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Inequalities in Human Well-Being in the Urban Ganges Brahmaputra Meghna Delta

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Abstract: The recently endorsed Sustainable Development Goals (SDGs) agenda unanimously agrees on the need to focus on inclusive development, the importance of eradicating extreme poverty and managing often complex human well-being impacts of rapid urban growth. Sustainable and inclusive urbanisation will accelerate progress towards the SDGs and contribute to eradicating extreme poverty. In tropical delta regions, such as the Ganges Brahmaputra Meghna delta region, urban growth and resulting intra-urban inequalities are accelerated by the impact of environmental and climate change. In this context, the present study uses the 2010 Household Income and Expenditure Survey to analyse the extent of wealth-based inequalities in human well-being in the urban delta region and the determinants of selected welfare measures. The results suggest that the extent of intra-urban inequalities is greatest in educational attainment and access to postnatal healthcare and relatively low in the occurrence of gastric disease. The paper concludes by providing policy recommendations to reduce increasing wealth inequalities in urban areas, thus contributing to sustainable development of the region.

Keywords: inequalities; human well-being; urbanisation; sustainable development; Bangladesh; Ganges Brahmaputra Meghna delta

1. Introduction

According to the latest UN figures, approximately 54% of the world's population live in areas classified as urban [1]. According to an emerging literature on urban concentration and economic growth, different world regions experience various challenges often related to rapid rates of urban growth or urban lifestyle. However, study conclusions often differ on the effects [2]. While populations in more developed regions are approximately 78% urban, in less developed regions, the equivalent proportion is 49%. In the Least Developed Countries (LDCs), 31% of the population live in urban areas, which is projected to increase to 50% by 2050 [1]. In densely populated cities, the negative impacts of rapid urban growth include high rates of pollution, translating into ill-health, overcrowding and housing deprivation [3,4].

While still predominantly rural, in the last 60 years, Bangladesh has experienced rapid urban growth, which has had a number of important consequences in terms of the country's human development. According to UN data [1], in 1950, only 4.3% of the population were urban, compared to over 28% in 2011. During this period, the urban population grew rapidly, increasing 26-fold and exceeding 42 million by 2011. At the same time, the rural population, while still considerably larger, only increased threefold, reaching almost 108 billion in 2011. The annual rate of urban growth was

particularly high between 1960 and 1980, when it exceeded 6%, slowly stabilising in recent years with an average urban growth rate of around 2.8% between 2005 and 2010.

In Bangladesh, rural to urban migration has been the main contributor to urban growth, accounting for around 70% of urban growth in the city of Dhaka [5]. Bangladesh is one of the most vulnerable countries in the world in terms of the impacts of climate change [6]. Among the top 39 cities exposed to natural hazards, Bangladesh's Dhaka is listed as the seventh most vulnerable city, while Chittagong in south-eastern Bangladesh is in 37th place [7]. The risk of floods, cyclones and other natural disasters from various factors, including sea level rise, is particularly high in the Ganges Brahmaputra Meghna (GBM) delta region, where environmental hazards along with poverty and lack of employment opportunities constitute push factors for migration [8,9]. While rural poverty is still predominant in the region, similar to the trends in other developing countries, urban poverty and intra-urban inequalities have been on the rise [10–14]. Rapid growth of cities and peri-urban areas has resulted in increased slum dwellings and greater complexity of urban areas [15]. Despite considerable progress in health indicators [16,17], large intra-urban disparities continue to exist, based on income, assets, social status and access to resources.

Given the evidence regarding the negative impacts of poorly managed or unplanned urban growth, ensuring inclusive urbanisation is crucial in order to advance sustainable development of communities and countries. Acknowledging the key role of urbanisation for human development, Sustainable Development Goal (SDG) 11 aims to "make cities and human settlements inclusive, safe, resilient and sustainable" [18]. In light of the growing recognition of urbanisation as part of broader development processes [19–23] and, consequently, human well-being, it is crucial to investigate the extent of existing intra-urban inequalities in rapidly urbanising economically and environmentally vulnerable countries and regions.

In this context, the main purpose of this study is to empirically assess the degree of wealth-based inequalities in human well-being in urban areas and assess the impact of wealth and other socio-demographic characteristics on the human well-being of households and individuals in the GBM delta in Bangladesh. Understanding these inequalities is crucial because the presupposed human well-being gap between rich and poor in urban areas can hamper the progress of development [24]. In the analysis, we focus on three specific aspects of well-being, i.e., health, education and overall consumption and use data from the most recent Bangladesh Population and Household Census as well as the 2010 Household Income and Expenditure Survey (HIES). These data are analysed applying standard inequality measures, such as Atkinson index, concentration index and concentration curves as well as logistic regression modelling. The next section describes and discusses the data and methods used. In Section 4, we discuss the results of the analysis examining the extent of intra-urban inequalities in selected well-being indicators. The final part of the paper contains conclusions and policy recommendations in the context of the current debates pertaining to the SDGs.

