Report on
Small Area Estimation of Functional Difficulties, Disability Registration and Healthcare Access for Persons with Disabilities

Bangladesh Bureau of Statistics
Statistics and Informatics Division
Ministry of Planning

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FOREWORD

I am delighted to commend the Bangladesh Bureau of Statistics (BBS) for the publication of the report on Small Area Estimation (SAE) using data from the National Survey on Persons with Disabilities (NSPD) 2021. The NSPD 2021 provides estimates for the prevalence of these indicators for the entire country, each division. Nevertheless, there is a growing demand from policymakers for estimates of these indicators at smaller delineations to better facilitate planning and monitoring the effectiveness of policies and programs.

The estimates of Persons with Disabilities have been disaggregated to the appropriate levels in the analysis. This examination also encompasses an investigation into the potential disaggregation of estimates for functional difficulties, disability registration and healthcare access using SAE methods, aiming to maintain an appropriate level of precision.

I would like to express my sincere appreciation to Mr. Mohammed Mizanur Rahman, Director General of BBS, for his timely support and guidance, which were pivotal to the successful completion of this activity. Special thanks to Mr. Md. Mashud Alam, Director of the Demography and Health Wing at BBS, and his dedicated team for their hard work and commitment in completing this report. I also extend my gratitude to all the distinguished members of the Programme Implementation Committee (PIC), Working Committee, Report Review Committee, and Editor's Forum for their invaluable contributions.

I sincerely acknowledge the support of UNICEF Bangladesh in facilitating this endeavor. I extend my gratitude to Prof. Dr. M. Nurul Islam, Pro-VC, World University of Bangladesh for his invaluable technical inputs and assistance in finalizing the report.

Finally, I expect that the findings presented in the report will be instrument for planners, policymakers, and other stakeholders in shaping policies and strategies in Bangladesh.

July, 2024

Dr. Shahnaz Arefin, *ndc*

Director General

Bangladesh Bureau of Statistics

PREFACE

I am very glad to announce that, Demography and Health Wing of Bangladesh Bureau of Statistics (BBS) jointly with UNCEF has completed the Small Area Estimation (SAE) using the data from the National Survey on Persons with Disabilities (NSPD) 2021 to estimate the prevalence in smaller geographical areas to effectively target more vulnerable regions.

This SAE report will provide district-level estimates of people with functional difficulties, disability registration, and healthcare access among people with disabilities in Bangladesh based on NSPD 2021 data, where the information about people with functional difficulties, disability registration, and healthcare access among people with disabilities was produced at division level. This report will serve as a valuable tool to support evidence-based policies of the Government, aid in comprehensive planning, and facilitate in-depth analysis for development partners, NGOs, practitioners, researchers, and students alike.

I would like to extend my special thanks to Dr. Shahnaz Arefin, ndc, Secretary, Statistics and Informatics Division, Ministry of Planning, for the valuable support and guidance throughout the preparation of the report. I would also like to express my appreciation to the distinguished members of the Programme Implementation Committee (PIC), Working Committee and other related committees for their contribution to prepare the report.

Furthermore, I extend my heartfelt appreciation to Mr. Md. Mashud Alam, Director of the Demography and Health Wing at BBS, and his team for their diligent efforts and commitment in completing this report. I extend my special thanks to UNICEF Bangladesh for their support in successfully preparing this report.

Any suggestions and comments for further improvement will be highly appreciated.

July, 2024

Mohammed Mizanur Rahman

Acronyms

BBS	:	Bangladesh Bureau of Statistics
EAs	:	Enumeration Areas
ELL method	:	Elbers, Lanjouw and Lanjouw method
GIS	:	Geographic Information System
HIES	:	Household Income and Expenditure Survey
ISRT	:	Institute of Statistical Research and Training
MICS	:	Multiple Indicator Cluster Survey
NSPD		National Survey on Persons with Disabilities
PIC	:	Programme Implementation Committee
PSUs		Primary Sampling Units
SAE	:	Small Area Estimation
SDGs	:	Sustainable Development Goals
SID	:	Statistics and Informatics Division
UN	:	United Nations
UNFPA	:	United Nations Population Fund
UNICEF	:	United Nations Children's Fund
WHO	:	World Health Organization

1. Introduction

1.1 Introduction

Disability is a fundamental aspect of human life, resulting from health conditions like dementia and environmental factors. An estimated 1.3 billion people, or 16% of the global population, experience significant disabilities today[1]. This number is increasing due to noncommunicable diseases and longer lifespans. They die earlier, have poorer health, and experience more limitations in everyday functioning than others[1]. Investing in disability inclusive prevention and care can benefit individuals and communities, with a return of almost $10 for every $1 spent[1]. Around 240 million children worldwide currently have some form of disability[2], a higher estimate than previous figures. This figure is based on a more inclusive understanding of disability, considering multiple domains of functioning, including psychosocial well-being.

Disability is a complex issue resulting from an individual's health conditions and personal, environmental, and social contexts[3,4]. It affects their ability to perform activities and participate in life situations. Physical disability encompasses physical impairment, activity limitations, and participation restrictions[5]. With an aging population and a shift in disease burden, the number of people with disabilities is increasing globally[6]. However, there is a lack of primary healthcare services tailored to the special needs of persons with disabilities[7]. persons with disabilities are often not targeted by preventive health care services or health promotion activities. Factors such as prohibitive costs, limited availability of services, physical barriers, inadequate knowledge and skills, and perceived discrimination negatively impact persons with disabilities and prevent them from seeking healthcare[8,9].

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[1]https://www.who.int/news-room/fact-sheets/detail/disability-and-health
[2]Children with Disabilities Overviews, http://data.unicef.org/topic/child-disability/overview/
[3]World Health Organization. International classification of functioning, disability and health: ICF. Geneva: World Health Organization; 2001.
[4]Officer A, Groce NE. Key concepts in disability. Lancet. 2009;374(9704):1795.
[5]Health Topics: Disabilities [http://www.who.int/topics/disabilities/en].
[6]World Health Organization. World Report on Disability. Geneva, Switzerland: WHO; 2011.
[7]Disability and health [http://www.who.int/mediacentre/factsheets/fs352/en].
[8] Badu E, Agyei-Baffour P, Opoku MP. Access barriers to health care among people with disabilities in the Kumasi metropolis of Ghana. Canadian Journal of Disability Studies. 2016;5(2):131–51.
[9] Senghor DB, Diop O, Sombie I. Analysis of the impact of healthcare support initiatives for physically disabled people on their access to care in the city of Saint-Louis, Senegal. BMC health services research. 2017;17(Suppl 2):695.

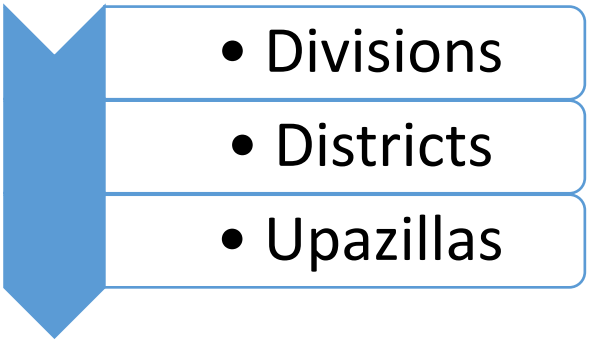
Socio-demographic characteristics, such as age, socio-economic status, education, and place of residence, also significantly influence persons with disabilities health care seeking behavior[10,11]. Perceived discrimination also plays a significant role in their health care seeking behavior[12].

Bangladesh government passed the Persons with Disabilities Rights and Protection Act, 2013 and Neuro-Developmental Disability Protection Trust Act, 2013, and two rules in 2015. The National Action Plan was adopted to continue implementing these laws and charters. According to the World Health Organization (WHO), an estimated 15% of the global population lives with some form of disability. In the context of Bangladesh, specific prevalence rates vary based on different studies and methodologies. The Bangladesh Bureau of Statistics (BBS) reported in the Household Income and Expenditure Survey 2016 that approximately 7.5% of the population had some form of disability[13]. Bangladesh has a high prevalence of disability, with 9.07% for males and 10% for females[13]. A study by Titumir and Hossain found that 27.8% of individuals living with disabilities have physical impairments, and 10.7% have multiple impairments[14]. The study evaluated birth defect registration practices at 37 Addis Ababa health facilities, including public and private institutions. Out of 37, 23 registered birth defects, while 14 did not register congenital anomalies, with 10 being private and four being public[15]. However, there is a lack of research evidence on the primary health care seeking behavior of persons with disabilities in Bangladesh. Few studies have explored the healthcare seeking behavior of persons with disabilities for treatment and rehabilitation of their disabling health conditions.

[10] Eide AH, Mannan H, Khogali M, van Rooy G, Swartz L, Munthali A, Hem KG, MacLachlan M, Dyrstad K. Perceived barriers for accessing health services among individuals with disability in four African countries. PLoS One. 2015; 10(5):e0125915.
[11] Yen SM, Kung PT, Tsai WC. Factors associated with free adult preventive health care utilization among physically disabled people in Taiwan: nationwide population-based study. BMC Health Serv Res. 2014;14:610.
[12]Moscoso-Porras MG, Alvarado GF. Association between perceived discrimination and healthcare-seeking behavior in people with a disability. Disability and health journal. 2018;11(1):93–8.
[13]Bangladesh Bureau of Statistics (BBS). Household Income and Expenditure Survey 2010. Government of Bangladesh: Dhaka, BBS, Planning Division, Ministry of Planning; 2011.
[14] Titumir RAM, Hossain J. Disability in Bangladesh: prevalence, knowledge, attitudes and practices. Dhaka: Unnayan Onneshan; 2005.
[15] Eshete M, Abate F, Abera B, Hailu A, Demissie Y, Mossey P, Butali A. Assessing the Practice of Birth Defect Registration at Addis Ababa Health Facilities. Ethiop J Health Sci. 2021 May;31(3):683-687.

1.2 Administrative Units of Bangladesh

Bangladesh is divided into 8 administrative Divisions and 64 Districts, although these have only a limited role in public policy. For local government, the country is divided into upazilas/thanas (sub-districts). The diagram below outlines the three tiers of government in Bangladesh.



National Survey on Persons with Disabilities (NSPD) 2021 provides estimates of the prevalence of functional difficulties, disability registration, and healthcare accessibility for the entire country and for each division. However, the accuracy of these estimates is highly dependent on the effective sample size at each level. At the district level, the standard errors of survey-based estimates become too large to be useful due to the small number of observations available for each district.

1.3 Literature of Small Area Estimation (SAE) and SAE on Functional Difficulties, Disability Registration and Health Accessiblity

The prevalence of functional difficulty, disability registration and health access are typically determined at the national and regional levels through extensive surveys. However, obtaining prevalence data at micro-level administrative units like districts is challenging due to insufficient data at those levels. This limits the use of design-based direct estimates, making it difficult for policymakers to focus on districts or lower administrative hierarchies. SAE is a statistical technique used to obtain precise estimates of target parameters for disaggregated administrative units. SAE methods have found extensive application in various fields, including demographic, epidemiological, economic, and social science research[16,17].

[16] Johnson FA, Chandra H, Brown JJ, Padmadas SS. District-level Estimates of Institutional Births in Ghana: Application of Small Area Estimation Technique Using Census and DHS Data. *J Off Stat*. 2010; 26(2):341–359.
[17] Johnson FA, Chandra H, Brown JJ, Padmadas SS. District-level Estimates of Institutional Births in Ghana: Application of Small Area Estimation Technique Using Census and DHS Data. *J Off Stat*. 2010; 26(2):341–359.

Estimates need to be precise, i.e., with small standard errors, so that the areas with the greatest need are identified correctly. This analysis includes an investigation using SAE methods to determine how finely the estimates of persons with functional difficulties, disability registration and health access among persons with disablities may be disaggregated while maintaining an appropriate precision level.

In many such models, for the estimate of a particular small area, additional accuracy is achieved by "extracting information" by using information from areas to which it is similar. As a result, combining data from different sources is a ploy used in some SAE techniques. New survey information, for example, maybe combined with census data to update estimates from the original census. For person with functional difficulties, disability registration and healthcare access among persons with disabilities, it is a common scenario that a statistical model is fitted to a survey data. This model is used to predict a variable whose data is not collected in the census, based on variables that are collected in both the survey and the census. The World Bank method[18,19], also commonly called the ELL (Elbers, Lanjouw and Lanjouw) method, is the most common methodology for SAE of poverty and malnutrition in developing countries. The free software PovMap[20] and PovMap 2[21] are now available on the World Bank website. Variations of the ELL method have been implemented for the World Bank in a number of other countries, including Thailand[22], South Africa[23], Brazil[24], the Philippines[25], and for the World Food Programme in Bangladesh[26], Nepal[27], and Cambodia[28].

[18]Elbers C., Lanjouw J. and Lanjouw P. (2003) Micro-level estimation of poverty and inequality, Econometrica, 71, 355-364.

[19] Elbers C., Lanjouw J.O. and Lanjouw P. (2001) Welfare in villages and towns: micro-level estimation of poverty and inequality, unpublished manuscript, The World Bank.

