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# Model of social sustainability for Dhaka city, Bangladesh

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The expansion and development of urban areas require a strategic priority of social sustainability to protect their inhabitants' quality of life and well-being. However, social sustainability in urban areas, particularly in developing regions, becomes more apparent due to the social problems caused by rapid urbanization. The main objective of this study is to propose a model of social sustainability for socially sustainable cities in developing regions. To accomplish this objective, a quantitative research strategy was used to gather responses from residents of Dhaka city via a structured questionnaire survey; Dhaka served as a representative city from a developing region. This study used a multistage sampling technique to select 564 residents of Dhaka city. The results showed that social sustainability significantly influenced socially sustainable urban development in Dhaka, determining 38 indicators under 11 social sustainability themes using exploratory and confirmatory factor analysis utilizing structural equation modeling. The implication of this model serves as a guiding framework intended to assist governmental bodies, policymakers, and urban planners in navigating the path toward achieving sustainable cities. Likewise, the proposed model provides policy implications for enacting and revising urban sector policies in developing regions, considering the fundamental themes of social sustainability. Eventually, this study contributes to implementing Sustainable Cities and Communities (SDG 11) in the 2030 Agenda for Sustainable Development, bridging the gap between urbanization and sustainable urban societies. Also, this model is a valuable tool for promoting socially sustainable urban development in developing regions.

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## Introduction

To promote the development of sustainable urban areas, countries are increasingly prioritizing the aspect of social sustainability. The world's population has dramatically moved toward city living over the last 70 years (United Nations, 2019). The UN projects that by 2050, >83% of urban people will reside in developing countries, up from >76%. Comparatively, 16% will live in developed nations. Lin (2016) noted that extreme and unexpected urbanization has direct and indirect impacts worldwide. In particular, all developing countries face the common urban expansion phenomenon (Beauchemin and Bocquier, 2016). Rapid urbanization with large populations has raised a big concern about making cities and urban areas healthier and better living places (Musa et al., 2018).

Due to rapid urbanization, the conception and practice of sustainable cities have gained global importance since the early 2000s and have become increasingly mainstream in policymaking (Joss, 2011). Significant challenges of rapid urbanization are related to social sustainability as cities are seen as sources of social problems (Bibri and Krogstie, 2017). Ensuring social sustainability is equally important for both developed and developing countries. However, rapid urbanization in most developing countries causes serious social problems in cities (Panda et al., 2016; Ghalib et al., 2017). These social problems, such as urban poverty, social segregation, and lack of social connection, are accountable for social sustainability, affecting its inhabitants' socially sustainable urban environment (Woodcraft, 2012; Ali et al., 2019).

Dhaka, the capital of Bangladesh, is considered an example of a city in a developing country. Dhaka has become one of the world's megacities with a tremendous population increase due to unchecked and rapid urbanization over the past four decades (Roy et al., 2018). However, Dhaka did not rank among the 18th urban agglomerations in 1970 (United Nations, 2019). In contrast, Dhaka's urban agglomeration ranked ninth among the world's top 67 cities in 2018, and it is expected to rank fourth among the world's 109 largest cities by 2030. Also, Dhaka is already second among the most unlivable cities (The Economist Intelligence Unit, 2018). Thus, this is an alarming sign of Dhaka's rapid urbanization.

As a result of the city's rapid urbanization, the urban residents of Dhaka are battling intensely with social problems, such as lack of standard housing, urban poverty, lack of health facilities, lack of women's empowerment, lack of public transportation, illiteracy, slums, corruption, and lack of open spaces (Satu and Chiu, 2019; Yasmin, 2019; Barai, 2020). Social problems cause a lack of social sustainability and slow down socially sustainable urban development for city residents (Woodcraft, 2012; Ali et al., 2019). It is crucial to apply social sustainability to ensure sustainable city enhancement. Thereby, social sustainability in Dhaka city demands appropriate attention to be successfully executed for socially sustainable urban development, which cannot be ignored, particularly as a developing country city.

In the last two decades, many social scientists have worked on social sustainability in an urban context. For instance, some authors attempted to analyze the topic of social sustainability using the urban form (Bramley and Power, 2009; Ali et al., 2019). Gonzalez-Mejia et al. (2014) looked at different ways to measure economic and social sustainability of urban systems. Nevado-Pena et al. (2015) discussed how the economic crisis in European cities affected sustainability's environmental and social aspects. Panda et al. (2016) developed and tested a framework in three states, emphasizing evaluating social sustainability indicators for urban India. In light of the lack of in-depth research conducted in prior studies, greater emphasis must be placed on proposing a model of social sustainability for socially sustainable urban areas. To cover gaps in the current literature, this study offers a social sustainability model for socially sustainable urban development in Dhaka based on country-specific conditions and people's essential social needs.

The present study is empirical evidence-based research that contributes to the current body of knowledge. First, previous research has focused on assessing social sustainability, but none has proposed a specific model of social sustainability for socially sustainable urban areas. Due to this fact, it becomes difficult for city management authorities to ensure the quality of life for the citizens of Dhaka city (Degert et al., 2016; Sarker, 2020). A city requires a structured and comprehensive social sustainability model that assists city management authorities in identifying essential social sustainability themes for a sustainable city for current and future generations. Hence, the issue of sustainability in Dhaka city is a significant concern to the city planner and the administration (Rajuk, 2015). More specifically, this model is explained by 38 indicators under eleven themes of social sustainability that are statistically significant in Dhaka city.

Secondly, rapid urbanization is a big concern for developing countries. This model is essential for cities in developing countries (Kolkata, Delhi, Shanghai, Beijing, Mumbai, Kinki M.M.A., Beijing, Al-Qahirah, etc.) experiencing significant social problems due to rapid urbanization. In Mumbai, for instance, rapid urbanization adds to urban challenges for better quality housing, transport facilities, lack of sanitation, and clean drinking water (BBC, 2023). Thus, this model assists the city authorities of Mumbai in thinking about which indicators of social sustainability they need to focus on immediately to implement social sustainability, which aims to improve the livability of urban dwellers.

Third, the social sustainability model contributes to achieving Sustainable Cities and Communities (SDG 11) in the 2030 Agenda for Sustainable Development. Sustainable Development Goal 11 intends to make cities and human settlements inclusive, safe, resilient, and sustainable for present and future generations. Thus, this model provides explicitly the theme of social sustainability and its indicators that help make a city and community sustainable.

