbabwe	0.004	0.004	-0.022***	0.034***	-0.004
Constant	-0.001	0.002	0.034***	0.065***	0.018
Sample size	29075	28941	29262	30724	29133
R2	0.007	0.004	0.01	0.035	0.004

Note: * p<0.10; ** p<0.05; *** p<0.01.

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[1] See an outline of the international protocols concerning the rights of persons with disabilities in Beckman et al. (2016).

[2] The Model Disability Survey (MDS) is a stand-alone instrument developed by the Disability Unit of the World Health Organization (WHO). The Disability Screening Questions (DSQ-34) survey was initiated by a group of international experts in survey development about disability and has been applied in several large national representative surveys in Asia (WHO, 2017).

[3] Junior high school is compulsory for all the eight countries in this study, although the total number of school years for compulsory education vary among the countries.

[4] The MICS child survey instrument covers children aged 5–17, but the analysis only applies to the school children aged 6–17.

[5] We excluded 6 children who did not report any schooling information and 1259 children whose reported difference between their age and the reported school year was too small, indicating a data quality issue.

[6] We found a high variation of the prevalence in the behaviour or psychofunctional difficulties across SSA countries. One possibility is the risk of a diversified understanding and interpretation of the questions on the behaviour or psychofunctional difficulties due to the language and culture. Therefore, our analysis does not include behaviour or psychofunctional difficulties. Following the classification of disability by WG, if one does not report functional difficulties with the assistance of equipment, such as hearing aid or glasses, they are defined as non-disabled. However, it is controversial whether there is potential disability effects with these children; therefore we do not include them in our sample.

[7] There could be situations where certain types of disability have been caused by social conflicts and disasters, but we claim that this is rare and not the main reason for disability in our sample. To examine whether each type of disability is correlated with key factors, we regress each disability type on individual factors (children's age, gender, relationship to the household head, number of siblings, and school status of siblings), household factors (gender and educational level of the household head, family structure, and wealth index), and geographical factors (urban/rural, and country dummy). Appendix 2 presents the results. We find that these variables explain less than 1% of the likelihood of disability for all but one disability type. For the intellectual disability class, the model explains 3.5% of the variation, which is still low. We therefore consider our assumption to be sufficiently statistically correct to use it as a basis for our analysis.

[8] The coefficient estimations for all the control variables are available upon request.

[9] The base category for the OlderNE model is children in the age group of 10–11, otherwise they have the same characteristics as those for the regression on the YoungNE.