Spatial Disparities in Disability Prevalence at the District Level in Sub-Saharan African Countries

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Abstract

The World Health Organization estimates that that the highest prevalence of disability among individuals below age 60 is observed in sub-Saharan Africa. Yet, knowledge of disability remains limited in the region, which is partly due to the lack of robust and comparable measurements of disability. In Sub-Saharan Africa, sub-national and comparable estimates of disability prevalence are limited. This paper aims to use comparable sources of data to estimate and construct an atlas of sub-regional disability prevalence. We take data from the Demographic and Health Surveys and the Multiple Indicator Cluster Surveys which use the Washington Group on Disability Statistics short set of questions, which is designed to be a 'culturally neutral' disability screening tool. The questionnaire assesses limitations across six functional. We have data for a total of 26 Sub-Saharan African countries which were collected between 2016 and 2022. We aim to estimate the age-specific prevalence of functional limitation in the population aged 18-49 at the second subnational administrative division level in each country. Given the instability of direct estimates at the subnational level, we use recently developed small area estimation techniques that borrow strength over age and space. From our estimates we compute age standardized prevalences of limitation to facilitate comparison between regions and countries. Preliminary results show large heterogeneity between and within countries, but the amount of within-country differences varies from country to country. Overall, we found 682 subnational entities with age standardized disability prevalence significantly above 2.5%, 233 above 5%, and 31 above 10%.

Introduction

Developing countries continue to experience a relatively high burden of both infectious and non-communicable diseases (Vos et al. 2020). In terms of disability, the World Health Organization (WHO) estimates that 80% of the world's population living with some form of disability resides in developing countries and that the highest prevalence of disability among individuals below age 60 years is observed in sub-Saharan Africa (WHO and World Bank 2011). Evidence from developed regions indicates that people living with disabilities tend to face more adverse economic conditions than others (OECD 2010), suggesting that persons with disabilities in sub-Saharan Africa may be particularly vulnerable.

Yet, knowledge of disability remains limited in the region (WHO and World Bank 2011). This is partly due to the lack of robust and comparable measurements of disability. Good measurement is a prerequisite for robust analyses and efficient actions. This is particularly crucial for disability because it is an umbrella term usually employed to designate different aspects of the four components of the disablement process framework: pathology, impairment, functional limitation, and socio-economic participation restriction (Altman 2014; Verbrugge and Jette 1994). In addition, the term can be culturally dependent and tainted with stigma, leading to potential misreporting (Simo Fotso et al. 2019). In Sub-Saharan Africa, sub-national and comparable estimates of disability prevalence are limited. Where they are available, they are usually either at the level 1 sub-national administrative division (regions) or are local and non-representative (Cambois et al. 2019; GBD 2016 DALYs and HALE Collaborators 2017). However, these sub-regional estimates have proven important for planning for other public health issues like HIV (Dwyer-Lindgren et al. 2019) or malnutrition (Kinyoki et al. 2020).

To address the gap of comparable measurement, the Washington Group on Disability Statistics (WG), under the aegis of the United Nations Statistical Division, developed a `culturally neutral' disability screening tool known as the WG short set of questions (WG SS) (Madans et al. 2011). This tool is being integrated into national surveys and data is becoming increasingly available, thus opening a new window for international analysis of disability that will help prevent, compensate, and support the participation of people with disabilities.

This paper aims to use mainly these comparable sources of data to estimate and construct an atlas of sub-regional disability prevalence. It will also Question the international comparability of these estimates, given differences in questionnaire administration mode (proxy- versus self-respondent). This is particularly timely, as Sustainable Development Goal 10 (SDG-10) emphasizes reducing inequalities and leaving no one behind, especially individuals living with disabilities, by 2030.

Data and Methods

Data

We reviewed all surveys in the Demographic and Health Survey (DHS), Multiple Indicator Cluster Survey (MICS), and Living Standards Measurement Study (LSMS) series to identify those that used the Washington Group Short Set (WG-SS) tool to measure disability (DHS program 2025; LSMS-ISA 2025; UNICEF 2025). Only these surveys were included in our analysis. The WG-SS tool provides non-modeled, comparable data on disability that aligns with the International Classification of Functioning (ICF) framework of the World Health Organization (WHO) (WHO 2001) It assesses functional limitations among individuals aged 5 years and older across six core domains: seeing, hearing, walking, cognition, communication, and self-care. In MICS, the WG-SS was used for adults aged 18–49 years, which justifies the age range chosen for this study.

The DHS, MICS, and LSMS are nationally representative, household-based, two-stage stratified, cross-sectional, and standardized surveys. They are conducted by National Statistics Offices with technical support from The DHS Program, the United Nations Children's Fund (UNICEF), and the World Bank's LSMS – Integrated Surveys on Agriculture (LSMS-ISA) project, respectively. The data are publicly available upon request and are representative at the national, urban–rural, and first administrative region levels.