## Literature review

**Social sustainability and socially sustainable urban development**. Since 1987, several sectors have been actively pursuing sustainable development to improve global sustainability (Hemani and Das, 2016). They further stated that the concept became intertwined with 'Sustainable Cities' and 'Sustainable Urban Development' in 1990. Therefore, catalyzing a dedicated focus has started on sustainable urban development in developed nations from the 1990s onward (Yazar and Dede, 2012). Governments worldwide are actively integrating this agenda into urban planning and policy for urban redevelopment, as observed in projects in the UK, Germany, and the Netherlands that address physical, economic, social, and cultural aspects (Colantonio and Dixon, 2011; Chan et al., 2019). However, developing countries are just beginning to consider this issue and encounter more obstacles than developed nations (Kiamba, 2012). Yazar and Dede (2012) stress that developing countries must adopt sustainable urban development agendas through effective policies, plans, and administration. Sustainable urban development unveils urban challenges and seeks a symbiotic nexus among the environment, economy, and society, fostering resilience for a prosperous future (Ameen, 2017).

Social sustainability is an essential aspect of sustainable urban development that ensures the quality of life for every individual.

In the late 1990s, the significance of social sustainability on the sustainability agenda flourished (Elkington, 2013; Hajirasouli and Kumarasuriyar, 2016). Thus, the definition of social sustainability in the most recent academic literature is more specific than ever, notwithstanding the lack of previous emphasis (Partridge, 2014; McGuinn et al., 2020). Western Australian Council of Social Services (WACOSS) states, *"Social sustainability occurs when the formal and informal processes, systems, structures, and relationships actively support the capacity of current and future generations to create healthy and liveable communities"* (McKenzie, 2004, p. 18). Griessler and Littig (2005) explain that social sustainability comprises the characteristics of societies that provide for human needs and protect natural resources for future generations. In essence, social sustainability ensures the quality of life for everyone to create a sustainable future.

Over the past few decades, cities worldwide have worked on projects to improve infrastructure and services to improve the environment, society, and economy (de Jong et al., 2015). However, social aspects are receiving less priority in improving urban situations, especially in developing regions. With a greater emphasis on social aspects, the notion of socially sustainable urban development is garnering widespread attention in the academic literature (Cho et al., 2015; Shirazi and Keivani, 2019; Ring et al., 2021; Wrangsten et al., 2022). According to Enyedi and Kovács (2006), socially sustainable urban development is distinct from sustainable urban development since it emphasizes social aspects more. To achieve socially sustainable urban development, the social aspects emphasize the people's demands, including education, equality, community, and safety (Momoh, 2016). Hence, creating a socially sustainable urban area is becoming increasingly important to governments, executing organizations, policymakers, and NGOs.

**Synopsis of Dhaka city's social sustainability**. Starting in 1971, the tremendous strain of urbanization forced Dhaka to become a megacity. Rural-urban migration is the leading cause of Dhaka's rapid urbanization. Due to economic and commercial prospects, rural-urban migration in Dhaka boosts the population (Rajuk, 2015). Rajuk further reported that migration accounted for 63% of Dhaka's population growth in 2014, while natural rise accounted for only 37%. According to Demographia (2019), the population density in Dhaka city is 41,000 Per Square Kilometer, ranking 1st among the world cities for building up urban areas by population density per square mile.

Regarding sustainability, Dhaka has issues with accelerated urbanization and a high population density, which lead to social problems that affect the social sustainability status (Khatun, 2019). Satu and Chiu (2019) highlighted numerous social problems in Dhaka, including inadequate housing, community facilities, public transportation, healthcare, sanitation, shelter, and open spaces. Accordingly, the most challenging condition for Dhaka is maintaining its residents' social sustainability (Roy et al., 2021). Hence, implementing socially sustainable urban development in Dhaka City has become more critical.

To implement a socially sustainable city, the governance of Dhaka must concentrate on national and local policy agendas through a structured and comprehensive social sustainability model to overcome the hurdles. The National Urban Sector Policy focuses on sustainable urbanization in Bangladesh by ensuring social, economic, cultural, environmental, and institutional sustainability (Committee on Urban Local Governments, 2011). In particular, the lack of a structured and comprehensive social sustainability model challenges Dhaka city planning and policy implementation. Proposing a social sustainability model is necessary to achieving a socially sustainable Dhaka. Similarly, this model is vital for cities in developing countries where rapid urbanization is causing many social problems.

**Theoretical background and research hypotheses**. In 1938, the Theory of Urbanism focused on how a city grew due to rapid urbanization, leading to social problems. This theory also mentioned that urbanization in modern times makes extreme changes in almost every phase of urban social life. Eventually, urban social problems influence social sustainability status (Hemania et al., 2017; Ali et al., 2019). Therefore, to create a sustainable future, "sustainability" has increasingly gained attention.

The concept of "Sustainable Development" was explicitly introduced in *Our Common Future* report in 1987, which defined sustainable development as a development that meets the needs of the present without compromising the ability of future generations to meet their own needs (United Nations, 1987). Sustainable development is addressed by economic, social, and environmental dimensions. Consequently, sustainable development is called the Theory of Sustainable Development or Sustainability Theory. The Theory of Sustainable Development says that equal emphasis must be placed on economic, environmental, and social dimensions to maintain sustainability (Li et al., 2014; Ma et al., 2019; Jia et al., 2022; Yankovskaya et al., 2022; X Y Zhang et al., 2022; Y N Zhang et al., 2022; Zhang, 2022). However, recent literature has shown that social sustainability is less focused than economic and environmental dimensions. Moreover, this picture is more unbalanced in cities in developing countries. In other words, social sustainability is less concerned with assuring sustainable urban development in developing countries' megacities.

In 2001, the United Nations Commission on Sustainable Development (CSD) offered social sustainability themes. It is necessary to identify indicators for each theme to assess social sustainability. Utilizing and testing themes and indicators depends on country-specific situations and basic societal needs (United Nations, 2001). Thus, each country has made its own policies for the urban sector to ensure sustainability based on its citizens' needs. To maintain sustainability, Bangladesh also established a National Urban Sector Policy in 2011 that prioritizes the needs of its residents. This study selected eleven themes of social sustainability in the context of Dhaka, Bangladesh, based on the CSD and National Urban Sector Policy of 2011, namely (1) Health facilities (HF), (2) Gender equality and women's empowerment (GEWE), (3) Urban poverty and Slums Improvement (UPSI), (4) Urban children, the aged, disabled people, and the scavengers (UCADS), (5) Transportation availability (TA), (6) Satisfied with space (SWS), (7) Open space (OS), (8) Social capital (SC), (9) Social justice (SJ), (10) Safety (SF), and (11) Education facilities (EF).

Moreover, the New Urban Agenda was adopted in 2016 at the United Nations Conference on Housing and Sustainable Urban Development, where socially sustainable urban is one of the core dimensions of this agenda (UN-Habitat, 2020). This agenda is conscious that 95% of urban growth will occur in the developing world. Therefore, the New Urban Agenda focuses on socially sustainable urban development by highlighting the aspects of basic needs, community involvement in decision-making, equitable access to opportunities and services, sustainable community, and gender equality to make a sustainable urban. These components of socially sustainable urban are also mentioned by other well-known authors, viz. Bramley et al. (2006); Chan and Lee (2008); Bramley et al. (2009); Dempsey et al. (2011); Abdullah et al. (2014); Ali et al. (2019); Chan et al. (2019).

