Research Article

Assessment of sanitation service gap in urban slums for tackling COVID-19

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ABSTRACT

Coronavirus disease 2019 (COVID-19), caused by Severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), has been declared as a global pandemic by the World Health Organization (WHO). As the disease is highly infectious, the Global South countries are in a vulnerable situation with high urban population density and lack of Water, Sanitation, and Hygiene (WASH) services. The situation for the urban slum dwellers and low-income group clusters are becoming worse. Lack of health and sanitation service availability has already been an issue for them before the beginning of the pandemic. So, it is predictable that adopting this massive global pandemic is a critical challenge for them. This paper assesses the sanitation service gap in urban slums, which has become a severe challenge to tackle due to COVID-19. The study areas of this research are the Ranarmath slum and the Khema slum of Khulna city, Bangladesh. The SERVQUAL model has been used to identify the quality of sanitation service available in these informal residential settlements. The interpretation of questionnaire survey data from the two slums reveals that one slum lacks Assurance and Empathy, where the other slum lacks Tangibility and Responsiveness. However, the Tangibility, Reliability, and Responsiveness condition of both slums are flawed with the lack of latrine functionalities and services from concerned authorities. The incompatibility of the condition has been identified by evaluating the WHO's different sanitation management policy for COVID-19. The research concludes that sanitation services like handwashing facilities and water supply availability in the latrine directly related to COVID-19 prevention are indigent for these slums.

1. Introduction

The current world is going under a complicated situation that this generation had never seen before. After the massive Spanish flu pandemic in the 1920s, the COVID-19 is probably the most globalized pandemic affecting the economy and public health system (Barro et al., 2020). As urbanization and globalization have made the Global North and the Global South countries closer and more convivial than ever, it is expected that there is a possible chance of losing millions of lives in this pandemic. The death in the cause of Coronavirus is exceeding 200 thousand in the USA and 150 thousand in Brazil, which is already demonstrating the strength of this virus even in this modern era of public health and medical technology. The severity of the Global North countries indicates a worst-case scenario for the developing countries in Southeast Asia as India has already lost more than 100 thousand lives (Coronavirus Update (Live): 50,521,740 *Cases and 1,259,506 Deaths from COVID-19 Virus Pandemic - Worldometer, November 8, 2020*).

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Southeast Asian countries have already been facing issues like public health management, sanitation service quality, and waste disposal management (Davis, 2004). Besides, there have already been some life taking diseases like Dengue and Cholera, making the situation more complicated in these countries. Furthermore, the congested living mechanism is making these countries the most vulnerable in this pandemic situation. Specifically, the slums and overcrowded informal settlements are the prominent concerned places where the spreading of COVID-19 has the highest opportunity (Corburn et al., 2020; Mishra et al., 2020). So, the concerned authorities and urban planners need to find out the significant gaps that are already inbound in these low-income communities.

The measures needed for preventing this deadly disease from spreading involve washing hands deliberately, using water effectively, and maintaining a possible social distance (WHO, 2020, pp. 1–9; WHO and UNICEF, 2020). These preventing elements are directly related to sanitation service and its quality, incorporating handwashing facilities, water supply system in the latrine, and the number of users per latrine. The densely populated slum areas in the Global South countries like Bangladesh and India face sanitation service problems for a long time now (Isunju et al., 2011; Joshi et al., 2011). Several pieces of research have been conducted on this topic without considering the pandemic situation. Analytical Hierarchical Approach (AHP), Customer Satisfaction Index (CSI), and SERVQUAL model is getting more popular day by day in the field of sanitation service quality assessment (Alam & Mondal, 2019). But as a new global challenge is already affecting both developed and developing countries, it is essential to rigorously study the sanitation service gap of the urban slums, which are the city's most vulnerable residential areas. Also, methodological modification in the conventional sanitation service assessment tool for addressing the new challenge is essential.

This paper has tried to incorporate the preventing factors of COVID-19 with the current sanitation service gap of slum areas in Khulna city, Bangladesh. The research tries to reveal the current sanitation service quality of the slum areas by using a modified SERVQUAL indexing model and the gaps that can boost up the spreading of COVID-19. The paper is divided into five sections. Section 2 is briefly reviewing the tools that the paper is using and the current situation of COVID-19 around the globe. Section 3 and 4 explain the methods that the research used and the results and findings. The last section of the paper is the conclusion and discussion of the research.