2. Data and Methods

2.1. The Study Area

Our study area, the GBM delta, Bangladesh, is represented by 45 districts in the whole division areas of Khulna, Barisal, Dhaka and Sylhet and most of the Chittagong division in Bangladesh (Figure 1). In such poor deltaic regions, environmental and social vulnerabilities tend to be highly intertwined. These vulnerabilities can constitute both causes and consequences of rapid urbanisation, and have an impact on human well-being at the micro level. Coastal cities are likely to be affected by flooding, cyclones and other environmental consequences of climate change. Without a support net and explicit inclusion in relevant policy provisions, the poorest urban households are at a double risk of aggravating their already dire living conditions. Research found that amongst 11 Asian cities, Dhaka was most vulnerable to the impact of climate change [10]. A study amongst low income urban residents in Khulna confirmed that geographic location, as well as specific socio-economic contexts

and environmental threats, shape the way households perceive the most important challenges to their livelihoods [25].

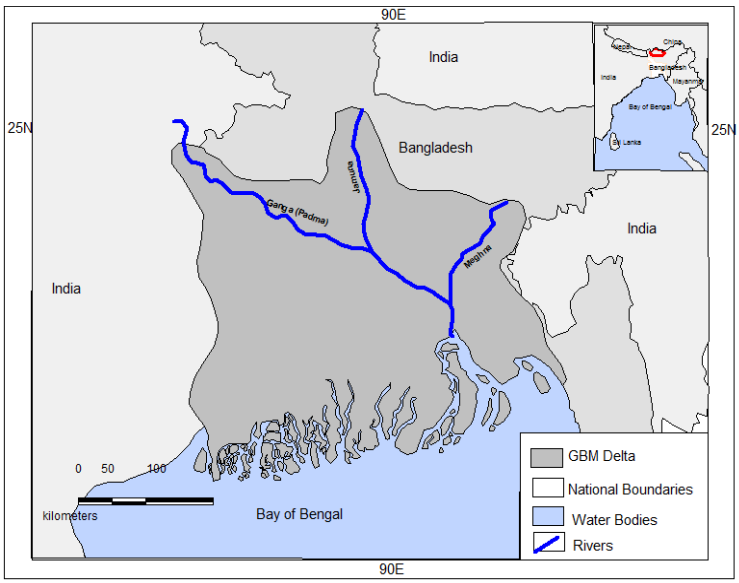


Figure 1. The study area.

2.2. The Dataset

In order to investigate the extent of inequalities in the study area, we use micro level data from the 2010 Household Income and Expenditure Survey (HIES). HIES is a nationally representative household survey conducted periodically by the Bangladeshi Bureau of Statistics (BBS). The sample size for the study area comprises 3300 urban households. Key variables of interest are household level and individual level indicators of human well-being, including utilisation of reproductive healthcare by household members, educational attainment and overall consumption. We classify household wealth based on wealth quintiles constructed using Principal Components Analysis (PCA). PCA is a commonly applied data reduction technique applied to generate asset indices, which are considered to approximate household wealth [26,27]. The specific assets included in the index are: household wall material; access to key services such as sanitation, water, electricity and internet; having a separate dining room; and ownership of selected assets (motor, fridge, TV, fan and computer). The list of variables included in the PCA, together with their descriptive statistics, are provided in the Supplementary Material. The first component (33% of variance explained) is used to predict the values of the index.

With regard to the outcome variables, we selected indicators that measure key aspects of human well-being, i.e., consumption, health and education. This selection has been motivated by the World Bank's measurement of human well-being, which underlines the understanding of "well-being" as a multidimensional concept [28]. These three aspects are also the key components of the human development index (albeit the fact that, given the availability of data and level of analysis, the specific indicators used differ) [29]. The indicators used in the present study have been selected based on the two main criteria. The first criterion was the existing evidence based on these indicators, while the second criterion was data availability. More specifically, with regard to health, we focus on indicators of access to health (antenatal and postnatal care) and health outcomes (gastric diseases).

In addition, we measure inequalities in health outcomes by using the indicator of the most commonly reported disease, i.e., gastric diseases (including ulcers). According to the Bangladesh Bureau of Statistics [30], amongst the respondents who suffered from chronic and long term diseases, approximately 24% had gastric problems with little difference between genders and places of residence. Household consumption and individual educational attainment are treated as continuous variables,

while individual access to reproductive healthcare services, health and health outcomes variables are binary. Following the definition by the UNDP (2011) [31], we consider the educational attainment of adults who are 25 or older. Total household consumption comprises food and non-food expenditure as classified by the BBS. Expenditures are standardised into monthly time periods and reported in Bangladeshi taka.

2.3. Methods

The statistical analysis is divided into three main parts. First, we report descriptive statistics for outcome variables and key explanatory variables used in the analysis. We then investigate wealth-based inequalities by means of descriptive statistics and standard inequality measures, such as concentration indices (CIs), concentration curves, Atkinson index and unadjusted regression coefficients. The concentration curve illustrates the extent of inequalities by plotting the shares of the well-being variable against the quintile of the wealth variable [32]. It is then compared against the 45 degree line, which represents perfect equality. The concentration index is defined as "twice the area between the concentration curve and the line of equality" [32] (p. 95). The values of the concentration index range from −1 to 1, with 0 indicating perfect equality. The negative values for the concertation index arise from a convention. In the case where the response variable represents a negative outcome, e.g., undernutrition, the negative value of the concentration index indicates that poorer groups are at a disadvantage [32]. Mathematically, the concentration index can be specified as follows:

$$C = 1 - \frac{2}{n\mu} \sum_{i=1}^{n} h_i(R_i - 1) \quad (1)$$

where n is the sample size, μ is the mean level of the health (or other well-being) variable, h_i is the well-being indicator for person i and R is the rank of the socio-economic status [32].