[20] Zhao, Q. (2006). User manual for povmap.World Bank. http://siteresources. worldbank. org/INTPGI/Resources/342674-1092157888460/Zhao_ ManualPovMap. pdf

[21] Zhou, Q. and Lanjouw, P. (2009) PovMap2: A User's Guide, The World Bank, http://go.worldbank.org/QG9L6V7P20.

[22]Healy A.J., Jitsuchon S. and Vajaragupta, Y. (2003) Spatially Disaggregated Estimation of Poverty and Inequality in Thailand

[23]Alderman H., Babita M., Demombynes G., Makhata N. and Ozler B. (2002) How low can you go? Combining census and survey data for mapping poverty in South Africa, Journal of African Economics, 11, 169-200.

[24]Elbers C., Lanjouw J.O., Lanjouw P. and Leite P.G. (2001) Poverty and Inequality in Brazil:
new estimates from combined PPV-PNAD data, unpublished manuscript, The World Bank.

[25]Haslett, S. and Jones, G. (2005a) Estimation of Local Poverty in the Philippines, Philippines National Statistics Co-ordination Board / World Bank, November 2005.

[26]Jones, G. and Haslett, S. (2003) Local Estimation of Poverty and Malnutrition in Bangladesh.Bangladesh Bureau of Statistics and UN World Food Programme.

[27] Jones G., and Haslett, S. (2006) Small-Area Estimation of Poverty, Caloric Intake and Malnutrition in Nepal, Published: Nepal Central Bureau of Statistics / UN World Food Programme / World Bank, September 2006, 184pp, ISBN 999337018-5.

In 2010, from the Household Income and Expenditure Survey (HIES)[29] poverty estimates were produced for the country at the division level, using poverty lines updated from the 2005 study using regional price indices. In a subsequent report by the World Bank[30](World Bank, 2013), this trend in poverty reduction is discussed and contrasted with the situation in health and nutrition outcomes. The World Bank analysis provides upazila-level estimates of economic poverty indicators, but not of undernutrition indicators. The HIES 2016 did not include anthropometric measures of children under five, so cannot be used to estimate stunting and underweight prevalence. Such measures are typically available only in surveys specifically focusing on health and nutrition.

According to our knowledge, small area estimates of persons with functional difficulties, disability registration and health access among persons with disabilities in Bangladesh have not been produced. Therefore, our main objective is to produce and map district-level estimates of person with functional difficulties, disability registration and health access among persons with disabilities in Bangladesh.

The statistical technique of small-area estimation is described in detail in the next section. Outputs, in the form of estimates at the local level together with their standard errors, can be combined with Geographic Information System (GIS) location data to produce a small area estimate map for the whole country, giving a graphical summary of which areas are suffering relatively from high deprivation.

1.4 Measures of Functional Difficulties, Disability Registration and Health Access

The study's outcome variable encompasses functional difficulties, disability registration and health access. The Washington Group on Disability Statistics measures functional difficulties by asking a set of questions, which are as follows, 1) Do you have difficulty seeing even if wearing glasses? 2) Do you have difficulty hearing even if using a hearing aid? 3) Do you have difficulty walking or climbing stairs? 4) Do you have difficulty remembering or concentrating? 5) Do you have difficulty with self-care (such as washing all over or dressing)? 6) Using your usual (customary) language, do you have difficulty

[28]Haslett, S., Jones, G., and Sefton. A. (2013) Small-area Estimation of Poverty and Malnutrition in Cambodia, National Institute of Statistics, Ministry of Planning, Royal Government of Cambodia and the United Nations World Food Programme, Cambodia, April 2013, ISBN 9789996375507.
[29]Report of the Household Income and Expenditure Survey (HIES), Bangladesh Bureau of Statistics, 2010, http://203.112.218.65:8008/WebTestApplication/userfiles/Image/LatestReports/HIES-10.pdf
[30]World Bank (2013) Bangladesh Poverty Assessment-2000-2010 Key Messages, World Bank, June 2013.

communicating (for example understanding or being understood by others)? For each question respondents can choose: a) no difficulty, b) some difficulty, c) a lot of difficulty, or d) Cannot do at all.

Therefore, the functional difficulties (FD) is defined as,

$$FD = \begin{cases} \textbf{Yes}, & \textbf{If person have at least one of domain of functional difficulties} \\ \textbf{No}, & \textbf{Otherwise} \end{cases}$$

On the other hand, disability registration and health access were categorized as 'Yes' and 'No'. These variables are dichotomized into two categories, with coding as follows: "yes" represented by 1, and "no" represented by 0.

1.5 Scope and Objectives

For many users, having an atlas of maps is far more practical than a highly technical report focusing on SAE methodology, even if the latter also includes more granular tabulated data. Our primary objective in creating maps showcasing people with functional difficulties, disability registration data, and the accessibility of health services for persons with disabilities at the district level is to facilitate the planning of development assistance programs. Moreover, these maps could serve as valuable research aids, allowing users to overlay geographic, social, or economic indicators for deeper analysis.

To ensure accessibility and user-friendliness, we've chosen to present detailed tabulations and maps of estimates at the district level in a separate document. This decision was made with the majority of users in mind. These small area estimates offer a comprehensive perspective on the geographical distribution of functional difficulties, disability registration rates, and the availability of health services for persons with disabilities.

2. Data and Methodology

2.1 National Household Survey on Persons with Disabilities (NSPD) 2021

The analysis is based on secondary data from a nationwide representative survey named National Household Survey on Persons with Disabilities (NSPD) 2021. The National Sample of Persons with Disabilities (NSPD) has been specifically designed to produce representative statistics for various disability indicators at the national, divisional, and urban as well as rural levels.

For the National Survey on Persons with Disabilities, 800 Primary Sampling Units (PSUs) or Enumeration Areas (EAs) were selected based on the sampling frame derived from the Population and Housing Census 2011. The survey took place in 2021 and utilized a sampling frame constructed from the Enumeration Area of the Housing and Population Census 2011. Before collecting data, households within the selected PSUs were updated for this survey through a process involving listing and mapping operations. The survey employed a two-stage stratified random sampling technique within the sampling frame of the Population and Housing Census 2011 to obtain a representative sample. In the initial stage, 800 PSUs were chosen from 8 divisions using the probability proportional to the size of the population. Subsequently, in the second stage, 45 households were selected through systematic sampling from each PSU.

This study used the 2011 Population and Housing Census sampling frame instead of the 2022 census sampling frame due to the principles of the indirect method of SAEtechnique. The 2022 sampling frame, which covers district-level data, allows for direct estimation techniques to determine the disability status of individuals, eliminating the need for indirect methods. However, the 2022 census sampling frame lacks data on functional difficulties, disability registration, and health access. This limitation restricts the use of design-based direct estimates, making it challenging for policymakers to focus on district-level.

2.2 Bangladesh Population and Housing Census 2011 (Census 2011)

Since 1974, Bangladesh has conducted population censuses every ten years, building on a census tradition dating back to 1872. The fifth Population and Housing Census of Bangladesh took place from March 15th to 19th, 2011. Its primary aim was to gather data on housing, households, and population to support development planning, human resource development programs, and economic management efforts.

In 2011, the Bangladesh Bureau of Statistics (BBS) carried out the fifth Population and Housing Census of Bangladesh following the conceptual framework provided by the United Nations. The preparatory work for the census began in early 2009, including the updating of maps and area geo-codes. The census employed a house-to-house interview method, incorporating a modified de-facto approach to enumerate the floating population on the census night. Enumeration Areas (EA) were delineated using GIS mapping techniques. On average, each Enumeration Area comprised approximately 120 households, with a total of 296 thousand EAs constructed for the census.

2.3 SAE Methodology

To theoretically place the SAE methodology, we begin with a target variable *Y*, for which we require estimates over a range of small subpopulations, usually corresponding to small geographical areas. In this report, *Y* is people with functional difficulty, disability registration and their health access. Auxiliary information, denoted *X*, representing additional variables that have been measured for the whole population, either by a census or via a GIS database, can be used under some circumstances to improve the estimates. It is customary to relate the two variables *Y* and *X* in a regression setup as

$$\log\left(\frac{P(Y_{ijk}=1)}{1-P(Y_{ijk}=1)}\right) = X_{ijk}\beta + c_i + h_{ij} + e_{ijk} \qquad (1)$$

where Y_{ijk} represents the measurement on the *k*th respondent in the *j*th household in the *i*th cluster, X_{ijk} represents the measurement on the fixed effects of the auxiliary variables for the *k*th individual in the *j*th household in the *i*th cluster c_i, while the other terms c_i, h_{ij} and e_{ijk}represent the random effects, $c_i$is the error term held in common by the *i*th cluster, h_{ij} the household level error within the cluster, and e_{ijk} the error within each sampled household. The relative importance of the three random effects can be measured by their respective variances σ_c^2, $\sigma_h^2$and σ_e^2.

2.4 Selection of Auxiliary Data

For fitting the model (1), the first step is to identify and select the auxiliary data to be used to predict the target variable *Y*. There could be two types of *X* variables: the survey variables, obtainable or derivable from the survey at household or individual level (in our case the NSPD 2021), and area-level variables applying to particular geographic units that can be

merged from other sources into the survey data using area codes (e.g., division, zila, upazila, union, mauza enumeration area codes). The latter includes means of census variables calculated at mauza level from the census data.

The choice of auxiliary variables should be done in such a way that they are comparable in the survey data and census data sets. It can be done initially by examining the survey and census questionnaires. In consultation with BBS staff, a preliminary identification and matching of common survey and census variables, was reported by Haslett, Jones and Isidro[31] and in Small-Area Estimation of Child Undernutrition in Bangladesh, 2023.

Common variables were then subjected to statistical checks to ensure that the corresponding survey and census variables matched statistically as well as conceptually. In the case of categorical data we compare proportions in each category: for numerical data, such as the household proportion of females, we compare the means and standard deviations.

2.5 Fitting the First Stage Model

The fitting of models for persons with functional difficulty, disability registration and healthcare accessibility using the NSPD 2021 data requires the design variables from the survey to produce unbiased estimates with the correct standard errors. Survey weights for the NSPD 2021 data are available in the data set used for all summary computations using the NSPD 2021dataset.

Choosing an optimal model for (1) is a complex problem because we have a large number of possible predictor variables (see Appendix A). There is also the case of the presence of multicollinearity because of the inter-relation among these variables. If interactions among the variables are considered, the number of variables becomes unusually large. Consideration of second order interactions, if not higher order, is a requirement to take into account the district distinguishability. However, over-fitting the model in this phase of the inclusion of variables should be avoided, so the number of predictors included in the model is small compared to the number of observations in the survey. Still, there is also the problem of selecting a few variables from the large number available, which appear to be useful, only to find that an apparently strong statistical relationship in the survey data does not hold for the population as a whole. We employ automated search to avoid losing important variables

[31]Haslett, S., Jones, G. and Isidro, M. (2014) Potential for Small Area Estimation of Undernutrition at sub-District Level in Bangladesh: Interim Feasibility Report to UN World Food Programme, Massey University, New Zealand, February 2014.

and/or over-fitting the model. A step-wise selection of variables is considered for this purpose.

Some implementations of the ELL methodology have fitted separate models for each stratum defined by the survey design. However, Small-Area Estimation of Child Malnutrition in Bangladesh, 2014[32] has employed an overall model arguing against the strata-wise fitting. The strata-wise fitting has the advantage of tailoring the model to account for the different characteristics of each stratum, but it can increase the problem of over-fitting if some strata are small. We initially chose to try for one model across the whole country, and then use regional interaction terms as necessary to allow for modeling differences between regions. This has the advantage of more stable parameter estimates and a better chance of finding genuine relationships that apply outside of the estimation data. The fitting of separate models to different strata, or areas such as districts, is related (but not identical) to the intermediate option of including explicit district-level effects in an overall model.

Appendix B includes the pertinent statistics for the final models concerning people with functional difficulties, disability registration, and healthcare accessibility. Model diagnostics incorporate sensitivity and specificity measures for each model.

2.6 Variance Modelling

The variance components, σ_c^2, σ_h^2 and σ_e^2 of the respective components can be estimated by restricted maximum likelihood (REML), for methodological details, see Laird and Ware[33] and Robinson[34]. In this study we use the simpler parametric bootstrap approach, sampling from normal distributions with variances set to the estimated variance components. There should be little difference in practice as estimation with this many levels encourages approximate normality in the residuals.