2. Literature review

2.1. Methods of sanitation service assessment

The earlier stages of research related to sanitation services focused extensively on the water supply and environmental impacts. It includes implementing the water supply network and the positive and negative effects that the sanitation system can create (Nanbakhsh, 1993). However, it is essential to incorporate sanitation as a public service to include the demand information and consumer preferences like Altaf and Hughes (1994) used in their research. The Contingent Valuation Method (CVM) has two components: a description of the convenience provided, including conditions of availability, and a procedure for eliciting a respondent's willingness to pay (WTP) for this with minimal bias (Altaf & Hughes, 1994). Considering CVM, sanitation services' demand can become complicated as economists, engineers, and social scientists share this field (Parry-Jones, 1999, pp. 1–12). But according to social science and smaller-scale projects, Participatory Approach (PRA) is more effective as CVM generally needs large capital investments (Altaf & Hughes, 1994; Parry-Jones, 1999, pp. 1–12).

Besides sanitation and its direct components, several aspects like health status, physical environment, and socio-economic and cultural conditions impact sanitation services quality (Nguyen-Viet et al., 2009). Among these aspects, particularly low-income areas, have unique challenges in terms of providing sanitation services. The necessity of exploring users' point of view is important as maintenance and the number of users can impact sanitation services (Mazeau & Reed, 2010). When the water, sanitation, and hygiene (WASH) is about developing countries and poor communities, the life-cycle cost approach (LLCA) is important for ensuring the service's sustainability on a quantitative basis. (Berg & Marques, 2011; Ratna Reddy & Batchelor, 2010). The conventional sanitation service concept incorporates water and environmental quality, which is also a subject of Millennium Development Goals (MDGs) (Jiménez et al., 2018; Zawahri et al., 2011). But the recent approaches supporting Sustainable Development Goals (SDGs) have adopted more in-depth qualitative methods and holistic approaches like interviewing the household members, which can provide further details about sanitation service conditions (Fuente & Bartram, 2018; Tiberghien et al., 2011).

As both qualitative and quantitative approaches have the importance of assessing the sanitation service condition in more impoverished communities, it is essential to integrate these two basic analysis methods (Fuente & Bartram, 2018; J. Platt, 2019). SERVQUAL model is an effective service-quality analysis method that incorporates the quantitative data from the household survey. But the flexibility of the model allows incorporating Customer Satisfaction Index (CSI) and Analytical Hierarchical Approach (AHP), making it a modified model with both qualitative and quantitative assessment tool for sanitation service (Alam & Mondal, 2019).

2.2. SERVQUAL model and its applications

The SERVQUAL model was developed mainly for assessing the service quality of marketing products. It is a tool that can provide a measure for the service and quality of a large number of products with limited modifications in scale (Lu & Liu, 2000). Initially developed by Parasuraman, Zeithaml, Berry in 1985, this model's primary purpose was to make the quality measurement of products and services a research subject. In the first place, they developed a model based on 10 determinants that can define the service and quality. Those are Reliability, Responsiveness, Competence, Access, Courtesy, Communication, Credibility, Security, Understanding/Knowing the customer, and Tangibles (Parasuraman et al., 1985). Later, they produced the SERVQUAL model with 22-item instruments to assess the customer perceptions of service quality (Parasuraman et al., 1988). The extended version of the model is much more precious, with a concept of measuring service performance through customer perceptions and expectations. The final version of the model has 5-dimensions (Tangibility, Reliability, Responsiveness, Assurance, and Empathy), including the service taker

and the service provider (Parasuraman et al., 1991).

Parasuraman's target of establishing the service-quality measurement as a research subject was indeed a successful try. In the present time, the SERVQUAL model is not only limited to marketing research but also many other service-related fields like public health service, sanitation service, and hotel service quality. As the model is malleable, researchers make clear-cut modifications according to the field of interest, which provide a significant advantage. Though the major 5 dimensions remain unchanged, most of the study modify the components under these dimensions as needed. Examples can be found in different research fields. In hospital service, quality is the most crucial concern for the customers (patients). Both the functional and the technical quality gap can be identified through the SERVQUAL model's help, which is an easy and efficient measurement technique (Kansra & Jha, 2016; Lee, 2006; Lu & Liu, 2000). Different challenges related to hotel services, such as high customer demand, increasing competition in the market, and demand for full services, can be included in this model to understand customer satisfaction and expectations more preciously (Ikiz & Masoudi, 2008; Kargari, 2018). Railway service quality measurement is another subject of SERVQUAL with the help of some statistical analysis, which makes it more relevant in transportation (Hundal & Kumar, 2015; Niu et al., 2019). Furthermore, the Customer Satisfaction Index (CSI) integration with the model can strengthen the research's evaluation more authentic and empirically accurate (Alam & Mondal, 2019; Wei & Bin, 2008).