Based on the discussion above, social sustainability is estimated to influence socially sustainable urban development in Dhaka city

significantly. Therefore, this study developed 11 hypotheses about how social sustainability affects socially sustainable urban development. The study's hypothesis (H) is as follows:

***H1:*** *Health facilities have a positive influence on socially sustainable urban development.*

***H2:*** *Gender equality and women's empowerment positively influence socially sustainable urban development.*

***H3:*** *Urban poverty and slum improvement positively influence socially sustainable urban development.*

***H4:*** *Urban children, older people, disabled people, and scavengers have a positive influence on socially sustainable urban development.*

***H5:*** *Transportation availability has a positive influence on socially sustainable urban development.*

***H6:*** *Satisfying with space positively influences socially sustainable urban development.*

***H7:*** *Open space has a positive influence on socially sustainable urban development.*

***H8:*** *Social capital has a positive influence on socially sustainable urban development.*

***H9:*** *Social justice has a positive influence on socially sustainable urban development.*

***H10:*** *Safety has a positive influence on socially sustainable urban development.*

***H11:*** *Education facilities have a positive influence on socially sustainable urban development.*

## Data, measurements, and methods

**Study area, sample selection, and data collection**. This research includes Dhaka city as a study area (geographic location). A quantitative research approach using a structured questionnaire was used to obtain primary data. This study considers Dhaka city's residents as a population for sample selection. However, the criteria for this study comprise Dhaka city voters who respond to the survey with their opinions. Voters' living experiences allow them to make insightful observations about Dhaka's social sustainability. A manageable sample size is required since getting data from all voters and the researcher's financial and time restraints is challenging. The sample size for this study was calculated using G*Power 3.1.9.7; the explicated sample size was 287, and the real power was over 0.80, indicating a reasonable sample power (Chin, 2001). Thus, the minimum sample size for this study should be 287 (see Supplementary Fig. S1). Residents of Dhaka city provided 573 responses for this study.

In addition, a multistage sampling technique was used to choose the participants. In the first stage, Dhaka city voters were selected using purposive sampling. Using a systematic sampling technique, 23 wards from city corporations were chosen in the second stage. In the third stage, a systematic sampling technique was used to select the houses of target respondents, namely voters, by collecting information on voters from the ward commissioner's office and the Bangladesh Election Commission. Finally, the researcher obtained 573 responses from Dhaka city residents.

**Preliminary study**. As part of the pre-testing procedure, this study examined the content validity of the survey questionnaire. To check the content validity of the individual item (I-CVI) and overall scale (S-CVI) scores, a structured questionnaire was sent to six highly experienced and top authorities, including Directors of Urban Planning and Development, City Planners, Consultants, and Program Analysts from national and international platforms with four scale degrees of relevance (consistency, representative of concepts, relevance to concepts, and clarity in terms) (see Supplementary Table S3). According to experts' recommendations, 01 items must be merged with other existing items, and 02 items must be rearranged. Finally, 62 items were chosen under 11 social sustainability themes for the preliminary study based on expert comments and relevance ratings. For the preliminary research, the study collected 109 responses from the residents of Dhaka city. After conducting the pilot study, some questions were re-examined to understand the language better.

**Table 1 Variables and items of social sustainability and socially sustainable urban development.**

| No. | Name of variables (themes) | Items (indicators) |
|---|---|---|
| 1 | Health facilities | 5 |
| 2 | Gender equality and women's empowerment | 7 |
| 3 | Urban poverty and slums improvement | 6 |
| 4 | Urban children, the aged, the disabled, and the scavengers | 8 |
| 5 | Transportation availability | 4 |
| 6 | Satisfied with space | 4 |
| 7 | Open space | 5 |
| 8 | Social capital | 8 |
| 9 | Safety | 6 |
| 10 | Social justice | 4 |
| 11 | Education facilities | 5 |
| 12 | Socially sustainable urban development | 5 |
| Total 12 variables | | 67 items |

**Research variables**. This study selected 62 items under 11 social sustainability themes as an independent variable (Table 1). The study's dependent variable consisted of 05 socially sustainable urban development items. The selected social sustainability and socially sustainable urban development items are adopted from different scholarly literature (see Supplementary Tables S1 and S2).

**Data processing**. To eliminate errors, this study examined outlier identification, missing data, normality assessment, multicollinearity assessment, and reliability assessment. The study used the Mahalanobis D2 measure to detect outliers, where 09 observations out of a total response of 573 were removed as outliers (see Supplementary Table S4). With no outliers, the total number of responses to this study was 564. In addition, the study used SPSS version 22 to check for missing data and found no missing values in survey items. This study evaluated the dataset's normality by examining its skewness and kurtosis. All the skewness and kurtosis values for each item were within the threshold level ±2 (see Supplementary Table S5). It indicates that the study's data were distributed normally.

Using SPSS, the study also examined multicollinearity via tolerance and variance inflation factor (VIF) (see Supplementary Table S11). The coefficient outcome presented that the 'Tolerance' value is more significant than 0.10, and the VIF value is less than 10. Hence, this study did not identify multicollinearity issues that could aid future statistical analysis. Cronbach's alpha was used to analyze the reliability of 11 themes, as indicated in Supplementary Table S12. The result of the reliability analysis showed that the overall Cronbach's Alpha value was 0.951 with 62 items. Also, Cronbach's Alpha scores for all individual variables varied from 0.899 to 0.957, suggesting that all variables achieved greater than 0.70, a much higher reliability level. Thus, all the measuring variables meet the required threshold value of Cronbach's Alpha, which is acceptable, valid, and reliable for this study.

**Data analysis**. To propose a social sustainability model, this study employed exploratory factor analysis (EFA) and structural equation modeling (SEM) to perform confirmatory factor analysis (CFA). The researcher used a different dataset for EFA (219 responses) and CFA (345 responses). According to Henson and Roberts (2006), using the same dataset for EFA and CFA can be potentially misleading and uninformative. Green et al. (2016) further noted that applying EFA and CFA on the same dataset demonstrates only two integrated modeling approaches. The authors suggested using EFA and CFA on a different dataset. This study used separate EFA and CFA datasets to obtain the scientific findings.