2.7 Simulation of Predicted Values

A total of 100 bootstraps predicted values $Y_{ij}^{\ b}$ were produced for each child age 5 or women age 20-24 in the census for each target variable, as described in Section 3.4. For the three-level models, height-for-age, weight-for-age and weight-for-height, this was amended slightly to

[32]Bangladesh Bureau of Statistics, Small-Area Estimation of Child Undernutrition in Bangladesh, 2014.
[33]Laird, N.M. and Ware, J.H. (1982). Random-effects models for longitudinal data, Biometrics, 38, 963 - 974.
[34]Robinson, G.K. (1991) That BLUP is a good thing: the estimation of random effects, Statistical Science, 6, 15-51.

$$Y_{ijk}^{b} = X_{ijk}\hat{\beta}^{b} + c_i^{b} + h_{ij}^{b} + e_{ijk}^{b} \ , \quad b=1, 2,\ldots,B$$

with the residuals at each level c_i^b, h_{ij}^b, e_{ijk}^b $they\ were$ drawn independently from normal distributions with mean zero and variances equal to the estimated variance components from the regression analysis.

2.8 Production of Final Estimates

The predicted probabilities for each person from the census can then be assessed as being people with functional difficulties, disability registration, and healthcare accessibility and each of these measures is separately grouped at the appropriate geographic level. Our main target is district-level small-area estimates, but we have also considered higher levels of aggregation (division), compared with the direct survey estimates. For example, the estimated prevalence of indicators for small area *R* is:

$$OL_R^b = \sum_{\substack{i,j \in R \\ ij \square R}} I(Prob_{ij}^b > thereshold)/N_R$$

where N_R is the number of eligible children in *R*.

The 100 bootstrap estimates for each small area, e.g. S_R^1, $S_R^2, \ldots, S_R^{100}$ $S_R{}^1$,…,$S_R{}^{100}$ were summarized by their mean and standard deviation, giving a point estimate and a standard error for each indicators at each small area.

3. Results for Persons with Functional Difficulties, Disability Registration and Health Accessibility in Bangladesh

The NSPD 2021 supplied direct estimates at the district level for individuals with functional difficulties, disability registration, and health access. We utilized these direct estimates to validate and compare the corresponding estimates derived from the SAE methodology.

Appendix Tables C.2, C.4, and C.6 display three sets of district estimates along with their respective standard errors (SE). The standard errors for the direct survey estimates were extracted from the reported values in the NSPD 2021 report. Conversely, for the Small Area Estimates (SAE), the standard errors were computed as the standard deviations of 100 bootstrap estimates. This methodology ensures a comprehensive evaluation of the reliability and accuracy of the estimates derived through the SAE approach in comparison to the direct survey estimates.

A standardized different has been added between the two sets (direct estimate and SAE), defined as

$$Z = \frac{\text{Small area estimate} - \text{direct estimate}}{\sqrt{(\text{small area estimate se})^2 + (\text{direct estimate se})^2}}$$

If both methods are correctly estimating the same quantities, then Z should approximate a standard normal distribution.

It is noted that there is no enough reduction in standard error from the small-area methodology at the largest levels (divisions) of aggregation, but in all cases, the SAEs are more precise (i.e. smaller standard errors) than the direct estimates. This is because the uncertainty in the direct estimates due to sampling variability is replaced by uncertainty in the estimated model for the SAEs. At the lower levels in precision is much more dramatic for improvement.

3.1 Persons with Functional Difficulties

According to Table C.1, the small area estimates (SAE) of functional difficulties closely align with the direct estimates at the division level, with an average absolute difference of

approximately 1.18%. The accompanying graph illustrates a straight-line fit of the two sets of estimates, encompassed by a 95% confidence band.

As shown in Figure 3.1, all SAE estimates for each division lie within the 95% confidence band of the corresponding direct estimates. This demonstrates a high degree of consistency between the SAE estimates and the direct estimates for functional difficulties across all divisions.

To sum up, the SAE method gives estimates for functional difficulties that are very close to the direct estimates at the division level. This is shown by the fact that their confidence intervals overlap and their estimates are very close to each other.

Figure 3.1 Straight Line Fit of The Two Sets of Estimates of Functional Difficulties in The Division Level

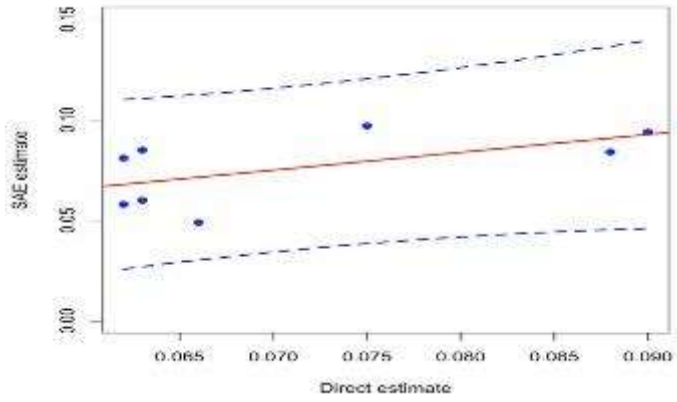


Figure 3.2 offers a thorough evaluation of the overall agreement between the two methods by displaying the Z scores in a Q-Q plot. The straight line in the plot indicates that the Z scores closely follow a standard normal distribution. Moreover, the magnitude of the standardized values remains well within the three-standard deviation limits (<3.0).

This indicates a robust agreement between the two estimation methods, further supported by the observation that the Z scores follow a distribution closely resembling the expected standard normal distribution. The fact that the standardized values remain within the acceptable range of three standard deviations underscores the reliability and validity of the estimates obtained through both methods.

Figure 3.2 Q-Q Plot of the Z-score Computed for Comparison Between SAE of Persons with Functional Difficulties for Division Against the Direct Estimates Provided in NSPD 2021

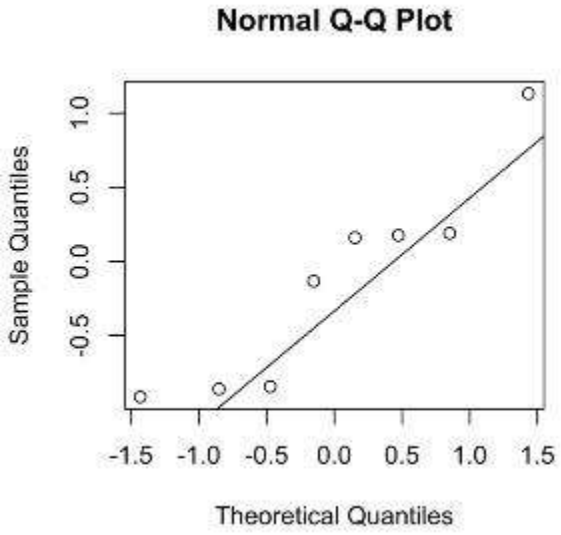


Table 3.1 provides a summary of division-level estimates for individuals with functional difficulties. Notably, the standard errors are small, averaging only 2.3% for SAE. The SAE estimates for individuals with functional difficulties vary from 4.9% to 9.7%, while the direct estimates range from 6.2% to 9%. For a comprehensive listing of these estimates, please refer to Appendix C.

Table 3.1 Summary of Division-Level Estimates of Persons with Functional difficulties Prevalence

	Minimum	Maximum	Median	Mean	Std. Deviation	95% Percentile	
						Lower	Upper
Direct Estimate	0.062	0.090	0.065	0.071	0.012	0.062	0.090
Std Error	0.001	0.002	0.002	0.002	0.000	0.001	0.002
SAE Estimate	0.049	0.097	0.083	0.076	0.018	0.051	0.096
Std Error	0.015	0.030	0.023	0.023	0.005	0.015	0.029

Table 3.2 summarizes the district-level estimates of people with functional difficulty. The standard errors are relatively small, averaging only 0.6% for the direct estimate and 2.4% for the SAE. The SAE estimates of people with functional difficulties range from 1.5% to 12.4%, while the direct estimates range from 3% to 15.6%. Appendix C provides a comprehensive listing of the estimates.

Table 3.2 Summary of District-Level Estimates of Persons with Functional Difficulties Prevalence

	Minimum	Maximum	Median	Mean	Std. Deviation	95% Percentile	
						Lower	Upper
Direct Estimate	0.030	0.156	0.069	0.075	0.024	0.036	0.128
Std Error	0.002	0.019	0.006	0.006	0.003	0.003	0.012
SAE Estimate	0.015	0.124	0.082	0.078	0.021	0.030	0.112
Std Error	0.004	0.036	0.025	0.024	0.007	0.009	0.035

3.2 Having Registration of Persons with Disabilities

As like the estimates of respondent functional difficulties, the SAE estimates of having registration of peosons disabilities are compared with the estimates from NSPD 2021. This comparison is also listed in Table C.3. Table C.3 indicates that the small-area estimates for having registration of persons with disabilities closely align with the direct estimates at the division level, with an average absolute difference of 1.34%. Figure 3.3 illustrates a straight line fit of both sets of estimates, accompanied by the 95% confidence band for the direct estimates. This graphical representation highlights that all SAE for every division fall within the 95% confidence band of the direct estimates. This further underscores a high level of agreement between the estimates derived from both methods for individual divisions.

The comparative analysis between the two methodologies is presented in Figure 3.4, showcasing a Q-Q plot of Z scores. The plot exhibits a linear trend, indicative of Z scores adhering closely to a standard normal distribution. Furthermore, the standardized values remain within three-standard deviation limits (<3.0), underscoring their consistency and adherence to expected norms.

Figure 3.3 Straight line fit of the two sets of estimates of Having Registration of Persons with Disabilities in the Division Level

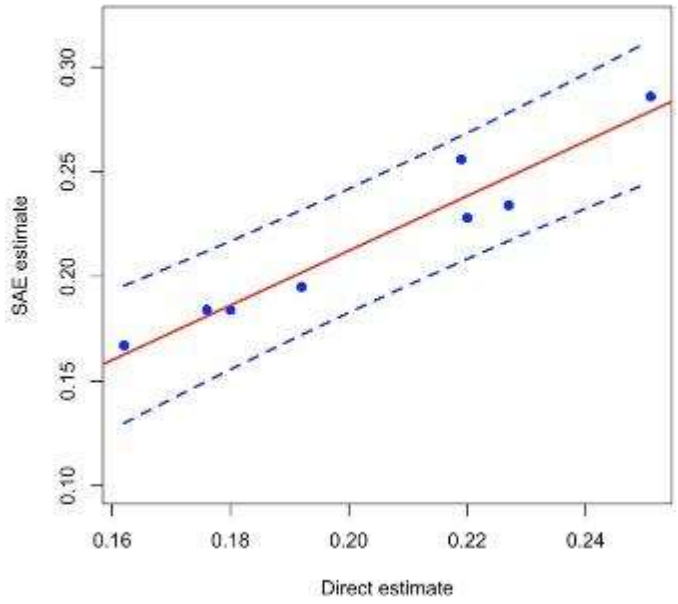


Figure 3.4 Q-Q Plot of the Z-Score Computed for Comparison Between SAE of Having Registration of Persons with Disabilities for Division Against the Direct Estimates Provided in NSPD 2021

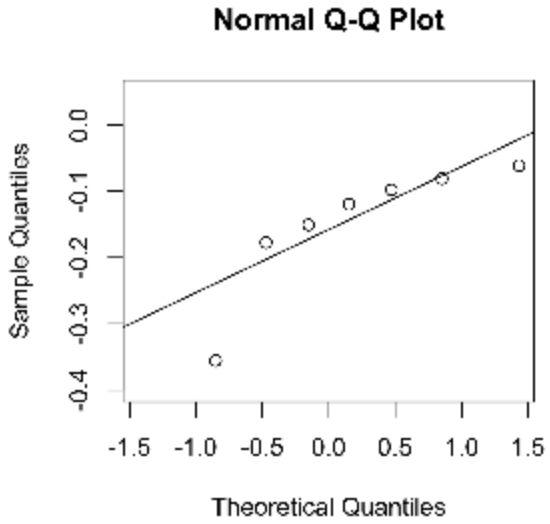


Table 3.3 provides a summary of division-level estimates for disability registration. The direct estimates exhibit smaller standard errors compared to SAE averaging only 1.3%. The SAE estimates for the registration of persons with disabilities range from 16.7% to 28.7%, while direct estimates range from 16.2% to 25.1%. For a detailed breakdown of the estimates, please refer to the complete listing provided in Appendix C.

Table 3.3 Summary of Division-Level Estimates of Having Registration of Persons with Disabilities Prevalence

	Minimum	Maximum	Median	Mean	Std. Deviation	95% Percentile	
						Lower	Upper
Direct Estimate	0.162	0.251	0.251	0.203	0.030	0.164	0.247
Std Error	0.010	0.017	0.013	0.013	0.002	0.010	0.017
SAE Estimate	0.167	0.286	0.212	0.217	0.041	0.170	0.281
Std Error	0.044	0.097	0.050	0.097	0.018	0.045	0.092

Table 3.4 provides a summary of district-level estimates for persons with disabilities registration. Notably, these estimates exhibit smaller standard errors compared to those for participation in disability registration, averaging only 6.2%. The SAE estimates of having registration of persons with disabilities at the district level range from 16.3% to 29.9%, while the direct estimates span from 8.1% to 63.3%. For a detailed breakdown of these estimates, please refer to Appendix C.