To date, the WG-SS tool has been used to assess disability among adults in DHS surveys in the following African countries: Kenya (2022), Mali (2018), Mauritania (2019), Mozambique (2022), Nigeria (2018), Rwanda (2019), Senegal (2018–2019), South Africa (2016), Tanzania (2022), and Uganda (2016).

In MICS, the tool has been used in the following countries: Benin (2021), Central African Republic (2018), Chad (2019), Comoros (2022), DRC (2017), Eswatini (2021), Gambia (2018), Ghana (2017), Guinea-Bissau (2018), Lesotho (2018), Madagascar (2019), Malawi (2019), São Tomé and Príncipe (2019), Sierra Leone (2017), Togo (2017), and Zimbabwe (2019). It is important to note that MICS surveys using the WG-SS tool among adults were not conducted in any of the DHS countries listed above. This highlights the importance of using different data sources to achieve better coverage across Sub-Saharan Africa (SSA).

In addition to some of the countries mentioned above, LSMS collected individual-level disability data in the following four countries: Burkina Faso (2018, 2021), Côte d'Ivoire (2018, 2021), Ethiopia (2012, 2014, 2016, 2019, 2021), and Niger (2018, 2021). This brings the total number of countries included in the analysis to 30.

In DHS surveys, the questionnaire was administered to a proxy respondent, typically the household head, who reported the functional limitations of all household members. In MICS surveys, the questions were posed directly to individuals, who self-reported their own functional limitations. In LSMS, individuals aged 18 years and above were expected to respond primarily on their own behalf, although another household member could respond on their behalf if necessary (e.g., if the individual was unavailable).

Methods

The outcome of interest in our analysis is the age standardized prevalence of disability of the population aged 18-49 at the national, admin 1, and admin 2, and admin 3 levels. We consider a respondent in each survey to have a disability if they answered that they have at least "a lot of difficulty" in at least one of the following domains: seeing, hearing, communicating, remembering, walking, and washing. This cut off is chosen as per the WG suggestion to enhance international comparisons (Washington Group on Disability Statistics 2020). We calculated the age-standardized prevalence using the World Health Organization standard population.

We first calculated the age standardized prevalence at the country level and the admin 1 level using directly observed age-specific prevalences, calculated using the weighted responses from the surveys. That is, for a given country or area, if there are m_x respondents aged x, the direct estimate for age-specific prevalence is

$$p_x = \frac{1}{\sum_{i=1}^{m_x} w_{xi}} \frac{1}{m_x} \sum_{i=1}^{m_x} y_{xi} w_{xi},$$

where y_{xi} is an indicator variable for the ith respondent aged x that is 1 if the respondent has a disability and 0 otherwise, and w_{xi} is survey weight for the ith respondent aged x.

While the surveys are designed to be robust at the admin 1 level, we can assume a statistical model to produce more stable estimates at both the admin 1 and admin 2 levels. This is especially important at the admin 2 level, as direct estimates will be very noisy due to the small number of respondents in each area. We adapted a model that was recently proposed by Martin & Camarda (Martin and Camarda 2024) for estimating age-specific mortality risk in small areas. This approach models all areas simultaneously, and borrows strength from the sum of all areas, and over age and space for individual areas. The model requires no additional covariates, only the age and area specific responses to the survey, and spatial information on the location of each area. If y_{xj} is the number of respondents aged x in area j having a disability, andZ m_{xj} is the total number of respondents aged x in area j, the model assumes the following:

$$y_{xj} \sim Binomial(m_{xj}, p_{xj}),$$
$$logit(p_{xj}) = \eta_{xj},$$
$$\eta_{xj} = \eta_{x0} + \delta_{xj} + \gamma_j,$$

where, p_{xj} is the prevalence of disability of respondents aged x in area j, η_{xj} is the linear predictor for age x and area j, η_{x0} is the linear predictor for the sum of all areas being modeled, δ_{xj} are area-specific effects that are smooth in age and space, and γ_j are area specific terms that are not constrained to be smooth in space. This means that at every age and in each area, the prevalence of disability resembles the country-level age specific prevalence. Then, the prevalence can vary smoothly in age and space from the country-level prevalence. Finally, the γ_j allow for additional flexibility to allow for breaks from the smooth spatial pattern where the data suggest so. Thus, even in very small admin 2 areas, we borrow strength from neighboring ages and areas to estimate age-specific prevalence, which can then be used to compute the age standardized prevalence for each admin 2 area.