EFA is a statistical method for analyzing and interpreting interrelationships between multiple variables regarding their common underlying factors (Hair et al., 2022). Accordingly, this study used EFA to refine the data to find a set of interrelated constructs that reveal the actual structure of the constructs. For EFA, the study used 219 responses using the principal component analysis (PCA) under the SPSS. Moreover, CFA is a technique to test how well the measured variables represent a smaller number of latent constructs that can confirm or reject the measurement theory (Hair et al., 2022). It is also utilized to determine the structural model's unidimensionality, validity, and reliability for this study. Examining the acquired data, SEM assesses and analyses the correlations between observable and latent variables (Zheng et al., 2019; Kawesittisankhun and Pongpeng, 2020). This study evaluated and examined the relationships between the observable and latent variables using the CFA by SEM method through AMOS 26.0. Using CFA, the study also assessed both components of SEM, namely the measurement and structural models. The SEM method looks at the measurement error that leads to good confirmatory results. Consequently, the SEM method was utilized in this study to analyze the association between the independent (social sustainability) and dependent variables (socially sustainable urban development). This study used 345 responses for CFA and considered five observations per item.

**Findings**. This study proposed a model of social sustainability for socially sustainable urban development in Dhaka based on 564 responses using 62 items under 11 variables. The following sections discuss the study's findings.

**Exploratory factor analysis**. The Kaiser–Meyer–Olkin (KMO) value of this study's exogenous and endogenous variables was 0.902, representing adequate data sampling. Bartlett's test of sphericity is highly effective as the Sig value was 0.000, demonstrating that there is no multicollinearity across the constructs and that all components are appropriate for EFA. Table 2 illustrates KMO and Bartlett's test in EFA.

This study used communalities analysis to examine the interrelationship of 67 (exogenous and endogenous) items. Based on the findings, only SC5 (practicing social and ethical values) had an extraction value of <0.40 (see Supplementary Table S6). Consequently, the value of 66 items was more significant than 0.40, and the SC5 item was removed from further consideration. Moreover, the scree plot revealed 12 extracted factors, including 67 items with eigenvalues greater than 1. The scree plot assumes the curve began to flatten between 11 and 13 factors, resulting in the retention of 12 factors. Figure 1 depicts the scree plot of all retrieved factors' Eigenvalues.

Moreover, the 12 factors with eigenvalues greater than one are explained in Supplementary Table S13. The outcome showed that the extracted 12 factors explain 78.58% of the total variance. Besides, this study used PCA with varimax rotation to analyze the 67 items relevant to socially sustainable Dhaka. Supplementary Table S7 explains the rotated factor matrix. The results presented that the factor loading of 66 indicators, which were put in a twelve-factor matrix, was more significant than 0.50. To establish the internal consistency of this study, just one indicator, SC5, which had a factor loading of <0.50, was determined to be deleted. Hence, 66 indicators of the 12-factor matrix were significant for further analysis.

**SEM-based confirmatory factor analysis**. Before conducting CFA using SEM, the study tested outlier, missing data, normality, and multicollinearity concerns in the dataset (refer to data processing section). This study used a single and a full measurement

**Table 2 KMO and Bartlett's test in EFA.**

| | | |
|---|---|---|
| **Kaiser-Meyer-Olkin measure of sampling adequacy** | | **0.902** |
| Bartlett's test of sphericity | Approx. Chi-square | 14841.306 |
| | df | 2211.000 |
| | Sig. | 0.000 |

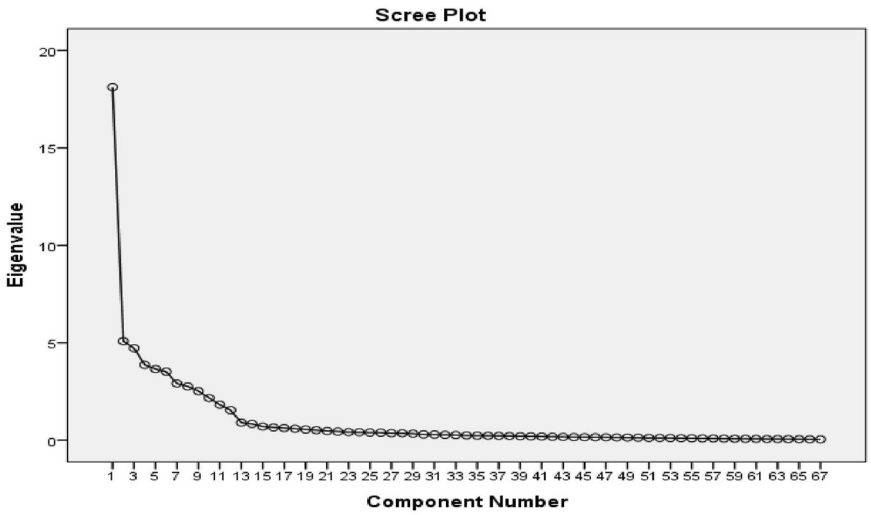


**Fig. 1 Scree Plot of 12 extracted factors, showing eigenvalues greater than one.** Source: software-generated photograph by author.

**Table 3 Discriminant validity of the full measurement model using the Fornell–Larcker criterion.**

| | HF | GEWE | UPSI | UCADS | TA | SWS | OS | SC | SJ | EF | SF | SSUD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **HF** | **0.892** | | | | | | | | | | | |
| **GEWE** | 0.179 | **0.750** | | | | | | | | | | |
| **UPSI** | 0.068 | 0.508 | **0.794** | | | | | | | | | |
| **UCADS** | 0.127 | 0.544 | 0.539 | **0.806** | | | | | | | | |
| **TA** | 0.127 | 0.157 | 0.176 | 0.184 | **0.887** | | | | | | | |
| **SWS** | 0.090 | 0.336 | 0.272 | 0.211 | 0.129 | **0.884** | | | | | | |
| **OS** | 0.257 | 0.401 | 0.372 | 0.400 | 0.030 | 0.279 | **0.754** | | | | | |
| **SC** | 0.165 | 0.496 | 0.411 | 0.432 | 0.242 | 0.285 | 0.388 | **0.829** | | | | |
| **SJ** | 0.083 | 0.579 | 0.588 | 0.525 | 0.205 | 0.336 | 0.404 | 0.507 | **0.879** | | | |
| **EF** | 0.109 | 0.203 | 0.180 | 0.119 | 0.016 | 0.253 | 0.116 | 0.108 | 0.194 | **0.873** | | |
| **SF** | 0.184 | 0.367 | 0.415 | 0.516 | 0.221 | 0.155 | 0.366 | 0.412 | 0.470 | 0.082 | **0.851** | |
| **SSUD** | 0.275 | 0.635 | 0.632 | 0.635 | 0.301 | 0.428 | 0.522 | 0.627 | 0.663 | 0.269 | 0.586 | **0.751** |

Constructs = *HF* health facilities, *GEWE* Gender Equality and Women's Empowerment, *UPSI* Urban Poverty and Slums Improvement, *UCADS* Urban Children, Aged, the Disabled, and the Scavengers, *TA* transportation availability, *SWS* satisfied with space, *OS* open space, *SC* social capital, *SJ* social justice, *SF* safety, *EF* education facilities, *SSUD* socially sustainable urban development.
According to Fornell and Larcker (1981), the square root of the average variance extracted (AVE) for each construct should be greater than other correlation values among the constructs. The result indicates that the full measurement model had good discriminant validity as the square root of AVE for each construct was more significant than other correlation values among the constructs.

model to validate the measurement models. This study used CFA in the measurement model to check the relationship between all constructs by establishing reliability, validity, and unidimensionality and evaluating the model's initial overall fit.