Table 3.4 Summary of District-Level Estimates of Having Registration of Persons with Disabilities Prevalence

	Minimum	Maximum	Median	Mean	Std. Deviation	95% Percentile	
						Lower	Upper
Direct Estimate	0.081	0.633	0.194	0.221	0.098	0.087	0.423
Std Error	0.019	0.141	0.038	0.021	0.024	0.021	0.119
SAE Estimate	0.163	0.299	0.206	0.217	0.034	0.164	0.286
Std Error	0.024	0.143	0.060	0.062	0.021	0.029	0.108

3.3 Healthcare Access among Persons with Disabilities

In Table C.5, the SAEestimates of healthcare access among persons with disabilities are compared with the estimates from NSPD 2021 for reference. It is evident that the small-area estimates of healthcare access among persons with disabilities closely correspond to the direct estimates at the division level, showcasing an average absolute difference of 5.23%. Additionally, the figure 3.5 depicts a straight line fit of the two sets of estimates, accompanied by the 95% confidence band for the direct estimates. This visual representation highlights that all SAE estimates for every division fall within the 95% confidence band of the direct estimates, indicating a robust level of agreement between the estimates derived from both methods for individual divisions.

The overall agreement between the two methods can be checked in Figure 3.6, where the Z scores were plotted in a Q-Q plot that depicts a straight line indicating that the Z scores

follow a near standard normal distribution. Moreover, the magnitude of the standardized values are well within three-standard deviation limits (<3.0).

Figure 3.5 Straight Line Fit of the Two Sets of Estimates of Healthcare Access in the Division Level

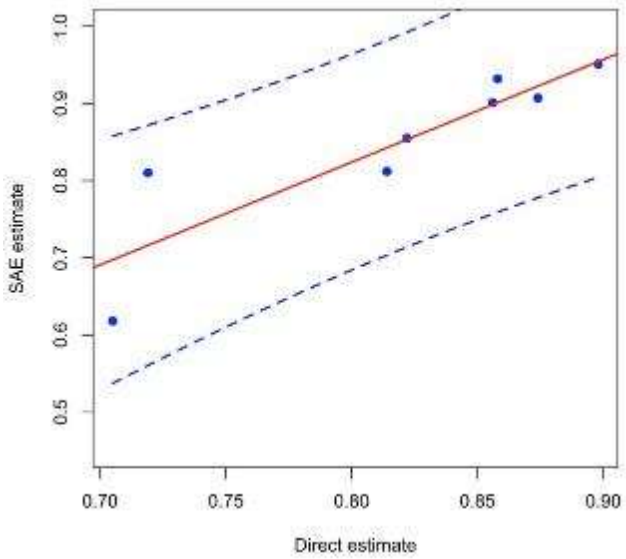


Figure 3.6 Q-Q Plot of the Z-Score Computed for Comparison Between SAE of Healthcare access for Division Against the Direct Estimates Provided in NSPD 2021

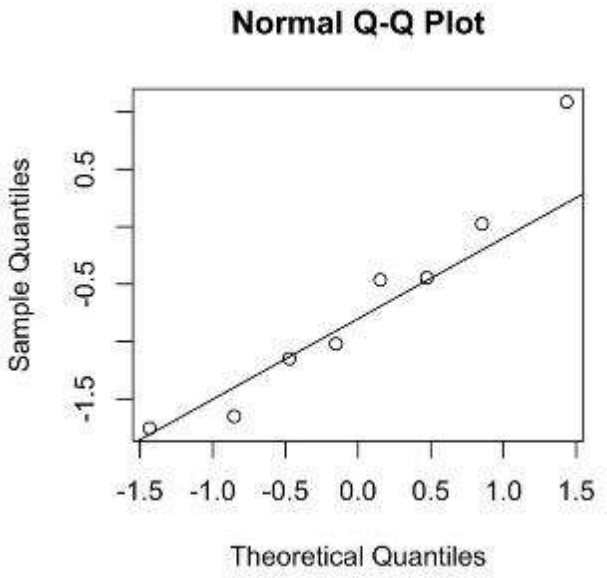


Table 3.5 provides a summary of division-level estimates for healthcare access prevalence of persons with disabilities. The direct estimates exhibit smaller standard errors compared to SAE averaging only 0.3%. The SAE estimates for the registration of persons with disabilities range from 61.8% to 95.1%, while direct estimates range from 70.5% to 89.8%. For a

detailed breakdown of the estimates, please refer to the complete listing provided in Appendix C.

Table 3.5 Summary of Division-Level Estimates of Healthcare access among Persons with Disabilities Prevalence

	Minimum	Maximum	Median	Mean	Std. Deviation	95% Percentile	
						Lower	Upper
Direct estimate	0.705	0.898	0.839	0.818	0.071	0.707	0.894
Std Error	0.002	0.004	0.003	0.003	0.001	0.002	0.004
SAE Estimate	0.618	0.951	0.878	0.848	0.107	0.652	0.948
Std Error	0.032	0.080	0.073	0.063	0.020	0.034	0.080

The district-level estimates for healthcare access among persons with disabilities are summarized in Table 3.6. The estimates seem to have smaller standard errors to those for participation in disability registration, having an average of only 0.9%. The SAE estimate of healthcare accessibility among persons with disabilities at district level range from 42.5% to 97.2% while the direct estimate ranges from 46% to 97.6%. A complete listing of the estimates is given in Appendix C.

Table 3.6 Summary of District-Level Estimates of Healthcare Access among Persons with Disabilities Prevalence

	Minimum	Maximum	Median	Mean	Std. Deviation	95% Percentile	
						Lower	Upper
Direct estimate	0.460	0.976	0.824	0.805	0.117	0.584	0.964
Std Error	0.003	0.020	0.008	0.009	0.004	0.003	0.017
SAE Estimate	0.425	0.972	0.852	0.845	0.102	0.580	0.964
Std Error	0.025	0.119	0.074	0.069	0.025	0.038	0.106

3.4 Maps for Persons with Functional Difficulties, Disability Registration and Healthcare Access

Maps depicting the estimates of persons with functional difficulties for each division are provided in Appendix D.1.1. The summary statistics of district-level prevalence reveal that the prevalence of functional difficulties at the division level ranges from 4.90% to 9.70%. The district-level map indicates that Bagherhat has the highest prevalence of functional difficulties at 12.4%, while Dhaka district has the lowest prevalence at 1.50% (Appendix D.2.1).

Maps illustrating disability registration at the division level are available in Appendix D.1.2. The summary statistics indicate that the prevalence of disability registration across divisions ranges from 16.70% in Mymensingh to 28.60% in Rangpur. At the district level, the map shows that Sunamganj has the highest disability registration rate at 29.9%, whereas Mymensingh has the lowest rate (Appendix D.2.2).

Maps depicting healthcare access are presented in Appendix D.1.3 and D.2.3. The Rangpur division boasts the highest healthcare access, with 95.1%, while the Dhaka division has the lowest at 61.8%. At the district level, Kurigram has the highest healthcare accessibility at 96.4%, closely followed by Lalmonirhat (96.4%), Panchagarh (96.4%), Gaibandha (95.3%), and Rangpur (94.9%). Conversely, Dhaka district exhibits the lowest healthcare accessibility at 42.5%.

4. Conclusion and Discussion

In this report, district-level estimates of persons with functional difficulties, disability registration, and healthcare accessability among persons with disabilities in Bangladesh have been generated and mapped. The SAE methodology utilized combines survey data from the NSPD 2021 with auxiliary data from the 2011 Population and Housing Census. For individuals with functional difficulties, a single model incorporating division-level effects was employed and found to be adequate for prediction. Similarly, a single model was used for predicting the likelihood of disability registration among individuals, proving effective for this purpose.The small-area estimates obtained for each indicator exhibited standard errors comparable to those of direct estimates. Sensitivity and specificity were employed as measures of model diagnostics, yielding good results for the models predicting persons with functional difficulties and disability registration, and moderate results for healthcare access among persons with disabilities (characterized by moderate sensitivity but higher specificity). The small-area estimates produced in this report have low standard errors, and generally align with those from the NSPD 2021, with some exceptions. Specifically, estimates for individuals with functional difficulties in Dhaka, Gazipur, and Narayanganj districts were underestimated, while disability registration in Sunamganj was overestimated compared to direct estimates. Additionally, the model for district-level healthcare access underestimated the estimates for Dhaka and Narayanganj districts. This trend is also evident in the upazila estimates of participation in organized learning within the upazilas of Sylhet district, which are relatively lower. The variables used may have contributed to these lower values for the peripheral upazilas of Sylhet. Small-area estimation works best in aggregate, so caution should be exercised when using individual-level estimates for upazilas in flagged districts for policy purposes.

5. Appendices

A. Potential Auxiliary Variables

Table A.1: Individual and household-level variables in NSPD 2021 and Census 2011

Sl.	Variable name
1	Gender
2	Child age 0-11 months
3	Child age 12-23 moths
4	Child age 24-35 months
5	Child age 36-47 months
6	Child age 48-59 months
7	Log of household size
8	HH has electricity
9	HH head has secondary education
10	HH head married or other than married
11	Prop of adult female in household
12	Prop of child age 7-14 in household
13	Kitchen separate house
14	HH has electricity, urban
15	HH head married or other than married, urban
16	Prop of adult female in household, urban
17	Prop of household own land for agriculture in mauza
18	Prop of household has no toilet facility in mauza
19	Prop of child age 7-14 has literacy in mauza
20	Prop household has pucka or semi pucka house in mauza
21	Mother has at least secondary education
22	Poverty rate district wise
23	Aman production district wise
24	Aus production district wise
25	Boro production district wise

B.1 Model for Persons with Functional Difficulties

Coefficients	Estimate	Std. Error	Z-value	p-value
(Intercept)	-4.277	0.374	-11.420	<0.0001
Age	0.051	0.001	93.011	<0.0001
log of household size	-0.178	0.025	-7.158	<0.0001
hh_electricity	-0.548	0.081	-6.742	<0.0001
prop_adultfemale	-0.398	0.073	-5.485	<0.0001
prop_child7_14	0.357	0.072	4.955	<0.0001
electri_urban	-0.086	0.030	-2.875	0.004
pop_own_land_ag_mauza	-0.364	0.062	-5.851	0.000
pop_child_literacy_mauza	-0.695	0.382	-1.821	0.069
pop_h_pucka_or_semi_mauza	0.669	0.365	1.830	0.067
Division_Chattogram	0.169	0.046	3.649	<0.0001
Division_Dhaka	0.133	0.045	2.945	<0.0001
Division_khulna	0.329	0.048	6.888	<0.0001
Division_Mymensingh	0.077	0.052	1.480	0.139
Division_Rajshahi	0.380	0.046	8.259	<0.0001
Division_Rangpur	0.236	0.048	4.958	<0.0001
Division_Sylhet	0.161	0.052	3.064	0.002

Note: To avoid multicolinerity, Barishal Division has been treated as reference

N	n_{psu}	P	Sensitivity	Specificity	σ_c^2	σ_h^2	σ_e^2
155031	800	17	0.9527	0.3765	0.5292	0.2634	7.0303

B.2 Model for Having Registration for Persons with Disabilities

Coefficients	Estimate	Std. Error	Z-value	p-value
(Intercept)	-0.543	0.156	-3.482	<0.0001
Age	-0.024	0.001	-18.534	<0.0001
prop_adultfemale	0.599	0.201	2.980	<0.0001
prop_child7_14	-0.765	0.198	-3.874	<0.0001
prop_adultfe_ur	-0.616	0.256	-2.408	0.016
pop_own_land_ag_mauza	0.640	0.164	3.894	<0.0001
Division_Chattogram	-0.162	0.120	-1.351	0.177
Division_Dhaka	-0.189	0.122	-1.551	0.121
Division_Khulna	0.001	0.121	0.012	0.991
Division_Mymensingh	-0.370	0.145	-2.543	0.011

Coefficients	Estimate	Std. Error	Z-value	p-value
Division_Rajshahi	0.062	0.120	0.517	0.605
Division_Rangpur	-0.289	0.123	-2.344	0.019
Division_Sylhet	0.139	0.132	1.052	0.293

Note: To avoid multicolinerity, Barishal Division has been treated as reference

n	n_{psu}	P	Sensitivity	Specificity	σ_c^2	σ_h^2	σ_e^2
7933	795	13	0.9687	0.9443	1.2027	0.6448	2.2512

B.3 Model for Healthcare Access for Persons with Disabilities

Coefficients	Estimate	Std. Error	Z-value	p-value
(Intercept)	-0.726	0.194	-3.744	<0.0001
Age	0.020	0.000	52.773	<0.0001
loghsize	-0.376	0.019	-20.168	<0.0001
prop_adultfemale	-0.125	0.056	-2.240	0.025
prop_child7_14	-0.283	0.043	-6.593	<0.0001
prop_adultfe_ur	0.153	0.053	2.878	0.004
pop_no_toilet_mauza	-0.996	0.354	-2.812	0.005
pop_h_pucka_or_semi_mauza	1.787	0.190	9.422	<0.0001
Division_Chattogram	0.960	0.026	36.571	<0.0001
Division_Dhaka	-0.098	0.023	-4.181	<0.0001
Division_Khulna	0.485	0.028	17.266	<0.0001
Division_Mymensingh	0.915	0.031	29.502	<0.0001
Division_Rajshahi	0.561	0.027	20.596	<0.0001
Division_Rangpur	1.281	0.033	38.944	<0.0001
Division_Sylhet	1.167	0.031	37.936	<0.0001