Conversely to the concentration index, the Atkinson index accounts for the variation in sensitivity to inequalities across the income distribution [33]. The values of the index range from 0 to 1, with 0 indicating perfect equality. As pointed out by de Maio (2007, p. 850) [33]), the interpretation of the index can allow estimation of the percentage of the income needed in order to achieve "an equal level of social welfare as at present if incomes were perfectly distributed".

Finally, we apply multiple linear and logistic regression modelling using both adjusted and unadjusted models (the latter control for selected explanatory variables). In the logistic regression (with binary outcome variables), the regression coefficients are usually estimated using maximum likelihood estimation. In the multiple linear regression (when outcome variables are continuous) we use the Ordinary Least Squares (OLS) approach. We acknowledge the limitation of potential endogeneity and the fact that the results refer to associations only and may not necessarily imply causal effects. Socio-economic controls, such as age and sex, are incorporated in the models in order to examine whether the magnitude and significance of regression coefficients change when household and individual level characteristics are taken into account. Model selection is conducted using standard post estimation criteria, including R^2 and F-test for linear models, and Bayesian Information Criterion (BIC) and Akaike Information Criterion (AIC) for logistic models. Multicollinearity was tested using the variance inflation factor (VIF) test, with 10 as a threshold value.

The following equation was estimated for linear regression models:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \ldots + \varepsilon_i;\ i = 1, 2, \ldots, n \quad (2)$$

where Yi denotes the value of the continuous dependent variable (i.e., household consumption or educational attainment of adults), and X_{1i}, X_{2i}, X_{3i}, ... denote explanatory variables, such as household size, household wealth and age and gender of household head. β_0 is the intercept; β_1, β_2, β_3 are the adjacent coefficients that show the magnitude and direction of relationship with Y_i; and ε_i; indicates the error term.

In addition, we estimated logistic regression models as follows:

$$\text{logit}(Y_i) = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \cdots + \varepsilon_i; i = 1, 2, \ldots, n \quad (3)$$

where Yi denotes the presence or absence of antenatal or postnatal care or sanitation with values 0 or 1 (0 = absence, 1 = presence), β_0 is a constant, X_{1i} indicates household wealth and β_1 is the coefficient that shows the magnitude and direction of relationship with Y_i. X_{2i}, X_{3i}, X_{4i} ... denote the control variables (household level socio-economic characteristics and the characteristics of the household's head). β_2, β_3, β_4 ... denote adjacent coefficients to the corresponding variables, and ε_i means error term.

The next section reports the results of the analysis, while the discussion of the results is provided in the final section.