The model is fit as a penalized generalized linear model using the iteratively reweighted least squares algorithm. The amount of smoothness and flexibility in the model is determined by 5 smoothing parameters. We selected these parameters using a grid search that minimizes the Akaike Information Criterion (AIC). We chose the AIC rather than the Bayesian Information Criterion (BIC) since it gives a closer fit to the data, and we wanted to avoid spatial oversmoothing (Aho et al. 2014).

The model as presented so far does not include the survey weights, which would lead to biased estimates. Several approaches to incorporate survey weights in a regression framework exist, and we followed a pseudo-likelihood approach using scaled weights (Vandendijck et al. 2016; Rabe-Hesketh and Skrondal 2006). That is, we scale weights to the sample size:

$$w^*_{xji} = m_{xj} * \frac{w_{xji}}{\sum_{i=1}^{m_{xj}} w_{xji}},$$

where w_{xji} is now the weight for respondent i in area j aged x. Now, we run the model using the weighted counts y^*_{xj} instead of the observed counts y_{xj}:

$$y^*_{xj} = \sum_{i=1}^{m_{xj}} w^*_{xji} * y_{xji},$$

where y_{xji} is the indicator variable for respondent i in area j aged x. This weighting takes into account the survey design and avoids biased estimates.

Although we have many neighboring countries, we opted to run the model for each country separately because of the widely varying level of disability at the country level. Likewise, the smoothing parameters were optimized for each country separately, providing the additional advantage of tuning the amount of within-country heterogeneity to each country's data specifically. While this choice may lead to some loss of strength if cross-border spatial clusters exist, it is more flexible if discontinuous breaks in the spatial pattern happen at national borders. Furthermore, it does not necessarily impose a break at the border, so if in the fitted results we see cross-border clusters emerge we can be confident that these are not an artifact of spatial oversmoothing.

We quantified uncertainty around our estimates through a parametric bootstrap procedure. We performed a series of hypothesis tests that the age standardized prevalence is above certain thresholds. The level of significance of these tests represents the degree of certainty the disability prevalence is high in a given area.

For assessing the comparability of surveys, we compared, in countries who conducted at least two types of surveys, weighted prevalence and confidence intervals. We estimated the magnitude of proxy-respondent bias using propensity score–weighted multivariate logistic regression (Elkasabi 2021)

Preliminay results

At the national level, we found that the age-standardized disability prevalence among adults ranged from 0.8% in Nigeria to 12% in the Central African Republic (CAR).

We also observed marked heterogeneity at the subnational level (figure 1). Overall, we found 682 subnational entities with disability prevalence significantly above 2.5%, 233 above 5%, and 31 above 10%. Areas with prevalence significantly above 10% are mainly located along the Ghana–Togo border, the CAR–DRC border, the south of DRC, and parts of Madagascar, underscoring the need for both national and global policymakers to focus efforts on these zones.

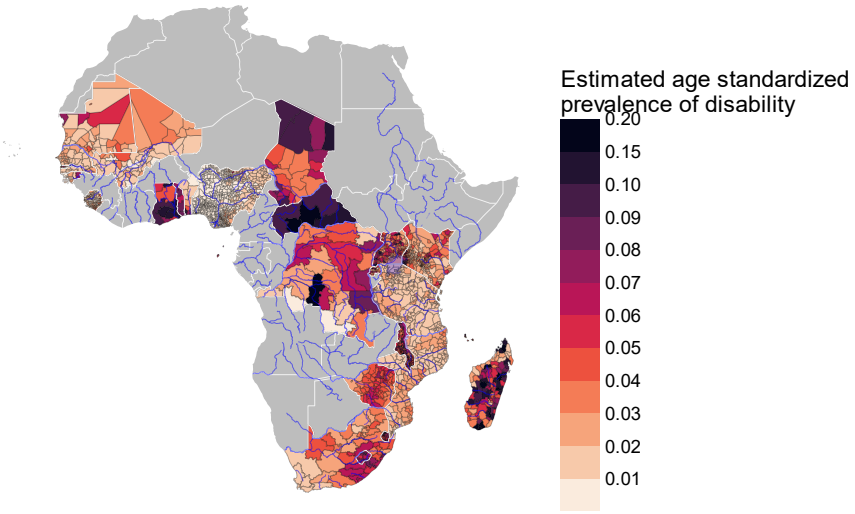

Figure 1 : Estimated of age standardized prevalence of disability at smallest available administrative level

The local database produced through this study provides policymakers, national and international program implementers, and researchers with a tool to efficiently target interventions and conduct further research among people with disability. Ultimately, it will contribute to improving the living conditions of people with disabilities and advancing progress toward Sustainable Development Goal 10 (SDG-10): Reduce inequality within and among countries.

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