Note: To avoid multicolinerity, Barishal Division has been treated as reference

N	n_{psu}	P	Sensitivity	Specificity	σ_c^2	σ_h^2	σ_e^2
155023	800	15	0.6061	0.9085	0.9085	0.8980	2.5092

C. Summary of Small-Area Estimates

Table C.1 Division Wise Comparison of Estimates of Persons with Functional Difficulties from NSPD 2021

Division	SAE Estimate (%)	Std Error	Direct Estimate (%)	Std Error
Barishal	8.10	0.022	6.22	0.002
Chattogram	6.00	0.017	6.27	0.001
Dhaka	4.90	0.015	6.58	0.001
Khulna	8.40	0.025	8.82	0.002
Mymensingh	8.50	0.024	6.31	0.002
Rajshahi	9.40	0.03	8.97	0.002
Rangpur	9.70	0.026	7.42	0.002
Sylhet	5.80	0.021	5.77	0.002

Table C.2 District Wise Comparison of Estimates of Persons with Functional Difficulties from NSPD 2021

SI No	District	SAE Estimate (%)	Std Error
1.	Bagerhat	12.40	0.034
2.	Bandarban	6.90	0.028
3.	Barguna	9.30	0.028
4.	Barishal	7.40	0.022
5.	Bhola	7.40	0.014
6.	Bogura	10.00	0.031
7.	Brahmanbaria	6.10	0.017
8.	Chandpur	8.40	0.023
9.	Chattogram	3.90	0.009
10.	Chuadanga	6.90	0.022
11.	Cumilla	6.10	0.021
12.	Cox's Bazar	5.70	0.019
13.	Dhaka	1.50	0.004
14.	Dinajpur	8.60	0.027
15.	Faridpur	6.90	0.025
16.	Feni	5.80	0.018
17.	Gaibandha	10.50	0.027
18.	Gazipur	3.30	0.01
19.	Gopalganj	8.10	0.027
20.	Habiganj	6.80	0.023
21.	Joypurhat	10.10	0.035
22.	Jamalpur	8.70	0.026
23.	Jashore	7.10	0.023
24.	Jhalokati	8.70	0.027
25.	Jhenaidah	7.70	0.027
26.	Khagrachhari	8.30	0.029

SI No	District	SAE Estimate (%)	Std Error
27.	Khulna	7.90	0.022
28.	Kishoregonj	8.00	0.023
29.	Kurigram	11.80	0.036
30.	Kushtia	7.70	0.022
31.	Lakshmipur	8.20	0.017
32.	Lalmonirhat	10.70	0.025
33.	Madaripur	7.40	0.026
34.	Magura	9.90	0.031
35.	Manikganj	9.40	0.031
36.	Meherpur	7.10	0.019
37.	Moulvibazar	5.60	0.021
38.	Munshiganj	5.70	0.021
39.	Mymensingh	8.20	0.021
40.	Naogaon	10.80	0.036
41.	Narail	9.80	0.032
42.	Narayanganj	2.60	0.009
43.	Narsingdi	5.40	0.017
44.	Natore	9.40	0.03
45.	Chapainawabganj	7.00	0.024
46.	Netrakona	9.00	0.029
47.	Nilphamari	8.60	0.017
48.	Noakhali	7.20	0.016
49.	Pabna	9.20	0.028
50.	Panchagarh	9.20	0.029
51.	Patuakhali	8.50	0.024
52.	Pirojpur	8.70	0.023
53.	Rajshahi	7.50	0.026
54.	Rajbari	8.20	0.027
55.	Rangamati	7.00	0.026
56.	Rangpur	9.60	0.025
57.	Shariatpur	9.20	0.029
58.	Satkhira	9.10	0.028
59.	Sirajganj	10.60	0.03
60.	Sherpur	8.80	0.024
61.	Sunamganj	7.50	0.026
62.	Sylhet	4.10	0.016
63.	Tangail	9.20	0.028
64.	Thakurgaon	8.20	0.023

Table C.3 Division Wise Comparison of Estimates of Having Registration of Persons with Disabilities from NSPD 2021

Division	SAE Estimate (%)	Std Error	Direct Estimate (%)	Std Error
Barishal	22.80	0.051	22.00	0.015
Chattogram	19.50	0.048	19.20	0.011
Dhaka	18.40	0.044	17.60	0.01
Khulna	23.40	0.057	22.70	0.013
Mymensingh	16.70	0.049	16.20	0.015
Rajshahi	25.60	0.069	21.90	0.012
Rangpur	18.40	0.048	18.00	0.012
Sylhet	28.60	0.097	25.10	0.017

Table C.4 District Wise Comparison of Estimates of Having Registration of Persons with Disabilities from NSPD 2021

SI No	District	SAE Estimate (%)	Std Error
1.	Bagerhat	23.00	0.06
2.	Bandarban	26.50	0.143
3.	Barguna	22.70	0.06
4.	Barishal	22.40	0.054
5.	Bhola	23.30	0.035
6.	Bogura	25.40	0.069
7.	Brahmanbaria	20.10	0.052
8.	Chandpur	19.30	0.054
9.	Chattogram	18.10	0.028
10.	Chuadanga	23.50	0.054
11.	Cumilla	19.80	0.063
12.	Cox's Bazar	20.70	0.06
13.	Dhaka	16.30	0.024
14.	Dinajpur	18.50	0.055
15.	Faridpur	20.30	0.072
16.	Feni	18.70	0.047
17.	Gaibandha	18.20	0.044
18.	Gazipur	19.00	0.035
19.	Gopalganj	20.00	0.064
20.	Habiganj	29.00	0.093
21.	Joypurhat	26.00	0.078
22.	Jamalpur	16.50	0.049
23.	Jashore	23.20	0.055
24.	Jhalokati	22.20	0.063
25.	Jhenaidah	23.90	0.065
26.	Khagrachhari	23.20	0.112
27.	Khulna	22.10	0.049

SI No	District	SAE Estimate (%)	Std Error
28.	Kishoregonj	19.60	0.053
29.	Kurigram	18.80	0.068
30.	Kushtia	23.50	0.051
31.	Lakshmipur	19.40	0.037
32.	Lalmonirhat	18.40	0.04
33.	Madaripur	20.10	0.07
34.	Magura	23.90	0.07
35.	Manikganj	20.20	0.073
36.	Meherpur	23.90	0.049
37.	Moulvibazar	28.30	0.094
38.	Munshiganj	19.30	0.059
39.	Mymensingh	16.30	0.043
40.	Naogaon	26.80	0.081
41.	Narail	23.70	0.072
42.	Narayanganj	18.60	0.042
43.	Narsingdi	18.90	0.049
44.	Natore	26.00	0.07
45.	Chapainawabganj	25.90	0.07
46.	Netrakona	17.80	0.069
47.	Nilphamari	18.20	0.03
48.	Noakhali	19.30	0.039
49.	Pabna	25.30	0.062
50.	Panchagarh	19.60	0.066
51.	Patuakhali	23.10	0.055
52.	Pirojpur	22.50	0.053
53.	Rajshahi	25.10	0.069
54.	Rajbari	20.30	0.068
55.	Rangamati	23.60	0.105
56.	Rangpur	17.90	0.045
57.	Shariatpur	20.50	0.079
58.	Satkhira	24.00	0.063
59.	Sirajganj	25.30	0.063
60.	Sherpur	16.50	0.044
61.	Sunamganj	29.90	0.105
62.	Sylhet	27.70	0.095
63.	Tangail	19.20	0.054
64.	Thakurgaon	18.60	0.045

Table C.5 Division Wise Comparison of Estimates of respondent in Healthcare Access among Persons with Disabilities from NSPD 2021

Division	SAE Estimate (%)	Std Error	Direct Estimate (%)	Std Error
Barishal	81.00	0.079	71.90	0.004
Chattogram	90.10	0.044	85.60	0.002
Dhaka	61.80	0.080	70.50	0.003
Khulna	81.20	0.080	81.40	0.003
Mymensingh	93.20	0.042	85.80	0.003
Rajshahi	85.50	0.074	82.20	0.003
Rangpur	95.10	0.032	89.80	0.002
Sylhet	90.70	0.071	87.40	0.003

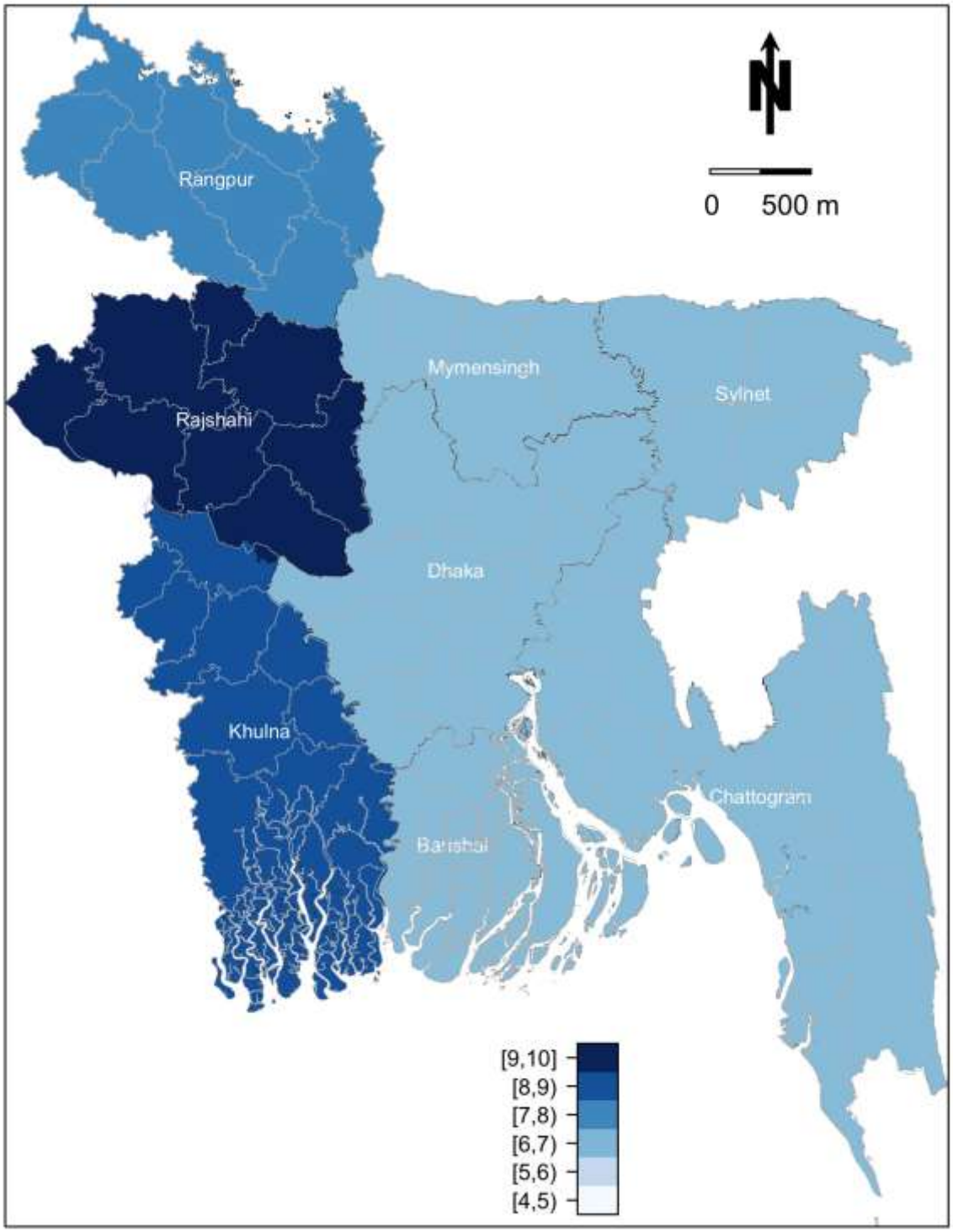
Table C.6 District Wise Comparison of Estimates of respondent in Healthcare Access among Persons with Disabilities from NSPD 2021

SI No	District	SAE Estimate (%)	Std Error
1.	Bagerhat	89.40	0.060
2.	Bandarban	91.30	0.104
3.	Barguna	82.80	0.083
4.	Barishal	81.30	0.083
5.	Bhola	78.70	0.071
6.	Bogura	86.90	0.068
7.	Brahmanbaria	91.60	0.047
8.	Chandpur	93.80	0.040
9.	Chattogram	84.60	0.040
10.	Chuadanga	78.00	0.091
11.	Cumilla	91.60	0.054
12.	Cox's Bazar	91.30	0.054
13.	Dhaka	42.50	0.059
14.	Dinajpur	93.40	0.042
15.	Faridpur	70.20	0.119
16.	Feni	89.50	0.055
17.	Gaibandha	95.30	0.031
18.	Gazipur	57.80	0.073
19.	Gopalganj	77.40	0.100
20.	Habiganj	93.70	0.056
21.	Joypurhat	85.20	0.085
22.	Jamalpur	94.60	0.037
23.	Jashore	77.90	0.089
24.	Jhalokati	81.70	0.088
25.	Jhenaidah	80.60	0.091
26.	Khagrachhari	94.80	0.060
27.	Khulna	80.50	0.071
28.	Kishoregonj	75.20	0.096