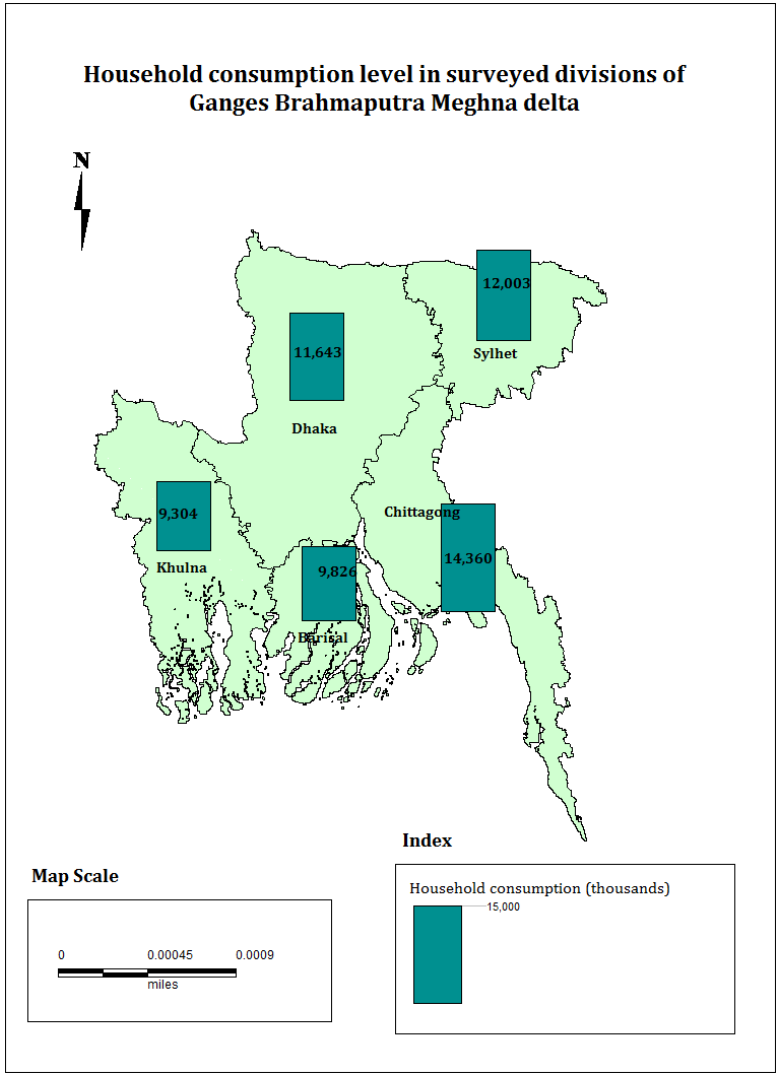
3. Results

3.1. Descriptive Statistics

Table 1 provides summary descriptive statistics for key variables used in the household level analysis (outcome variable: HH consumption). With regard to outcome variables, as can be noted, the mean monthly household consumption in the study area was approximately BD taka 16,102 (approximately USD 207), with the minimum value of BD taka 702 (USD 9) and maximum value of BD taka 215,048 (USD 2768). The mean educational attainment of adults aged 25 years or older was 5.7. 56.3% of interviewed women in the urban GBM delta reported access to antenatal care, while only 21.4% reported access to postnatal care. In fact, 3.5% of all respondents said that they had suffered from a gastric disease in the last 12 months. Average values for all dependent variables are presented in Figure 2, which shows the spatial variability of wealth, education, occurrence of gastric disease and maternal care, by region. Concerning explanatory variables used in the analysis of household consumption, the mean age of household head was 44 years and 11.6% of household heads were females. Approximately 8.6% of all households reported that they received remittances. The majority of interviewed households were located in Dhaka division (60.7%), followed by 18.7% of households in Chittagong and 12.4% in Khulna.

Table 1. Descriptive statistics of outcome variables and key explanatory variables used in the HH level analysis (outcome variable: HH consumption).

Variable	Mean	Minimum	Maximum	*n*
Outcome variables				
HH consumption	16,102	702	215,048	3300
Educational attainment	5.7	0	19	7235
Access to antenatal care	56.3	-	-	3986
Access to postnatal care	21.4	-	-	3986
Gastric diseases	3.5	-	-	14,880
HH Level Explanatory Variables (Outcome Variable: Consumption)	**Mean**	**Minimum**	**Maximum**	***n***
HH characteristics				
Education of HH head	5.9	0	19	3300
Age of HH head	44.1	11	100	3300
HH head is female	11.6	-	-	383
HH size	4.4	1	17	3300
HH received remittances	8.6	-	-	284
Region				
Barisal	4.59	-	-	151
Chittagong	18.66	-	-	616
Khulna	12.43			410
Sylhet	3.66	-	-	121
Dhaka	60.66	-	-	2002