**Measurement model**. In assessing a single measurement model, twelve measurement models were examined that the study found after conducting EFA. CFA was performed on all constructs used in this study, and the average variance extraction (AVE), composite reliability (CR), individual item reliability (R2), and goodness-of-fit (GOF) indices were used to evaluate the measurement model's validity. A total of 11 items were eliminated from the 66 items in the single measurement model due to Modification Indices (MI) values (>15) and Squared Multiple Correlations (R2) (<0.30). Hence, 55 items were retained under 12 factors and selected to assess the full measurement model (see Supplementary Table S8).

To assess the full measurement model, this study considered several issues, i.e., factor loading, R2 value, MI value, standardized residual covariance (SRC), and GOF. The two-headed arrow linked the full measurement model, showing the constructs' covariance. This study's goodness-of-fit indices did not produce adequate results in the first or second iteration. The model was a rerun, and the final iteration had better goodness-of-fit indices than the second iteration; for example, chiSq/df = 1.583 with a cutoff point <5, RMSEA = 0.041 with a cut-off point < 0.08, CFI = 0.953 with a cut-off point >0.90, GFI = 0.855 with a cut-off point >0.90, IFI = 0.953 with a cut-off point >0.90, TLI = 0.947 with a cutoff point >0.90, PGFI = 0.727 with a cut-off point >0.50, and PNFI = 0.784 with a cut-off point >0.50 (see Supplementary Fig. S2). Even though the goodness-of-fit index (GFI) was.855, Hair et al., (2011) stated that GFI values of more than 0.80 are acceptable. In a complicated model, the GFI with a lower value was accepted (Byrne, 2010; Hair et al., (2011)). Thus, all the goodness-of-fit indices for the full measurement model were satisfied. Ten items out of 55 were excluded because of their MI value and SRC (higher than 2.58), as shown in Supplementary Table S9. Likewise, this full measurement model attained unidimensionality (factor loading >0.50), Construct Validity (achieved the fitness indices), Convergent Validity (see Supplementary Table S10), Discriminant Validity (refer to Table 3), and Construct Reliability (see Supplementary Table S10). Hence, 45 items were retained and selected for assessing the structural model (see Supplementary Table S9).

**Structural model**. After completing the full measurement model, this study evaluated the structural model using 41 items (without dependent items) under 11 variables. The study assessed the R-square values, standardized residual covariance, goodness-of-fit indices, and modification indices to validate the structural model. According to Henseler et al. (2009), the R-square value must be higher than 0.25. R-square values of 0.75, 0.50, and 0.25 are typically considered substantial, moderate, and weak, respectively (Henseler et al., 2009; Hair et al., 2011).

This study's structural model was intended to examine the interrelations of the variables that relate to independent to dependent variables. The one-headed arrow explains the relationship between the variables in the structural model, which depicts independent and dependent variables. The structural model has a chance to boost the goodness-of-fit indices in the first iteration, especially for the GFI value. After re-specifying the model and the results of goodness-of-fit indices were improved and pretty good in the 1st iteration, e.g., chiSq/df = 1.594 with a cut-off point <5, RMSEA = 0.042 with a cut-off point < 0.08, CFI = 0.956 with a cut-off point >0.90, GFI = 0.866 with a cut-off point >0.90, IFI = 0.956 with a cut-off point >0.90, TLI = 0.950 with a cut-off point >0.90, PGFI = 0.722 with a cut-off point >0.50, and PNFI = 0.779 with a cut-off point >0.50 (refer to Fig. 2). Though the goodness-of-fit index (GFI) value was 0.866 with a cut-off point >0.90, it was more significant than 0.80, which is also acceptable, as suggested by Hair et al. (2022) and Byrne (2010). GFI values between 0 and 1 are also acceptable (Hair et al., 2022).

Furthermore, the R2 value for the endogenous variable was 0.75 (Fig. 2), representing the influence of constructs the health facilities, gender equality and women's empowerment, urban poverty, and slums improvement, urban children, aged, the disabled, the scavengers, transportation availability, satisfied with space, open space, social capital, social justice, safety, and education facilities, which was 75%. Therefore, the R2 value of this study was substantial, as it was above the suggested threshold. The structural model of this study was appropriate as it adequately achieved all the model fit indices. The above findings assumed that social sustainability significantly influenced socially sustainable urban development, eventually revealed by the best model fit.

Table 4 shows the items removed and retained following the structural model assessment. Three out of 41 items were removed because of standardized residual covariance (greater than 2.58). Thirty-eight items remained, showing that the structural model met the required criteria. Hence, the structural model (final