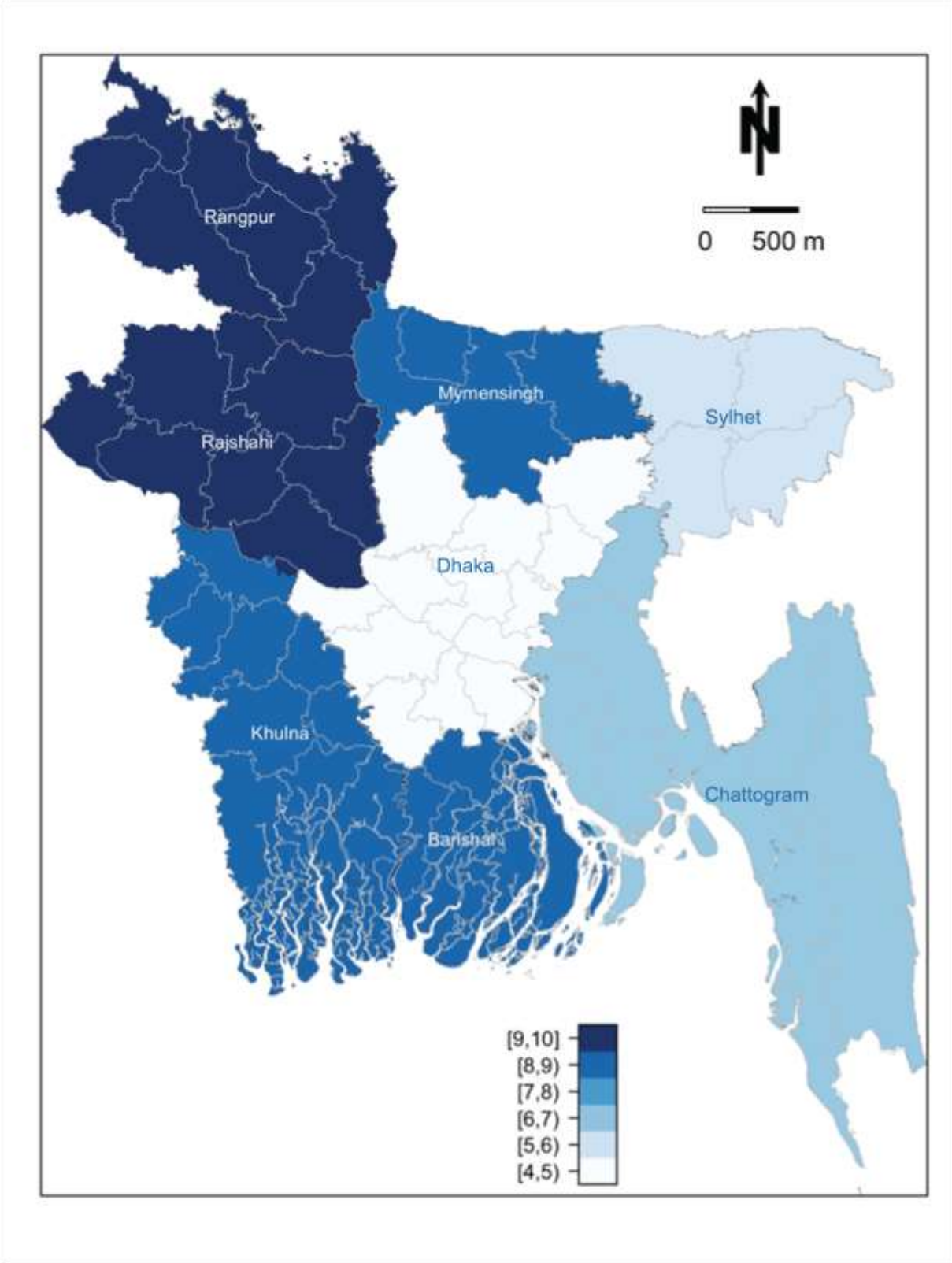
SI No	District	SAE Estimate (%)	Std Error
29.	Kurigram	97.20	0.026
30.	Kushtia	81.70	0.077
31.	Lakshmipur	93.10	0.035
32.	Lalmonirhat	96.40	0.025
33.	Madaripur	76.40	0.107
34.	Magura	84.80	0.081
35.	Manikganj	80.60	0.099
36.	Meherpur	76.00	0.086
37.	Moulvibazar	90.20	0.074
38.	Munshiganj	76.30	0.101
39.	Mymensingh	92.10	0.043
40.	Naogaon	83.90	0.088
41.	Narail	85.10	0.082
42.	Narayanganj	58.10	0.085
43.	Narsingdi	68.40	0.102
44.	Natore	86.20	0.076
45.	Chapainawabganj	75.90	0.098
46.	Netrakona	93.40	0.053
47.	Nilphamari	94.60	0.032
48.	Noakhali	92.30	0.039
49.	Pabna	88.50	0.061
50.	Panchagarh	96.40	0.030
51.	Patuakhali	81.40	0.082
52.	Pirojpur	81.80	0.078
53.	Rajshahi	82.40	0.083
54.	Rajbari	76.40	0.106
55.	Rangamati	94.00	0.056
56.	Rangpur	94.90	0.033
57.	Shariatpur	79.50	0.106
58.	Satkhira	81.20	0.085
59.	Sirajganj	90.50	0.055
60.	Sherpur	94.40	0.036
61.	Sunamganj	94.00	0.059
62.	Sylhet	86.70	0.087
63.	Tangail	80.70	0.084
64.	Thakurgaon	93.70	0.039

D1: Small-Area MAPs at Division Level

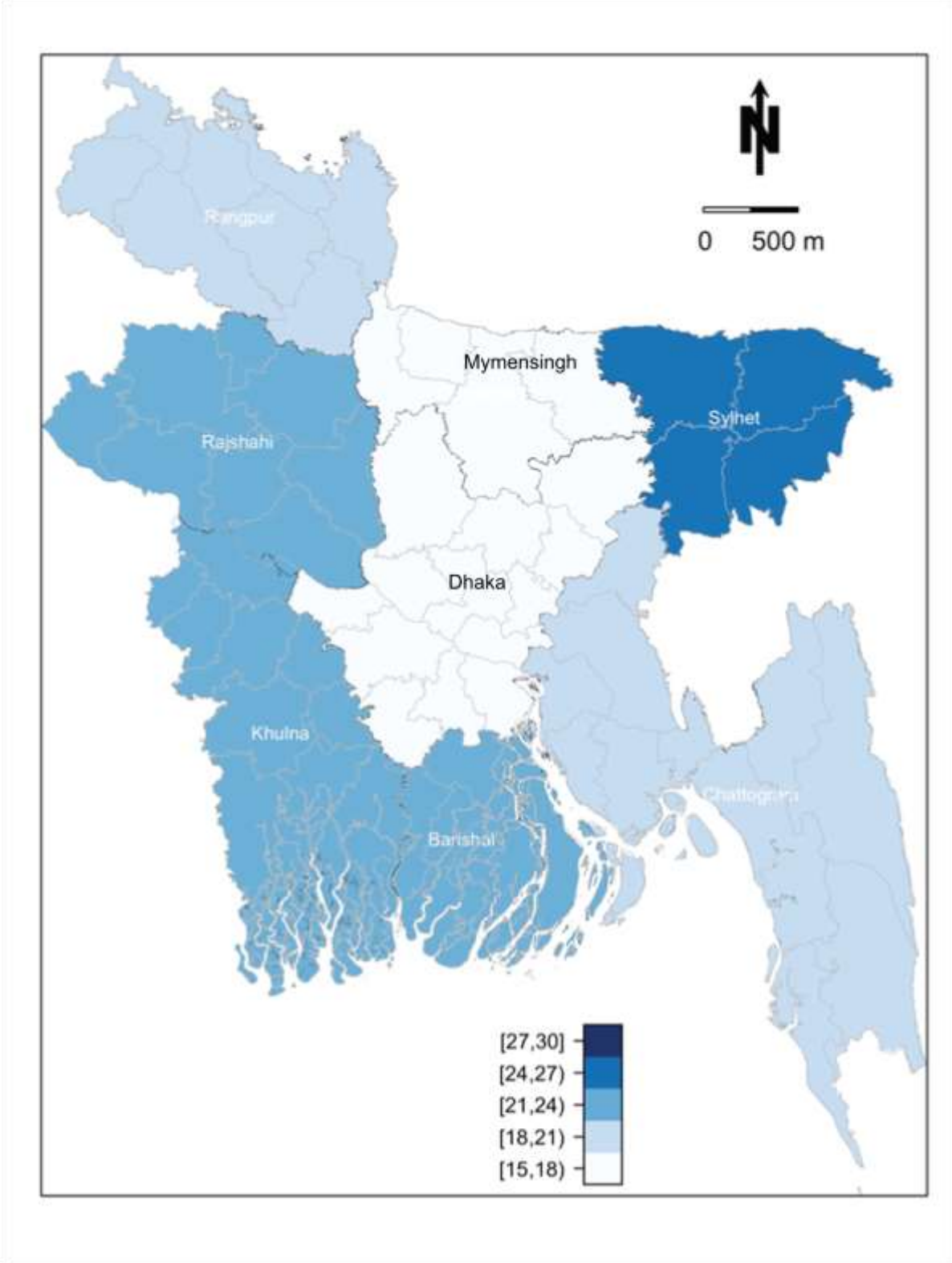
D1.1: Persons with Functional Difficulties (Direct)



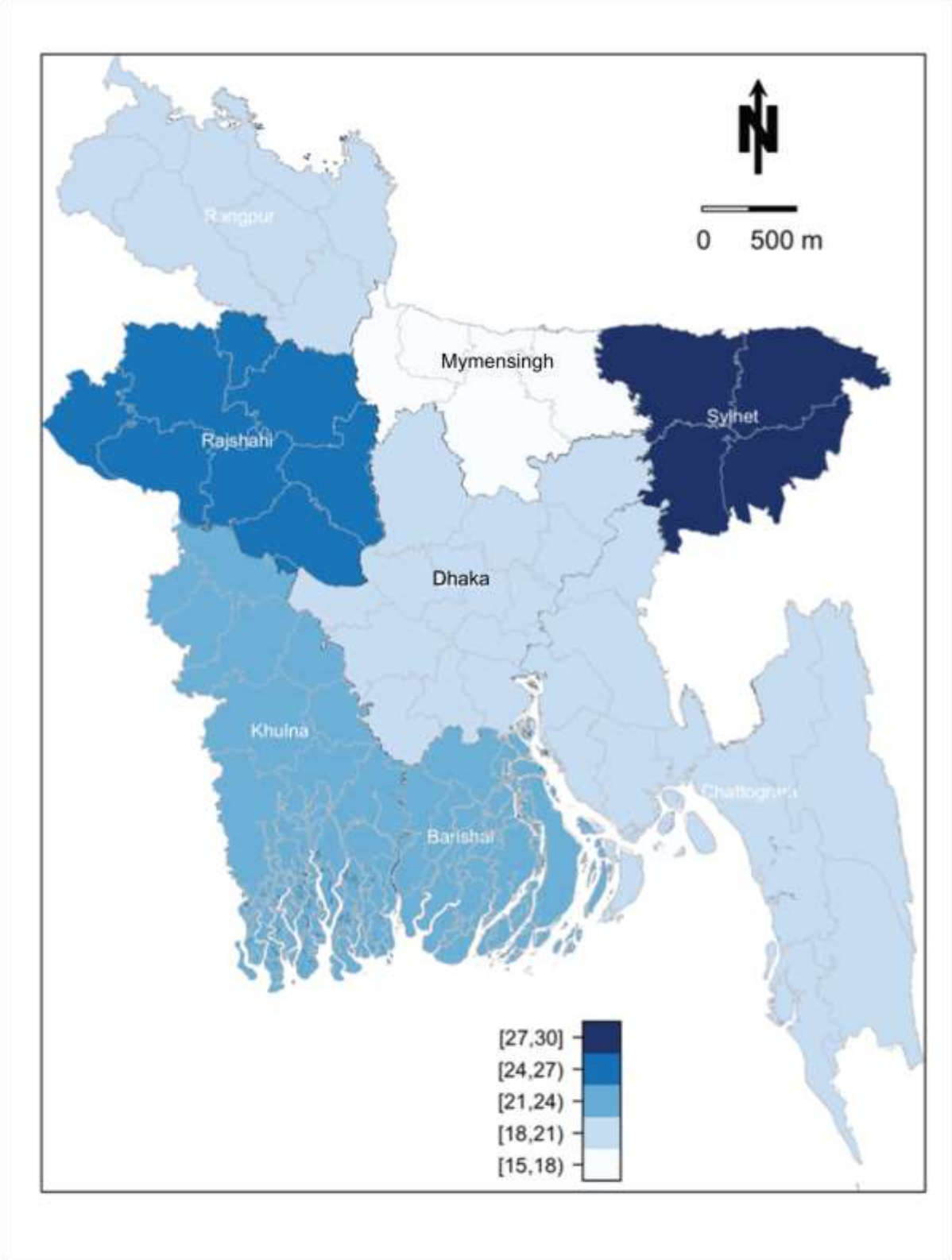
Persons with Functional Difficulties (SAE)