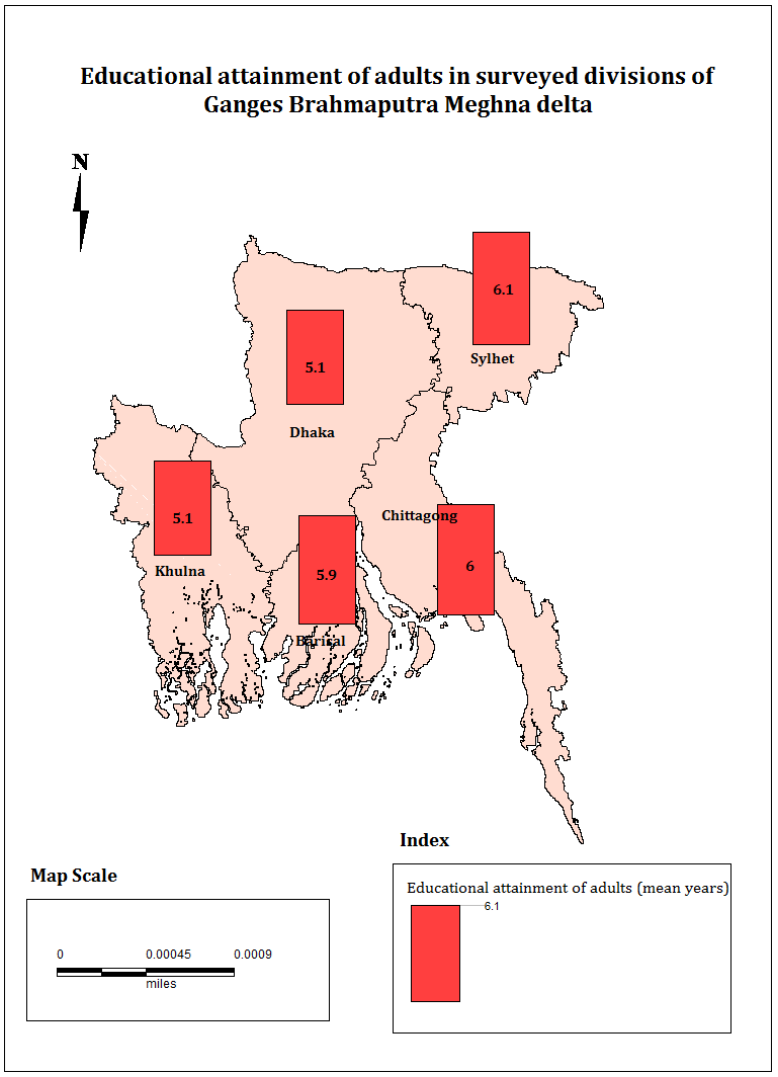


Figure 2. *Cont.*

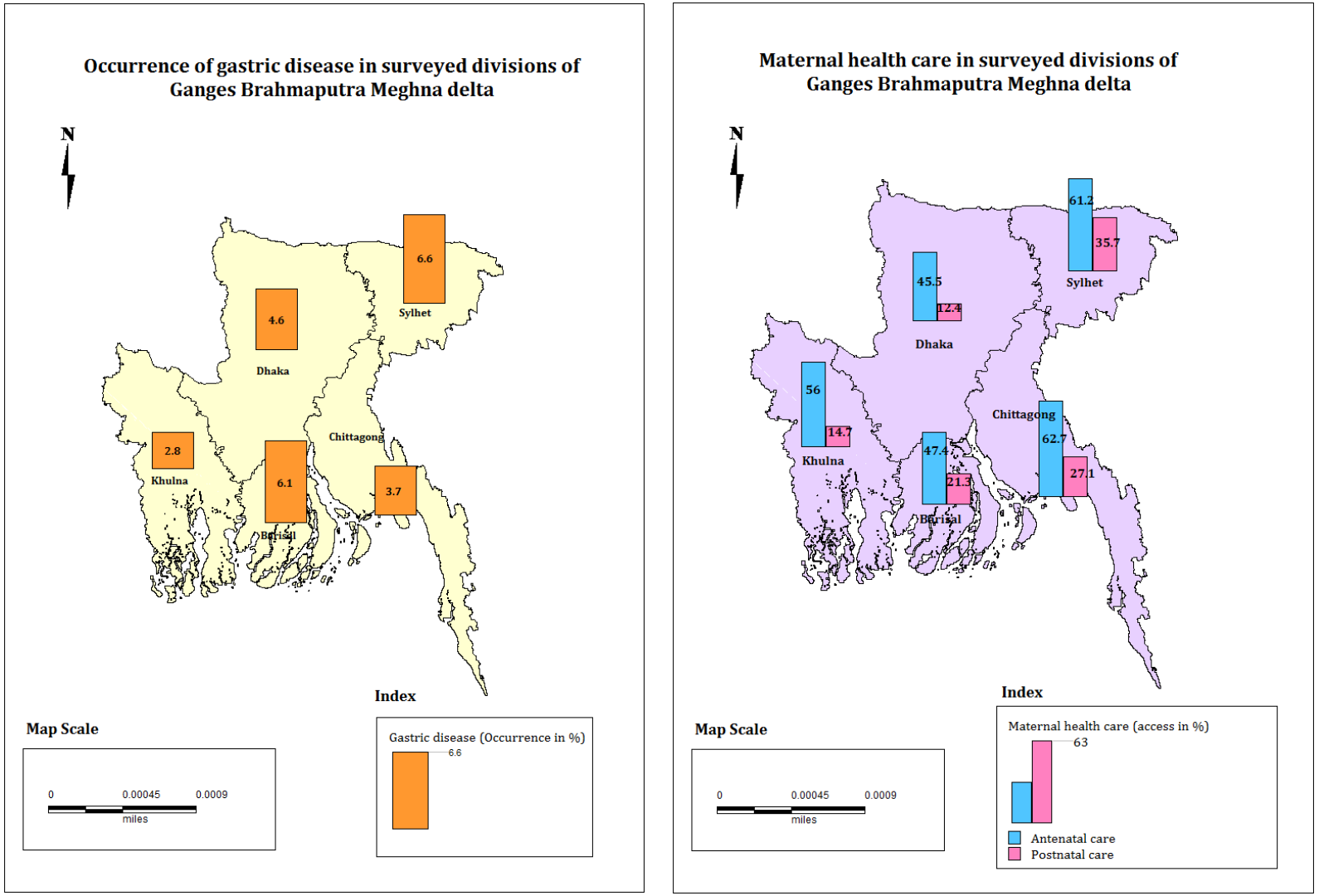


Figure 2. Spatial differentials in household well-being in the urban Ganges Brahmaputra Meghna delta.

3.2. Inequality Measures

Table 2 provides a summary of intra-urban inequalities in human well-being by means of descriptive statistics disaggregated by wealth. As can be observed, for all well-being variables there is a decline in human well-being based on household wealth. For example, educational attainment varies from 1.5 years for those in the poorest wealth quintile to 9.2 for individuals in the richest wealth quintile. Similarly, stark differences exist in access to reproductive healthcare. While on average access to antenatal care is 56%, amongst the poorest households only 40% of women are able to benefit from this care. The pattern is less pronounced when looking at gastric diseases; however, even in this case, the proportion of poorest individuals suffering from gastric diseases is higher than the aggregate average.

Table 2. Inequalities in human well-being continue to be stark in the urban Ganges Brahmaputra Delta.

Dimension of Poverty	Q1	Q2	Q3	Q4	Q5	Total	*n*
HH consumption (mean)	7576	9548	11,252	14,270	28,340	16,102	3300
Educational attainment of adults (mean)	1.5	3.0	3.9	5.9	9.2	5.7	7235
Antenatal care (% with access)	40.4	47.5	52.7	57.4	67.6	56.3	3986
Postnatal care (% with access)	9.6	9.3	11.1	21.2	38.9	21.4	3986
Gastric diseases/ulcer (% suffering from)	5.1	3.7	4.4	2.7	3.0	3.5	14,880

Note: Wealth-based inequalities, Q1—quartile 1; Q2—quartile 2; Q3—quartile 3; Q4—quartile 4; Q5—quartile 5.

Figure 3 and Table 3 complement the analysis. Figure 3 illustrate intra-urban inequalities by displaying concentration curves for selected well-being indicators. As highlighted previously, the distance from the 45 degree line indicates the extent of existing inequalities. For the variables with negative values (such as food insecurity and gastric ulcer), the inequality line would lie above the reference line, while for the variables with positive outcomes (e.g., access to antenatal care) the inequality line will lie below the 45 degree reference line.

Table 3. Selected inequality measures in household well-being in Bangladesh.