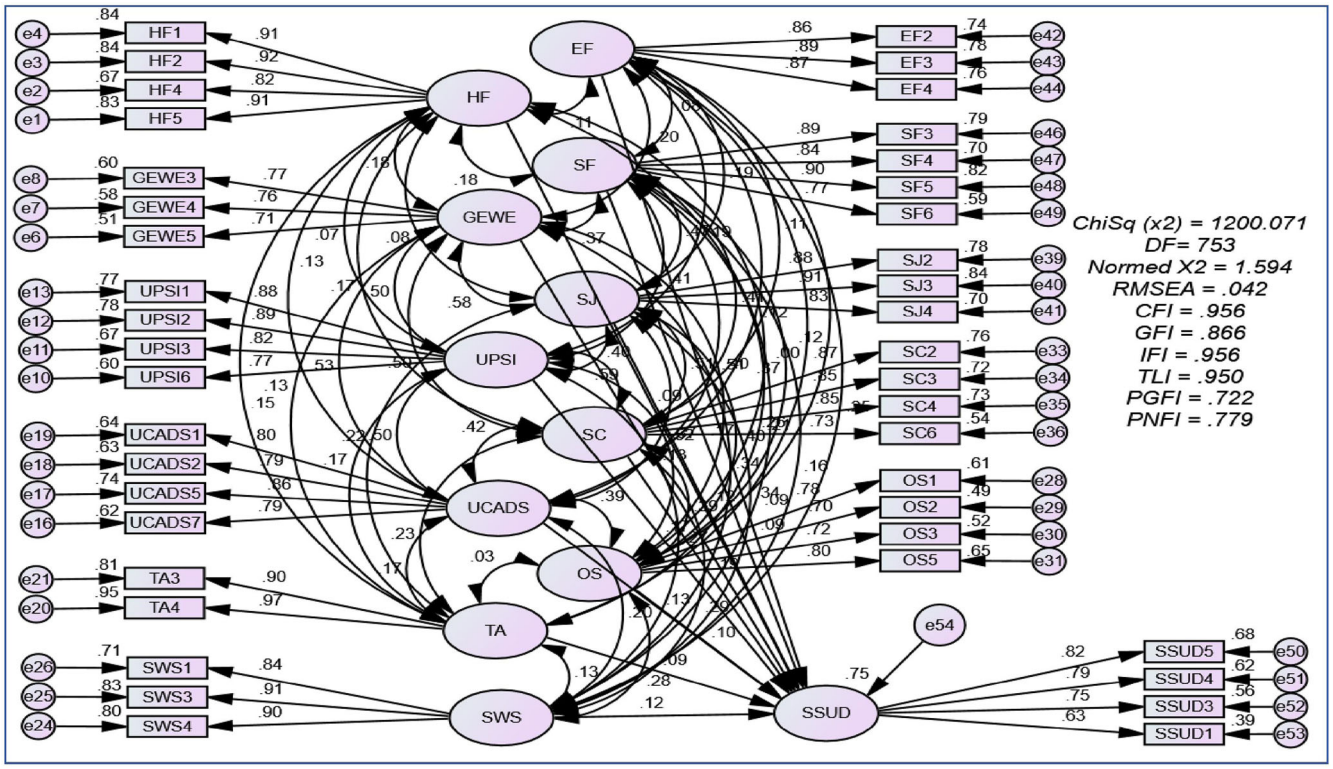


**Fig. 2 Structural model (final iteration) using AMOS.** Source: software-generated photograph by author. Note: ChiSq Discrepancy chi-square, df degree of freedom, Normed $\chi^2 = \chi^2/df$, RMSEA root means square of error approximation, CFI compared fit index, GFI Goodness-of-the fit index, IFI incremental fit index, TLI Tucker–Lewis's index, PGFI parsimony goodness-of-fit index, PNFI Parsimony normed fit index. HF health facilities, GEWE gender equality, and women's empowerment, UPSI urban poverty and slums improvement, UCADS urban children, aged, the disabled, and the scavengers, TA transportation availability, SWS satisfied with space, OS open space, SC social capital, SJ social justice, SF safety, EF education facilities, and SSUD socially sustainable urban development.

iteration) is considered more suitable and significant for comprehending the relationship between social sustainability and socially sustainable urban development. Finally, 38 indicators (items) under 11 themes (variables) of social sustainability are essential for Dhaka city's socially sustainable urban development.

**Hypothesis testing**. In this study, EFA and CFA validated the proposed model, and now the hypothesis must be tested. This study assessed hypothesis testing based on the relationship between the factors in the structural model. Through the structural model, path analyses were performed in this study. Using twelve valid constructs for the full measurement and structural models, the structural model was employed to test the hypothesis. To determine whether a $p$ value is significant, the beta coefficient value ($\beta$) and critical ratio (C.R.) were established for hypothesis testing. The findings of the structural model analysis are presented in Table 5, which also includes standardized estimates, standard errors, critical ratio/$t$ values, and $p$ values at the significant level.

The results of the structural model indicated that eleven hypotheses were statistically significant. It shows that all hypotheses positively correlate with the study's outcome. The results of the hypothesis testing made it clear that social sustainability has a direct influence on socially sustainable urban development. The social sustainability model for socially sustainable urban development in Dhaka city is finally shown in Fig. 3.

## Discussion

In this study, the H1 is accepted at a significance level of 95%, where $\beta = 0.065$ and C.R. = 2.269, indicating that health facilities significantly positively influence socially sustainable urban development. Chan et al. (2019) stated that health facilities are directly related to urban regeneration to maintain social sustainability. However, the current urban expansion in Dhaka city has put a strain on healthcare services and infrastructures, endangering the sustainability of the natural and built environments (Roy et al., 2019). Hence, urban governing bodies must prioritize providing sufficient health facilities to foster social sustainability in Dhaka. The study also found that gender equality and women empowerment significantly influence ($\beta = 0.158$, C.R. = 2.021) Dhaka's socially sustainable urban development at a 95% significance level (H2). Women comprise 50% of a country's population, allowing them to actively engage in all development projects, making gender equality and women's empowerment crucial for sustainable development (Bayeh, 2016). Specifically, 'Goal 5' of the 2030 United Nations Agenda for Sustainable Development states that gender equality is a fundamental human right and a necessary foundation for a peaceful, prosperous, and sustainable society (Roig et al., 2020). However, sexual assault is becoming more prevalent in cities. According to the Thomson Reuters Foundation, Dhaka is the 7$^{th}$ most hazardous city for women (Foundation, 2017). Therefore, the government and non-governmental organizations must pay close attention to Dhaka's socially sustainable urban development by ensuring gender equality and women's empowerment.

Based on the statistical results, this study found $\beta = 0.163$ and C.R. = 3.226 with a 99% significance level, which accepts H3; it reveals a strong positive effect of urban poverty and slum improvement on socially sustainable urban development in Dhaka. According to Kisiała and Rącka (2021), urban poverty substantially influences social factors that impede sustainable city development, such as high unemployment, social morbidity, growing crime rates, and inadequate housing. As urban poverty

**Table 4 Items removed and retained in structural model assessment.**

| Name of variables | Number of items | Removed items | Retained items |
|---|---|---|---|
| Health facilities (HF) | 4 | Not removed | HF1<br>HF2<br>HF4<br>HF5 |
| Gender equality and women's empowerment (GEWE) | 3 | Not removed | GEWE3<br>GEWE4<br>GEWE5 |
| Urban poverty and slums improvement (UPSI) | 5 | 1 | UPSI1<br>UPSI2<br>UPSI3<br>UPSI6 |
| Urban children, aged, disabled, and scavengers (UCADS) | 5 | 1 | UCADS1<br>UCADS2<br>UCADS5<br>UCADS7 |
| Transportation availability (TA) | 3 | 1 | TA3<br>TA4 |
| Satisfied with space (SWS) | 3 | Not removed | SWS1<br>SWS3<br>SWS4 |
| Open space (OS) | 4 | Not removed | OS1<br>OS2<br>OS3<br>OS5 |
| Social capital (SC) | 4 | Not removed | SC2<br>SC3<br>SC4<br>SC6 |
| Social justice (SJ) | 3 | Not removed | SJ2<br>SJ3<br>SJ4 |
| Safety (SF) | 4 | Not removed | SF3<br>SF4<br>SF5<br>SF6 |
| Education facilities (EF) | 3 | Not removed | EF2<br>EF3<br>EF4 |
| Total 11 variable | Total 41 items | 03 Items dropped | 38 items retained |

has grown pervasive in Dhaka, it has become a significant development constraint (Baffoe and Roy, 2022). Hence, the government, urban planners, and management authorities should emphasize urban poverty and slum development for a socially sustainable Dhaka city. In addition, this study found $\beta = 0.131$ and C.R. = 2.333, which accepts H4, implying that urban children, the aged, the disabled, and the scavengers significantly positively affect socially sustainable Dhaka. Pitarch-Garrido (2018) stated that if cities don't provide the most disadvantaged citizens with enough support, it will lead to an unsustainable scenario over the long run. Kabir et al. (2018) revealed that the lack of access to equal rights exacerbates inequality among disadvantaged groups in Dhaka city. To maintain social sustainability, the most marginalized social groups must get special consideration (Saunders et al., 2020).