2.3. Sanitation service and SERVQUAL model

Sanitation service is one of the major subjects in the field of public health and sustainable planning. Mostly it is vital to the meager income groups like a slum or informal settlement dwellers who couldn't find adequate sanitation service (Aceng, 2020; Alam & Mondal, 2019). Example of using the SERVQUAL model for measuring service quality of sanitation is not wide-ranging. But several researchers adopted this model for finding out the gap of sanitation service in the urban areas and for a specific group of people like slum dwellers (Alam & Mondal, 2019; Jurado Bello et al., 2009; Seppälä et al., 2004). Most of them have used different mechanisms and an integrated model to enhance the SERVQUAL model's efficiency, like developing a waste index and identifying the impact of garbage on urban residents (Jurado Bello et al., 2009). But one of the most popular integrations with the SERVQUAL model is the Customer Satisfaction Index (CSI). It is always important to consider the customer's expectations in case of a broader field like water utility and sanitation service of the city (Seppälä et al., 2004). The model can be used in small scale system like for assessing the sanitation quality of a restaurant where the emotions and expectations of the customers can affect directly to the whole restaurant service quality (Park et al., 2016). Integration of the Analytical Hierarchical Approach (AHP) can further upgrade the efficiency of the model by identifying the gaps that the customers are facing in case of sanitation service (Alam & Mondal, 2019).

2.4. COVID-19 and the current global south

COVID-19 is a pandemic that indicates the faults within the systematic public health mechanism of both Global North and Global South. As the pandemic's spreading is very random and unpredictable, the Global South's condition is unstable and uncertain. (Oldekop et al., 2020). The pandemic focuses on the lack of public health services and the role of sanitation and hygiene to prevent diseases. It is becoming impossible to fulfil the Sustainable Development Goal (SDG) 6.2, which incorporates equitable sanitation and hygiene service for all, especially for women and girls who are the subject of vulnerability (Aceng, 2020). Nearly 2.4 billion people in the world lack sanitation and hygiene service ("WHO | Lack of Sanitation for 2.4 Billion People Is Undermining Health Improvements," 2015). The current pandemic challenge is defying the conventional "having more people in less space" mechanism, a challenging problem for South Asian countries like India and Bangladesh where slum areas are very popular in important cities (Acuto, 2020).

The Global South's informal settlements are already problematic for lack of basic needs like water, toilets, sewers, sanitation service, drainage, and waste collection. Their vulnerability is not limited to these basic needs. The economic instability and mobility restriction are making their income opportunities narrower than ever (Corburn et al., 2020; Ekumah et al., 2020). This issue affects the informal settlements and the city's entire economy as the slums are the source of the informal labor market and micro-level business. Aside from the economy, sanitation services deprivation can work as a catalyst for transmitting the disease, which is a more considerable concern (Corburn et al., 2020; Mishra et al., 2020).

3. Method

3.1. Primary selection of the study area

In the primary stage, Khulna city has been selected as the study area of this research. Khulna is the third-largest city of Bangladesh and also a vital city corporation area. After Dhaka, Chittagong, and Gazipur, Khulna has the most number of slums (1134) among other city corporations, municipalities, and urban areas, 8.14% of total slums in Bangladesh (Bangladesh Bureau of Statistics & (BBS), 2015). The impact of COVID-19 is also severe in this city. Khulna district has 7027 total cases till now, which is 8th in position among 64 districts of Bangladesh (কোভিড-১৯ ট্র্যাকার | বাংলাদেশ কম্পিউটার কাউন্সিল (বিসিসিসি)), January 14, 2020). As the test rate of Bangladesh is significantly low (around 20 thousand per 1 million population), it can be assumed that the number of actual cases is much more than the number of cases that have been reported (*Coronavirus Update (Live): 50,521,740 Cases and 1,259,506 Deaths from COVID-19 Virus Pandemic - Worldometer*, November 8, 2020.). Though there are cities like Dhaka and Chittagong where the slum numbers are high, and the problems are more severe, collecting data from these slums are difficult because of accessibility and security issue. The slums of Khulna city are comparatively more secure and accessible, making the data collection easier for this research.