Dimension of Poverty	Indicator	CC	AI	Unadjusted β	Adjusted β
Overall consumption	Food and non-food expenditure	0.242	0.117	1.28 [1]	0.90 [1]
Education	Educational attainment of adults	0.256	0.373	7.66	7.93
		CC	**AI**	**Unadjusted OR**	**Adjusted OR**
Health	Antenatal care (% with access)	0.090	0.437	3.08	2.56
	Postnatal care (% with access)	0.273	0.786	6.00	2.70
	Gastric disease/ulcer	−0.102	0.965	0.58	0.39

[1] β coefficient for logged outcome variable; Note: Wealth-based inequalities; CC—concentration index; AI—Atkinson index.

We observe that access to postnatal care exhibits the greatest intra-urban inequalities. On the other hand, relatively small inequalities can be seen when it comes to antenatal care and health and health outcomes related to gastric ulcers. The increased equity of suffering from gastric ulcer across the wealth quintiles compared to our other indicators can be partially explained by the fact that person to person contact is thought to be the most common route of transmission of helicobacter pylori [34]. Given overall poor sanitary conditions and overcrowding in the cities, there is little difference among individuals on this indicator according to wealth.

Finally, the inequality measures summarised in Table 4 confirm stark inequalities in all human well-being indicators. Concentration indices suggest that the greatest inequalities exist in educational attainment and postnatal care. Complementarily, unadjusted and adjusted regression coefficients show that inequalities are greatest in educational attainment and access to reproductive healthcare. Concerning overall consumption, for the richest households, consumption is almost 3.6 times higher than for the poorest households (2.5 times higher when controlling for additional socio-economic characteristics). The full regression models are discussed in the next section.

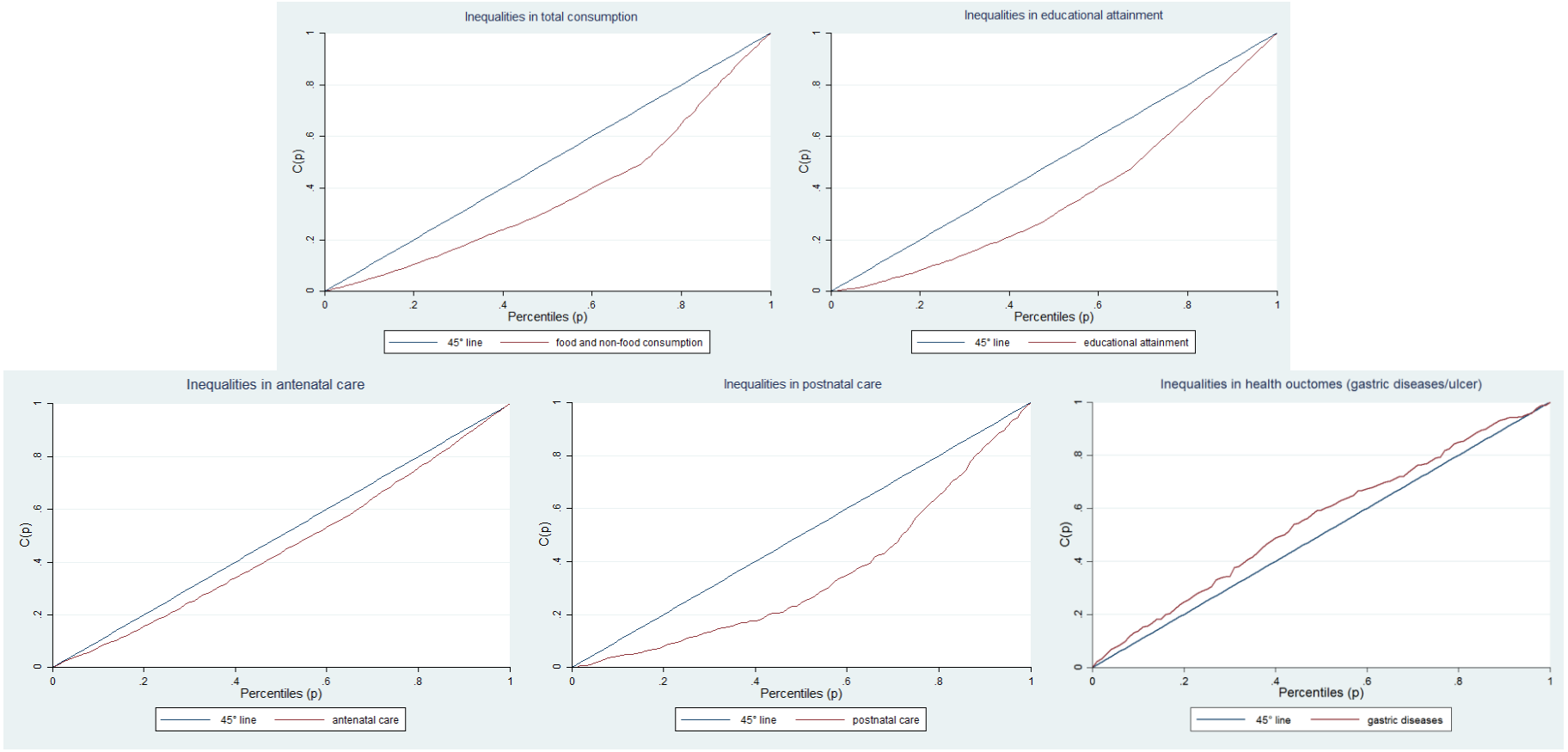


Figure 3. Inequalities in household well-being in the urban Ganges Brahmaputra Meghna delta.