The availability of transportation has a significant positive impact with $\beta = 0.075$ and C.R. = 2.228 at a 95% significance level on socially sustainable urban development in Dhaka (H5). This finding is also supported by Ali et al. (2019). Due to rapid urbanization, the transport condition of Dhaka city is characterized by prolonged traffic congestion, discomfort, lack of safety, and low air quality (Ahmed et al., 2017). The massive demand for adequate and quality public transport and walking routes in the Dhaka metropolis has not been met yet (Gallagher, 2016). Furthermore, with a 99% significance level, the study accepts H6, where statistical evidence indicates that satisfaction with space significantly affects Dhaka's socially sustainable urban development. 'Satisfied with space' refers to residents' contentment with the housing quality. Similar results were reported in the studies of Doğu and Aras (2019) and Larimian and Sadeghi (2021). Housing is a crucial component of the urban built environment and a vital factor of human existence; however, Dhaka's livability is significantly impacted by the low housing satisfaction level (Satu and Chiu, 2019). Therefore, the government should provide its citizens with quality housing facilities to ensure the social sustainability of Dhaka.

Additionally, the study found that open space positively influences Dhaka city's socially sustainable urban development with β coefficient = 0.108 and C.R. = 2.035 at a 95% significance level (H7). Ali et al. (2019) agreed with this finding when they found that open space in cities has a significant positive effect. Rapid urbanization in Dhaka city consumes more open places, leading to a loss of green space and environmental degradation (Sarker, 2020). Consequently, there is a demand from the citizens of Dhaka for adequate open space to ensure socially sustainable urban development. According to this study's findings, social capital in Dhaka city has a significant impact and is linked to socially sustainable urban development at a 99% significance level (H8). This finding is supported by Dogu and Aras (2019). In recent years, both sustainable development theory and practice have paid more attention to the role of social capital in supporting sustainable development (Hemani and Das, 2016). However, Dhaka City's social capital is considered a significant asset only for the urban poor (Tamanna and Hasan, 2015). Consequently, the social capital of Dhaka must consider an essential aspect of social sustainability that contributes to enhancing a socially sustainable city.

Regarding H9, the study found that social justice significantly influences Dhaka's socially sustainable urban development, where $\beta = 0.087$ and C.R. = 1.962. The attainment of urban sustainability necessitates reorganizing current planning methodologies to include the objectives of equity and social justice since a significant portion of the urban populace resides in the slums of Dhaka city (Ahmed et al., 2018). Similarly, safety has a significant favorable influence and is linked to socially sustainable urban development in Dhaka at a 99% significance level (H10). This finding validates earlier studies by Yu et al. (2017), Ali et al. (2019), Shirazi and Keivani (2019), and Larimian and Sadeghi (2021). Rajuk (2015) demonstrates that ensuring the safety of urban residents is crucial, particularly in highly populated cities like Dhaka.

Likewise, the H11 was accepted with β coefficient = 0.066 and C.R. = 2.113, demonstrating that education facilities significantly impact socially sustainable urban development in Dhaka. Education facilities are one of the critical components of the City Development Index (CDI), which gauges access to urban development and amenities (Huang et al., 2015; Alfaro-Navarro et al., 2017). For city residents, the Dhaka city government tries to provide adequate educational opportunities (Rajuk, 2015). However, providing sufficient education facilities is challenging for Dhaka's unchecked urban expansion (Sarker, 2020). To make Dhaka socially sustainable, the city authorities must prioritize educational facilities.

In contrast, the limitations of this study cannot be disregarded. First, this study only used a quantitative research approach. Second, this study used a questionnaire survey to collect data. Third, this study adopted only eleven social sustainability themes from the existing literature. Fourth, data analysis was limited to a modest sample size of only 564 responses. Fifth, it is essential to note that

**Table 5 Results of structural model analysis (hypotheses testing).**

| Hypothesis | Relation | | | Estimate | S.E. | C.R. | *P* | Decisions |
|---|---|---|---|---|---|---|---|---|
| H1 | SSUD | <--- | HF | 0.065 | 0.029 | 2.269 | 0.023 | Significant |
| H2 | SSUD | <--- | GEWE | 0.158 | 0.078 | 2.021 | 0.043 | Significant |
| H3 | SSUD | <--- | UPSI | 0.163 | 0.050 | 3.226 | 0.001 | Significant |
| H4 | SSUD | <--- | UCADS | 0.131 | 0.056 | 2.333 | 0.020 | Significant |
| H5 | SSUD | <--- | TA | 0.075 | 0.034 | 2.228 | 0.026 | Significant |
| H6 | SSUD | <--- | SWS | 0.092 | 0.033 | 2.792 | 0.005 | Significant |
| H7 | SSUD | <--- | OS | 0.108 | 0.053 | 2.035 | 0.042 | Significant |
| H8 | SSUD | <--- | SC | 0.142 | 0.038 | 3.715 | 0.000 | Significant |
| H9 | SSUD | <--- | SJ | 0.087 | 0.044 | 1.962 | 0.050 | Significant |
| H10 | SSUD | <--- | SF | 0.116 | 0.034 | 3.436 | 0.000 | Significant |
| H11 | SSUD | <--- | EF | 0.066 | 0.031 | 2.113 | 0.035 | Significant |

Significant level $p < 0.01$, 0.05. *SE* standard errors, *CR* critical ratio, *HF* health facilities, *GEWE* gender equality and women's empowerment, *UPSI* urban poverty and slums improvement, *UCADS* urban children, aged, the disabled, and the scavengers, *TA* transportation availability, *SWS* satisfied with space, *OS* open space, *SC* social capital, *SJ* social justice, *SF* safety, *EF* education facilities, and *SSUD* socially sustainable urban development.