According to the SNV (2014) baseline survey statistics, in Khulna, there are only 36.47% of households with hygienic sanitation practice. Assurance of toilet safety is 34.82% among the residents in Khulna. 2.93% of the residents are found who have no toilet. In terms of functionality, Khulna has 36% of residents having functional toilets in use, where 18% have problems with toilet functionality. The handwashing practice among the Khulna city residents is deficient, where 45% of households in Khulna have no handwashing station for hygienic sanitation practice (Kabir & Salahuddin, 2014). This information can trigger the importance of selecting Khulna city as one of the study areas for sanitation service and COVID-19 related research.

3.2. Detailed description of the study area

Two slums of Khulna city, Bangladesh, has been taken as the study area of this research. The Khalishpur slum, also known as Khema slum, is located at 22.85295 north latitude and 89.54541 east longitude. Khlishpur is an important middle-income residential area of Khulna. The other slum, Ranarmath slum, is located at 22.88958 north latitude and 89.50841 east longitude. It is situated in Fulbarigate, which is an industrial-residential mixed area of Khulna city. There are around 180 households, and about 1000 people are living in these two slums. The total area of these slums is only 3.5 acres, which makes the population overly dense. As social distancing is one of the significant criteria for controlling COVID-19, the population and area already indicate the risk these slum dwellers face. There are some other prevalent slums in Khulna, like Rupsha slum and Railway slum. But these slums are old and recognized by the government and NGOs. But Ranarmath slum is a new informal settlement (established in 2016), and Khema slum was previously the refugee camp of a minor ethnicity (Bihari), making these slums unique. Fig. 1 is showing the study area map of this research.
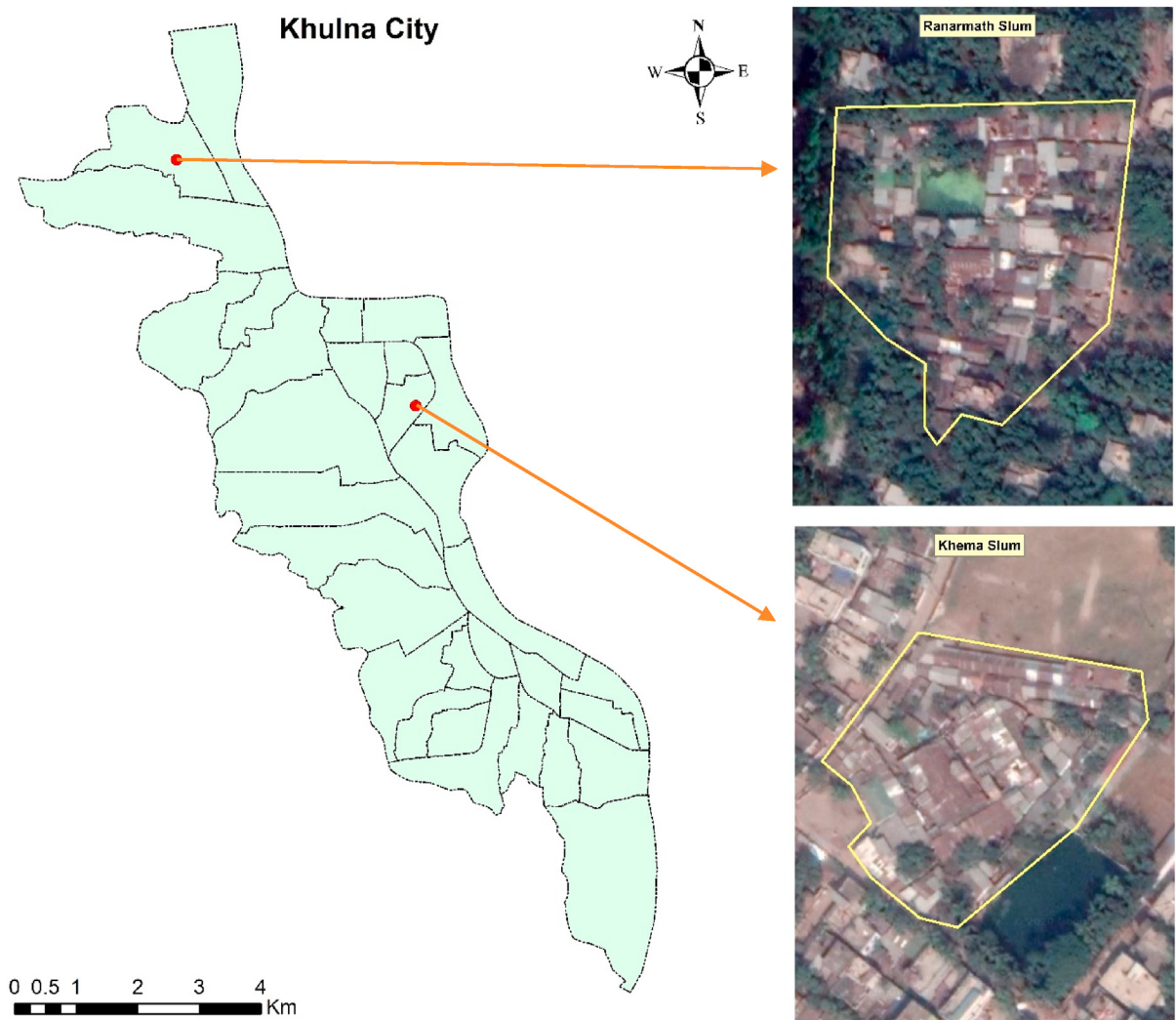