Table 4. Determinants of education and health: Results of five logistic regression models.

Variable	Model 1 Consumption	Model 2 Education	Model 3 Antenatal care	Model 4 Postnatal care	Model 5 Gastric diseases
	log β (SE)	β (SE)	OR (CI)	OR (CI)	OR (CI)
Wealth					
Poorer	0.19 (0.03) ***	1.48 (0.33) ***	1.23 (0.86; 1.76)	0.75 (0.45; 1.24)	0.68 (0.46; 0.99) **
Medium	0.35 (0.03) ***	2.43 (0.28) ***	1.61 (1.13; 2.30) ***	0.83 (0.50; 1.37)	0.83 (0.57; 1.20)
Richer	0.47 (0.04) ***	4.41 (0.32) ***	1.65 (1.12; 2.42) **	1.49 (0.92; 2.41)	0.47 (0.30; 0.72) ***
Richest	0.90 (0.05) ***	7.93 (0.30) ***	2.56 (1.72; 3.82) ***	2.70 (1.63; 4.46) ***	0.39 (0.26; 0.60) ***
Baseline: poorest	0.00	0.00	1.00	1.00	1.00
Other HH characteristics					
Education [1]	0.03 (0.00) ***	-	1.12 (1.09; 1.15) ***	1.20 (1.15; 1.25) ***	1.04 (1.01; 1.06) ***
Age [1]	0.005 (0.00) ***	−0.08 (0.01) ***	0.92 (0.91; 0.93) ***	0.96 (0.95; 0.97) ***	1.05 (1.04; 1.05) ***
Gender [1]	−0.03 (0.03)	−1.66 (0.10) ***	-	-	1.39 (1.10; 1.76) ***
Baseline: male	0.00	0.00	-	-	1.00
HH size	0.13 (0.01) ***	−0.13 (0.10) **	0.95 (0.90; 1.01)	0.94 (0.89; 0.99) **	1.04 (0.98; 1.09)
HH received remittances	0.15 (0.04) ***	-	0.96 (0.66; 1.41)	1.00 (0.68; 1.49)	1.30 (0.89; 1.89)
Baseline: HH did not receive remittances	0.00	-	1.00	1.00	1.00
Region					
Barisal	−0.13 (0.07) *	1.92 (0.46) ***	0.91 (0.68; 2.24)	1.84 (1.29; 2.63) ***	1.75 (1.28; 2.40) ***
Chittagong	0.18 (0.05) ***	1.08 (0.45) **	3.27 (2.48; 4.32) ***	4.26 (3.17; 5.73) ***	1.62 (1.20; 2.19) ***
Khulna	−0.13 (0.04) ***	0.68 (0.30) **	1.44 (1.14; 1.83) ***	1.14 (0.83; 1.57)	0.66 (0.48; 0.92) **
Sylhet	−0.03 (0.04)	0.52 (0.44)	2.27 (1.55; 3.31) ***	4.49 (3.04; 6.64) ***	2.28 (1.63; 3.18) ***
Baseline: Dhaka	0.00	0.00	1.00	1.00	1.00
Constant	7.99 (0.05) ***	5.93 (0.48) ***	10.63 (6.21; 18.21) ***	0.19 (0.10; 0.34) ***	0.01 (0.00; 0.01) ***
Wald chi [2]	-	-	468.7	430.1	626.3
p-value	-	-	0.000	0.000	0.000
AIC	-	-	2242.2	1730.8	598.1
R^2	0.645	0.400	-	-	-
F-test	143.9	178.8	-	-	-
p-value	0.000	0.000	-	-	-
Number of observations	3286	7211	3969	3969	14,824

Note: [1] indicates that when a variable is at the household level (Model 1) coefficients are reported for household head. CI—confidence interval, OR—odds ratio. Significance levels *, **, *** are 90%, 95%, and 99%, respectively.

3.3. Results of Multivariate Analysis

The regression results are reported in Table 4. Model 1 shows the effect of household wealth on overall consumption level when accounting for household level characteristics and place of residence. The wealth effect remains strong and highly significant ($p < 0.01$). Education and age of household head are all significant, with a 1% significance level. For example, a 10-year increase in educational attainment of the household head is associated with a 3% increase in overall consumption expenditure. Similarly, receiving remittances is associated with an increase in consumption of around 15%. Household size is also positively associated with overall household consumption level, which might be explained by the fact that in larger households more household members are contributing income. In terms of regional differences, households residing in Chittagong are likely to have the highest levels of consumption expenditure, while residing in the costal divisions of Barisal and Khulna is associated with the lowest levels of household consumption.

Model 2 summarises the determinants of education at individual level. As can be noted, there are stark wealth-based inequalities when it comes to the educational outcomes of adult household members. The expected educational attainment for individuals from the wealthiest households is 7.9 times higher than for individuals from the poorest households ($p < 0.01$). Household size is negatively associated with educational attainment, which is likely to be related to the fact that poorer and less educated couples tend to have larger families [32]. Furthermore, the results show that gender is an important predictor of educational attainment; being female is negatively associated with educational attainment. These results are in line with existing research and suggest a need for continuous scaling up of investment in girls and women, despite considerable progress made in this area in Bangladesh [15,35]. Finally, place of residence measured by region is also a significant predictor of education. In particular, compared to Dhaka and controlling for other factors in the model, residing in Khulna is negatively associated with educational attainment. On the other hand, ceteris paribus, those individuals who reside in Barisal or Chittagong are most likely to benefit from higher levels of education.