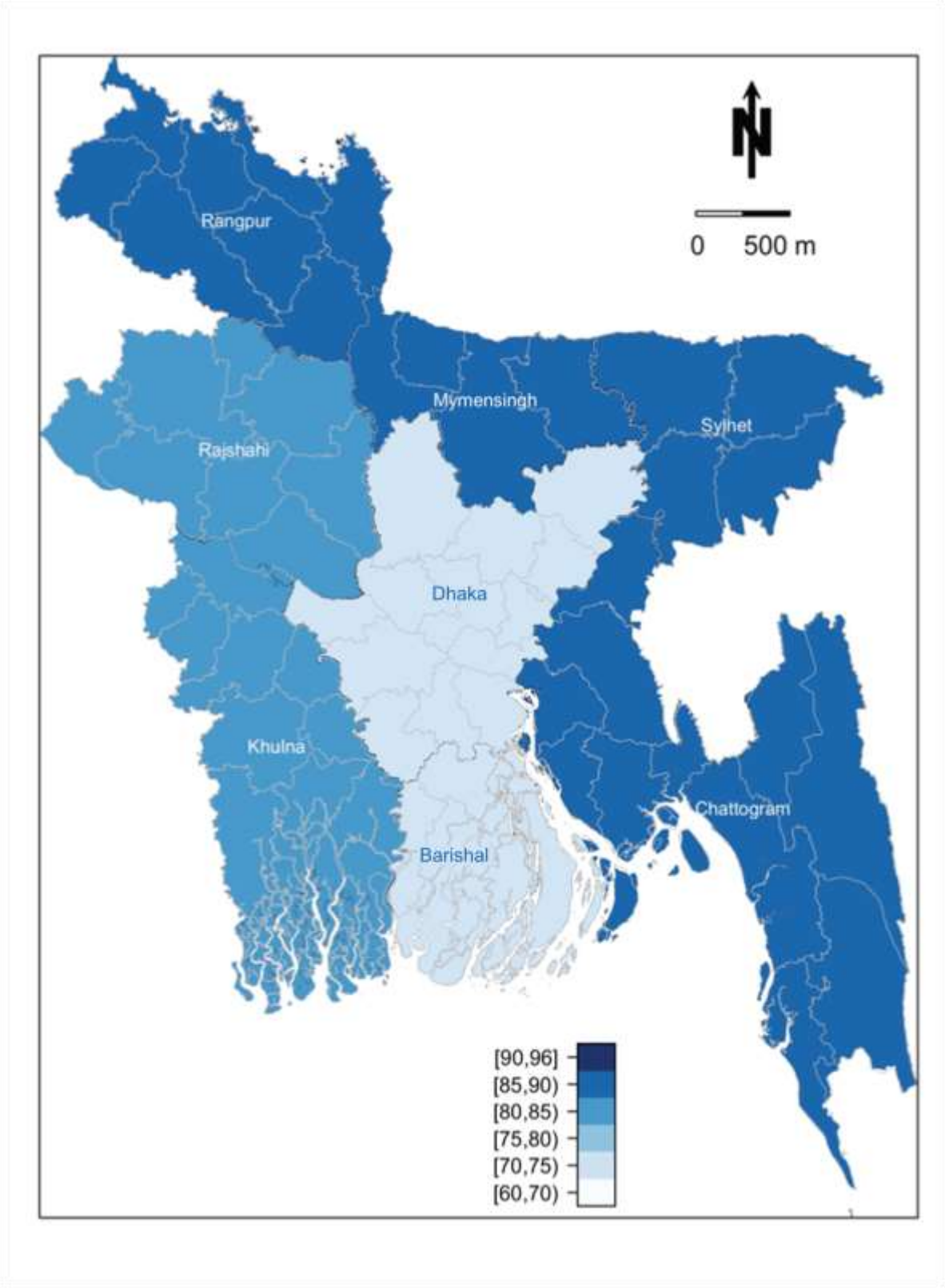
D1.2: Having Registration of Persons with Disabilities (Direct)



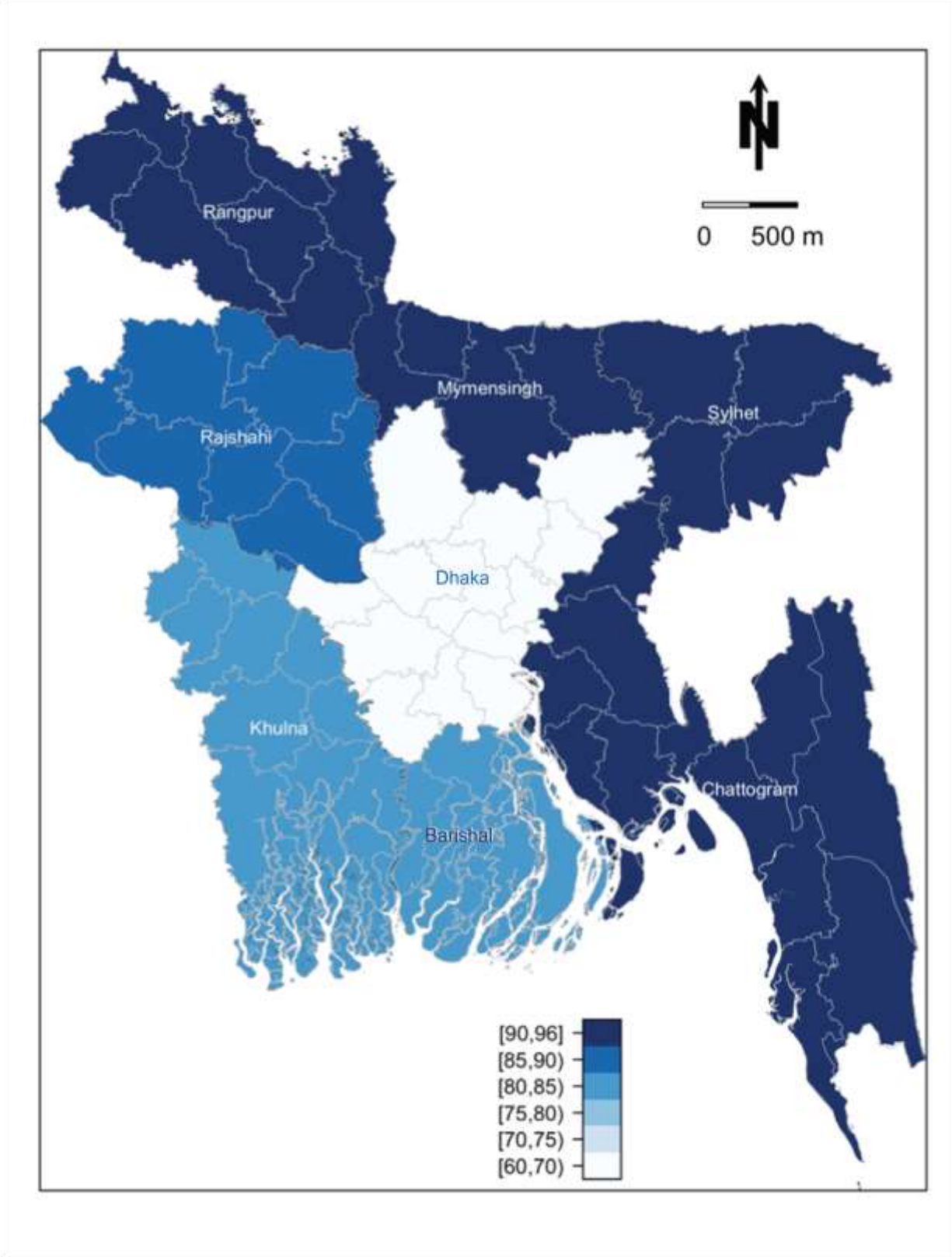
Having Registration of Persons with Disabilities (SAE)



D1.3: Healthcare Access among Persons with Disabilities (Direct)

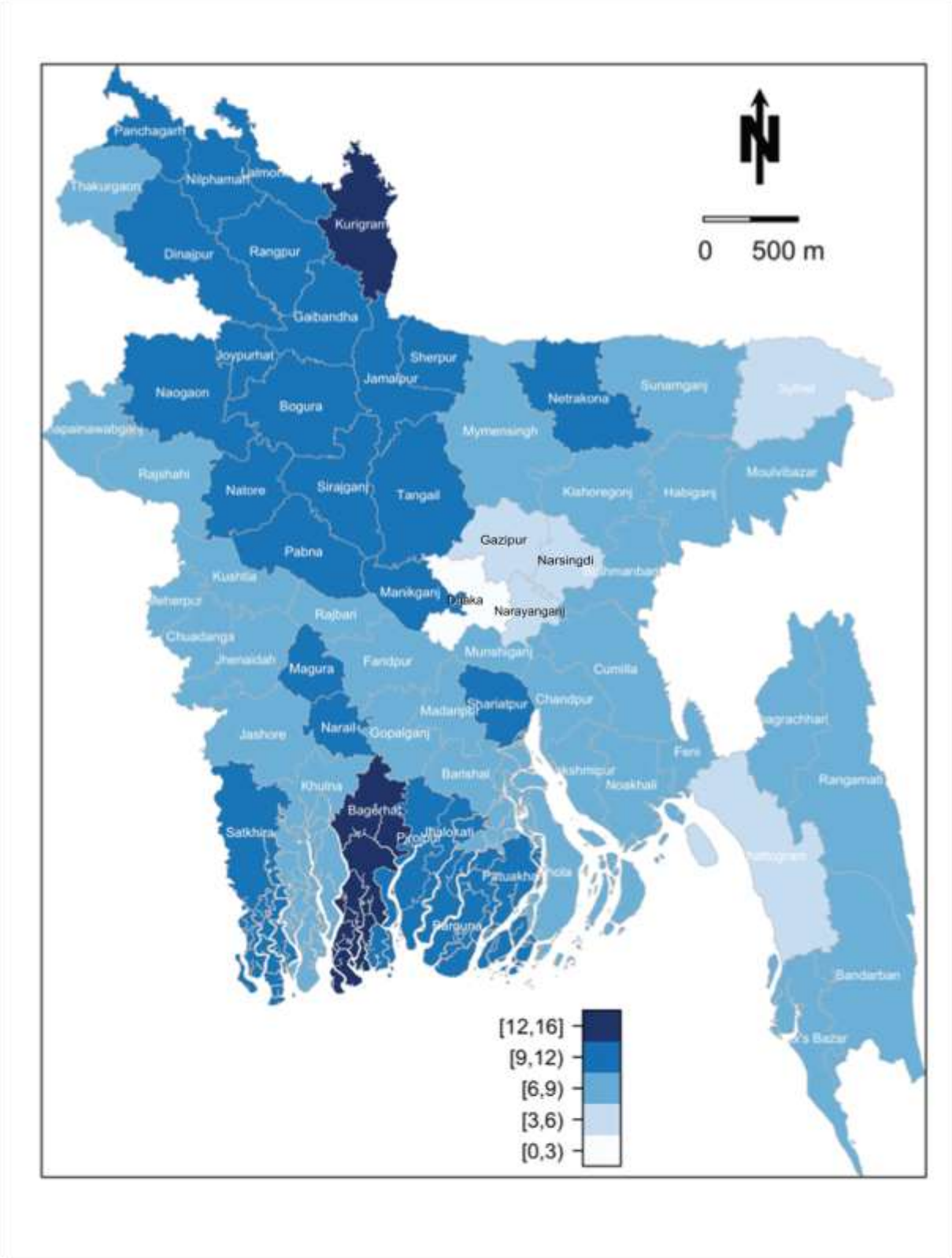


Healthcare Access among Persons with Disabilities (SAE)