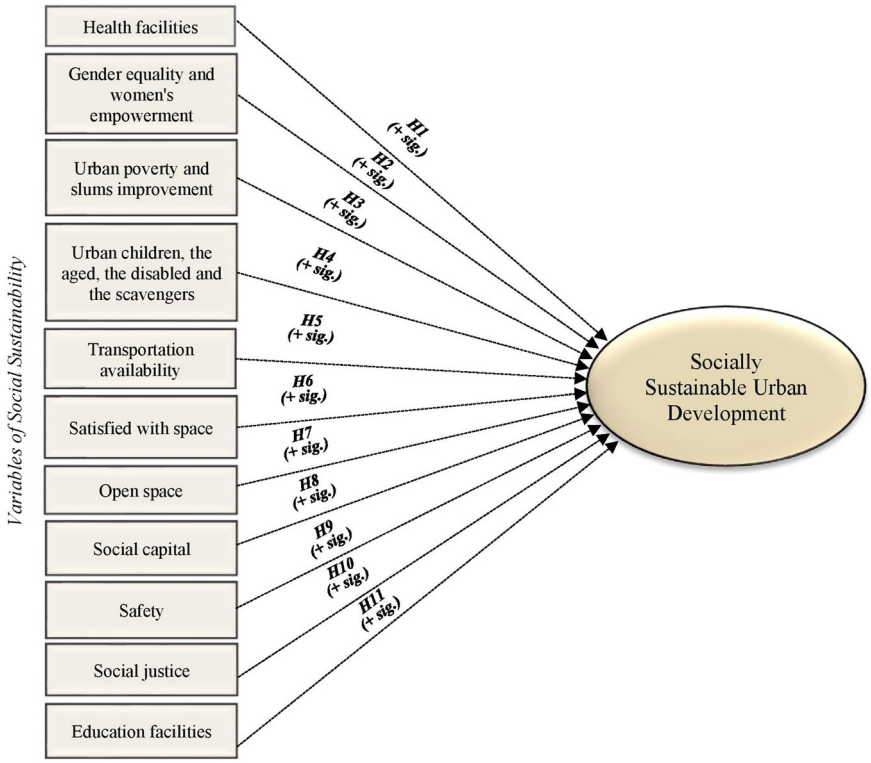


**Fig. 3 Social sustainability model for socially sustainable urban development.** Source: author-generated based on the results of structural model and hypotheses testing.

the study focuses on Dhaka as the geographical location under examination. From the limitations of this study, an opportunity is created for future researchers. For example, a mixed-methods research approach could incorporate different methods to help future researchers investigate various aspects of urban social sustainability and provide insightful findings. In addition, there are opportunities to use multiple data collection methods such as case studies, interviews, and focus group discussions to explore different aspects of social sustainability. Also, developing indicators for social sustainability based on city culture and basic social needs can be considered. Future investigations would benefit from including a larger sample for more comprehensive and robust results. Furthermore, the identification of challenges is significant not only to Dhaka but also to other rapidly urbanizing cities; it is recommended that future researchers adopt the same approach to explore other cities in Bangladesh and other regions facing similar challenges, such as Kolkata, Delhi, Shanghai, Beijing, Mumbai, and Cairo. Overall, the study helps researchers in developing countries to diversify their thinking on social sustainability for socially sustainable urban development.

## Practical implications and conclusion

In the context of the developing world, the increasing significance of social sustainability stems from its vital role in establishing sustainable urban centers. The lack of prioritization of social sustainability, particularly evident in cities within developing countries, presents a serious concern about the perception of socially sustainable cities for both current and future generations. According to limited researchers' knowledge, the lack of social

sustainability models for cities in developing countries cannot ensure socially sustainable urban development. In light of this, this study proposes a model based on the 11 social sustainability themes for socially sustainable urban development in Dhaka as a representative city of a developing country.

A comprehensive social sustainability model helps city management authorities to ensure socially sustainable urban. However, due to rapid urbanization, ensuring social sustainability is a significant concern not only for Dhaka city but also for many other cities facing the same situation, such as Delhi, Shanghai, Beijing, Mumbai (Bombay), Kinki M.M.A. (Osaka), Beijing, Al-Cahira (Cairo), etc. Furthermore, implementing social sustainability initiatives has become a significant challenge to city authorities due to many factors, such as weak urban governance, comprehensive long-term vision, inefficient urban management systems, lack of planned infrastructure development, and long delays in the planning approval process. In this regard, the implications of social sustainability are wide-ranging and can significantly impact individuals, communities, and society.

Therefore, this study's significant contribution is to develop and propose a model of social sustainability for socially sustainable urban development, especially in cities in developing regions. Based on its findings, this study demonstrates that social sustainability has a considerable positive effect on Dhaka's socially sustainable urban development. Similarly, this research examined the requisite goodness-of-fit indices, unidimensionality, validity, and reliability to demonstrate the statistical validity of this model. More specifically, this model is explained by 38 indicators under eleven themes of social sustainability that are statistically significant in Dhaka city. The city administration of Dhaka should consider these indicator-based social sustainability models to improve the quality of life of Dhaka city residents to make it a sustainable city. In this regard, this social sustainability model assists Dhaka's concerned authorities in formulating specific plans, policies, and execution, considering eleven social sustainability themes that ultimately enhance to ensure a sustainable Dhaka city. To make Dhaka socially sustainable, it is essential to revise the Structure Plan, Urban Area Plan, Detailed Area Plan, and Urban Sector Policy by considering the model of social sustainability. Likewise, this model will help cities in developing nations experiencing severe social problems due to fast urbanization. Thus, they should use this model to consider their context, which helps create socially sustainable urban. Finally, it will assist in implementing Sustainable Cities and Communities (SDG 11) of the 2030 Agenda for Sustainable Development.

## Data availability

This paper is a part of the Ph.D. work and the code of research ethics in the University of Malaya, any information will not be publicly disclosed for security reasons. However, the researchers are ready to share the dataset privately if any disputes occur.

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Contributors to the concept or design of the article: Dr. Sultana Razia, Contributed to analysis and interpretation of data: Dr. Sultana Razia, Drafting work or critically revising it for important intellectual content: Dr. Sultana Razia, Prof. Dr. Siti Hajar Abu Bakar Ah, Final approval of the version: Dr. Sultana Razia, Dr. Siti Hajar Abu Bakar Ah, Agreement to be responsible for all aspects of work: Dr. Sultana Razia, Prof. Dr. Siti Hajar Abu Bakar Ah.

## Competing interests

The authors declare no competing interests.

## Ethical approval

The study was approved by the Universiti Malaya Research Ethics Committee (UMREC) (Reference Number: UM.TNC2/UMREC-1018).

## Informed consent

All participants in this study were informed about the purpose of the research and how the data will be used. Informed consent was obtained from all participants.

## Additional information

**Supplementary information** The online version contains supplementary material available at https://doi.org/10.1057/s41599-023-02144-5.

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