Results examining the determinants of healthcare utilisation and health outcomes are presented in Models 3–5. Models 3 and 4 report the results for the determinants of reproductive healthcare utilisation, while Model 5 focuses on gastric diseases as the outcome variable. It can be noted that in all three models, household wealth plays an important role, as do education and age of household head. More specifically, the odds of having access to antenatal care for women in the wealthiest households are 2.56 times the odds for females from the poorest households. Women from the richest households are also significantly more likely to benefit from postnatal checkups (OR = 2.70, CI = 1.63; 4.46). Being an older woman is negatively associated with both postnatal and antenatal care, which might indicate that younger women have a greater awareness of the need for reproductive healthcare and may have greater physical and financial access to healthcare facilities. Ceteris paribus, household size is negatively associated with postnatal care (OR = 0.94, $p < 0.05$), but is not significant for antenatal care.

In terms of healthcare outcomes, the odds of having a gastric disease for individuals from the wealthiest households are approximately 0.39 times the odds of individuals from the poorest households (or 61% lower). Gender is a significant predictor of gastric diseases. Controlling for other factors included in Model 5, the odds of females having a gastric disease are 1.39 times the odds for males. Moreover, age and education are positively associated with the outcome. This is an interesting finding and could be explained by the fact that older individuals are less educated about the benefits of good hygiene. Finally, controlling for other variables, residing in Barisal, Chittagong and Sylhet (compared to Dhaka) is positively associated with the likelihood of having a gastric disease.

4. Conclusions

In contrast to the MDGs, the new SDG agenda recognises that sustainable development is conditional on inclusive and well-managed urban growth. Urbanisation has the ability to transform societies, and cities are the primary engine of economic growth and human development. Sustainable

urban development will thus accelerate progress towards the achievement of the SDGs and contribute to the end of extreme poverty. Like other developing countries, Bangladesh is becoming increasingly urban. In Bangladesh, rapid urban growth is often accompanied by economic and environmental vulnerability, in particular in the delta region. In this context, the aim of this study was to investigate the extent of wealth-based intra-urban inequalities in the Bangladeshi Ganges Brahmaputra delta. The findings of our study show that stark inequalities exist in all aspects of human well-being, as measured by selected well-being indicators.

More specifically, the widest inequalities are found in educational attainment and access to postnatal healthcare, which is likely to be related to limited access to these services for the poorest urban dwellers. Ceteris paribus, for women from the richest households, the odds of benefiting from postnatal care are 2.7 times the odds for women from the poorest households. Women from the richest households are also significantly more likely to benefit from antenatal care. Inequalities are less pronounced when looking at gastric diseases. However, even in this case, the proportion of the poorest individuals suffering from a gastric disease is higher than the aggregate average. In terms of regional differences, the results of this study show that households residing in Chittagong are most likely to have the highest levels of consumption expenditure, while households residing in the coastal divisions of Barisal and Khulna are associated with the lowest levels of consumption. Likewise, regional inequalities exist in educational attainment and access to reproductive healthcare facilities.

Disparities were also found in educational attainment, as the urban poor mostly spend their earnings to fulfil the most basic needs such as food and shelter [36]. Hossain (2005) [36] showed that more than 60% of the poor had no formal schooling and, at the time of the study, in 50% of households at least one school-age child was not attending school. A negative association between being female and having low educational outcomes was also found in previous studies. This may be attributed to the social context of Bangladesh, which is often characterised by female seclusion and subordination as well as limited exposure to new information [37], despite recent progress in gender equity [15]. Inadequate housing and use of polluted water in informal urban settlements and slum areas are a frequent cause of infectious diseases [38,39]. Thus, relatively low inequalities in gastric diseases can be attributed to the overall poor sanitary conditions and overcrowding in cities [31].

While the present study makes an important contribution to the existing body of literature, it has some limitations. First, as highlighted previously, we acknowledge a possibility of endogeneity bias owing to potential reverse causality between independent and dependent variables. As highlighted by previous studies [40], the relationships between education, wealth and consumption are complex and often bi-directional. Second, related to the first point, the results of this study relate to the strength and direction of association and do not necessarily imply causal effects. Further analysis is required to determine the latter.

Given the stark intra-urban inequalities in human well-being, it is crucial that global and national human development agendas and plans account for the existing and anticipated consequences of urban growth. Therefore, when investments in different sectors are made, investors should keep in mind the concept of "sustainable cities". A sustainable city can be defined as an organised system that enables all its citizens' needs to be met without damaging the natural world or endangering the living conditions of other people, now or in the future [41]. Thus, a sustainable city is a place where people live with sufficient income and free of anxiety. In this context, the SDG11 on sustainable cities and communities is an important step, both politically and from a policy and operational perspective. In addition to the SDG on urbanisation, inclusion of an overarching goal on inequalities constitutes a positive development in the recently endorsed SDG agenda. Given the results of the present study, it would be recommended that in addition to the current SDG indicators [42], additional indicators include variables allowing the monitoring of progress in reducing intra-urban inequalities in human well-being. In order to ensure progress in sustainable development targets and specific indicators pertaining to urbanisation, it is crucial to establish effective monitoring and evaluation mechanisms within a wider accountability framework.

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