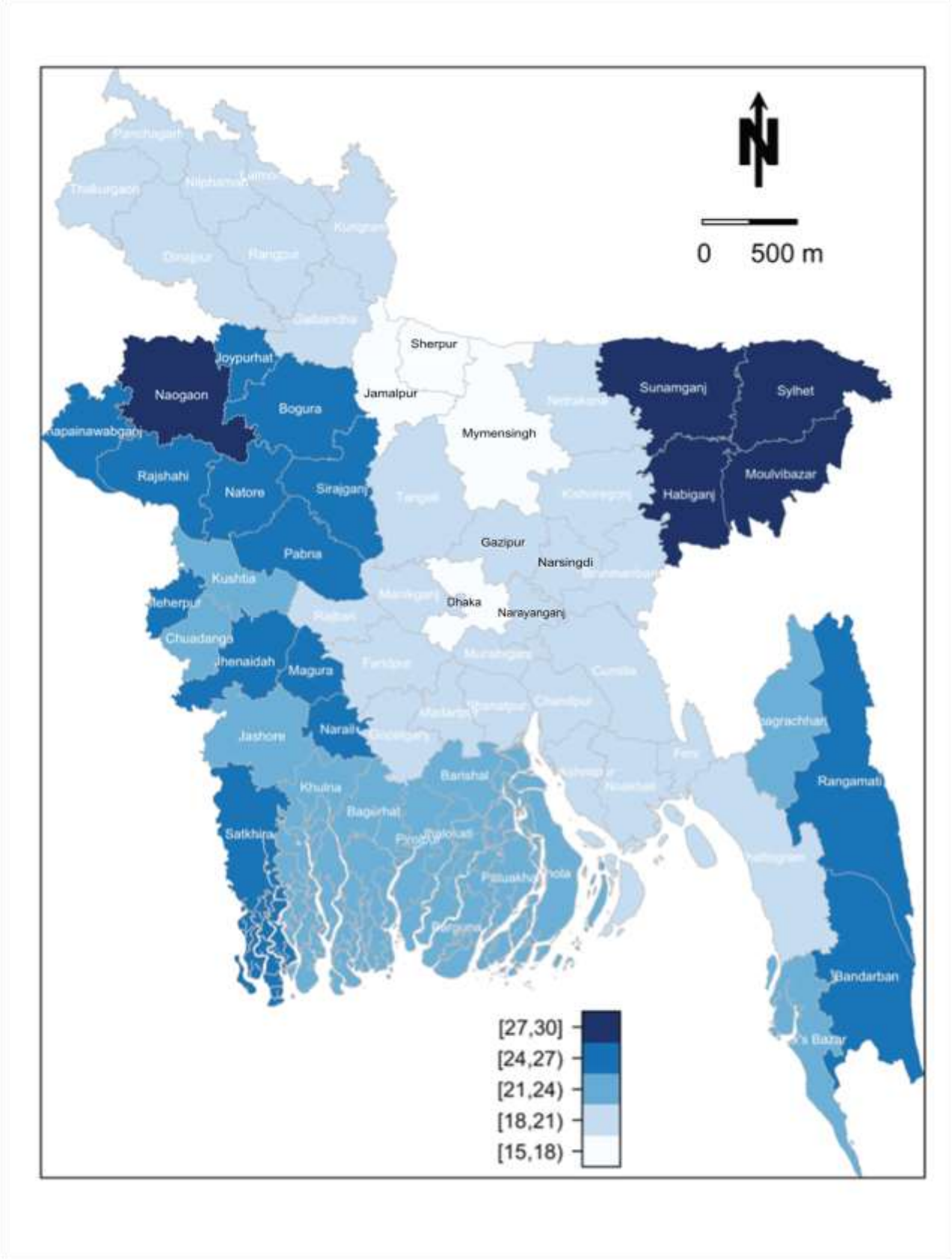


D2: Small-Area MAPs at District Level

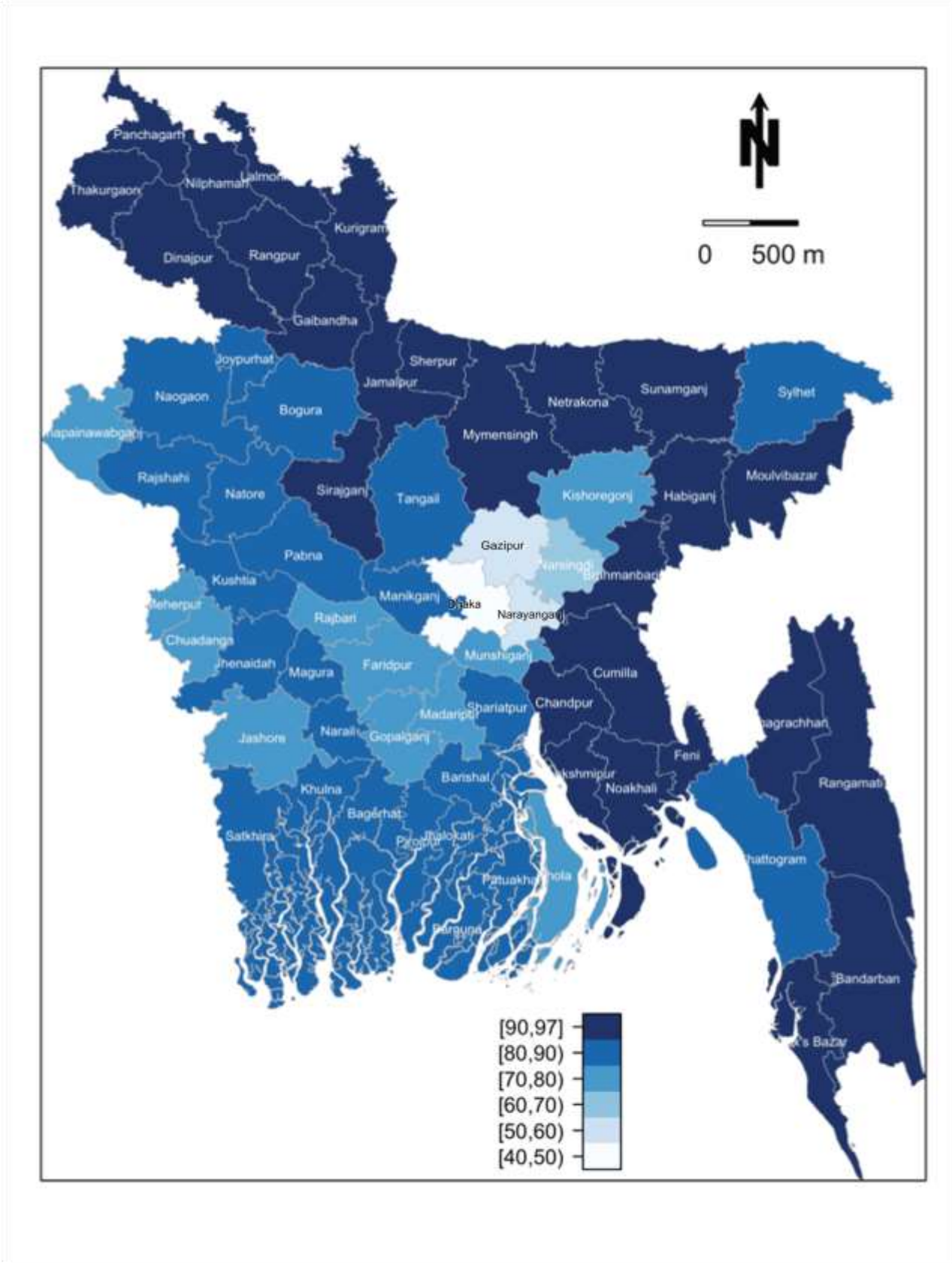
D2.1: Persons with Functional Difficulties (SAE)



D2.2: Having Registration of Persons with Disabilities (SAE)



D2.3: Healthcare Access among Persons with Disabilities (SAE)



E. Committees Involved

Programme Implementation Committee (PIC)

SL No.	Name, Designation and Organization (Not According to the Seniority)	Committee Designation
1.	Director General, Bangladesh Bureau of Statistics (BBS)	Chairperson
2.	Additional Secretary (Admin.), Statistics and informatics Division	Member
3.	Deputy Director General, Bangladesh Bureau of Statistics (BBS)	Member
4.	Line Director, Maternal, Neo natal, Child & Adolescent Health, DG Health	Member
5.	Director (Research), National Institute of Population Research and Training (NIPORT)	Member
6.	Director, FA & MIS, BBS	Member
7.	Deputy Secretary (SDG Cell), Statistics and Informatics Division	Member
8.	Deputy Secretary (Budget), Statistics and Informatics Division	Member
9.	Prof. Muhammad Shuaib, Institute of Statistical Research and Training, Dhaka University	Member
10.	Director, Institute of Statistical Research and Training, Dhaka University	Member
11.	Director, Institute of Nutrition and Food Science, Dhaka university	Member
12.	Chairman, Department of Population Science, Dhaka University	Member
13.	Statistics and Monitoring Specialist, UNICEF Bangladesh	Member
14.	Representative, Department of Women and Children Affairs	Member
15.	Representative, Department of Social Services	Member
16.	Representative, Department of Public Health Engineering	Member
17.	Representative, Directorate of Primary Education	Member
18.	Representative, Department of Labour	Member
19.	Chief, Population Planning and Research (PPR), UNFPA	Member
20.	Mr. Md. Sirajul Islam, Emeritus Scientist, ICDDR'B	Member
21.	Director, Demography and Health Wing, BBS and Focal Point Officer, Multiple Indicator Cluster Survey (MICS) 2018-19	Member - Secretary

Report Review Committee

SL No.	Name, Designation and Organization (Not According to the Seniority)	Committee Designation
1.	Dr. Md. Moinul Hoque Anshary Additional Secretary (Informatics), Statistics and Informatics Division	Chairperson
2.	Mr. Debdulal Bhattacharjee Joint Secretary (Budget, Financial Management & Audit and ICT) Statistics and Informatics Division	Member
3.	Mr. Md. Mir Hossain Joint Secretary (Informatics), Statistics and Informatics Division	Member
4.	Ms. Jasmin Akter Deputy Secretary (Development-2), Statistics and Informatics Division	Member
5.	Ms. Salma Pervin Deputy Secretary (Admin-4 Branch) Statistics and Informatics Division	Member
6.	Mr. Md. Azad Jahan Deputy Secretary (Informatics-1), Statistics and Informatics Division	Member
7.	Mr. Kalachand Sarker Deputy Secretary (Informatics-3), Statistics and Informatics Division	Member
8.	Mr. Md. Azgar Ali Deputy Director (RDP Section), FA & MIS Wing, BBS	Member
9.	Md. Alimul Azim Accounts Officer, Accounts Section, Statistics and Informatics Division	Member
10.	Ms. Munira Islam Deputy Secretary (Informatics-2), Statistics and Informatics Division	Member Secretary

Editor's Forum

SL No.	Name, Designation and Organization (Not According to the Seniority)	Committee Designation
1.	Mr. Mohammad Obaidul Islam, Deputy Director General, BBS	Convener
2.	Mr. Alauddin Al Azad, Director, Agriculture Wing, BBS	Member
3.	Mr. Md. Mashud Alam, Director, Demography and Health Wing, BBS	Member
4.	Mr. Kabir Uddin Ahmed, Director, Computer Wing, BBS	Member
5.	Mr. Md. Emdadul Haque, Director, Census Wing, BBS	Member
6.	Mr. Muhammad Atikul Kabir, Director, Industry and Labor Wing, BBS	Member
7.	Mr. Md. Abdur Rob Dhali, Director, BBS	Member
8.	Mr. H. M. Firoz, Director (In charge), FA & MIS Wing, BBS	Member
9.	Mr. Md. Rafiqul Islam, Director (In charge), National Accounting Wing, BBS	Member
10.	Mr. Md. Alamgir Hossen, Project Director, SVRS in Digital Platform Project, BBS	Member
11.	Mr. Mohiuddin Ahmed *MPH*, Project Director, HIES Project, BBS	Member
12.	Mr. Ziauddin Ahmed, Director, Statistical Staff Training Institute, BBS	Member Secretary

Working Committee

SL No.	Name, Designation and Organization (Not According to the Seniority)	Committee Designation
1.	Mr. Md. Mashud Alam, Director, Demography and Health Wing, BBS	Chairperson
2.	Mr. Kabir Uddin Ahmed, Director, Computer Wing, BBS	Member
3.	Mr. SK Shamsur Rahman, Deputy Secretary, Statistics and Informatics Division	Member
4.	Mr. Iftekhairul Karim, Deputy Director, Demography and Health Wing, BBS	Member
5.	Mr. Md. Alamgir Hossen, Deputy Director, Demography and Health Wing, BBS	Member
6.	Mr. Mahboob-E-Alam, Statistics and Monitoring Specialist, UNICEF Bangladesh	Member
7.	Ms. Asma Akhter, Deputy Director, Demography and Health Wing, BBS	Member
8.	Mr. Rashed-E- Mastahub, Deputy Director, Census Wing, BBS	Member
9.	Ms. Nayma Rahman, Deputy Director, Demography and Health Wing, BBS	Member
10.	Mr. Md. Mahabub Alam, Statistical Officer, Demography and Health Wing, BBS	Member
11.	Mr. Md. Sadequr Rahman, Statistical Officer, Demography and Health Wing, BBS	Member
12.	Mr. S. M Amimul Ehasan, Statistical Officer, Demography and Health Wing, BBS	Member
13.	Mr. Shakil Ahmed, Research Officer, UNICEF Bangladesh	Member
14.	Ms. Reshma Jesmin, Deputy Director, Demography and Health Wing, BBS	Member - Secretary

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