Fig. 1. Khulna city corporation area with the location of Ranarmath and Khema slum.

3.3. Selecting the indicators

This research is based on the SERVQUAL model, which is a modifiable model according to the service that needs evaluation. The output of the model depends on the indicators under each dimension. So, selecting the indicators is the primary challenge of this research. An extensive literature review from different organizational or research publications and reports based on sanitation services has been used for selecting the indicators. Table 1 is showing the selected indicators and references.

3.4. Questionnaire pattern and sampling

Questionnaire surveys have been used to collect data from both slums. The survey was conducted before the starting of the pandemic situation. As it is risky to conduct a face-to-face survey in this current situation, the conducted survey data has been used efficiently with experts' help to demonstrate the research result. 26 questions related to sanitation services representing the selected indicators have been used in this paper. Each of these questions (indicators) is separately under each of the SERVQUAL model dimensions. 6 of the questions are under Tangibility, 7 are Reliability, 4 are Responsiveness, 5 are Assurance, and the remaining 4 are under the Empathy dimension.

3.5. Reliability of the questionnaire

The reliability of the questionnaire has been tested through the Cronbach Alpha reliability testing method. For this purpose, 8 expert opinions have been collected through telephonic and email survey where the relevancy of the questions have been marked through a Likert scale of 1–5.5 is the most relevant, and 1 is the least relevant question. Among the experts, there are researchers, public health workers, doctors and development authority officers directly or indirectly related to the sanitation service and health sector. The result reveals a Cronbach Alpha value of 0.88, indicating that the questionnaire's reliability is good and acceptable to use.

3.6. Data collection and sampling

A simple random sampling method has been used to fix the number of respondents. The population and area of the slums are not that significant to use other sampling techniques like Snowball, Stratified, or Cluster sampling. Total 112 data (82 from Khema slum and 30 from Ranarmath slum) have been collected from these two slums. The sample size is quite suitable for 187 households (128 in Khema slum and 59 in Ranarmath slum) because of the congested area with limited unique service opportunities and homogenous characteristics of the households.

Table 1
Selected indicators and corresponding references.

Indicators	References
Number of Users per Latrine	Rahman et al. (2014)
Place for Pit/Septic Tank Sludge Dump	
Cleanness of Latrines	
Payment for Cleaning Latrines	
Selection of the Specific Type of Latrine	
Selection of the Specific Site for Installation of Latrines	
Latrines are secure for women and child at night	
Distance of Latrines from Waterbodies	
Latrines Are Physically Accessible	
Equal Opportunity for Using Latrines	
Emptying Process	
Segregation for Male & Female	
Initial financial & technical support to install the latrine	
Types of Latrine	Palestinian Hydrology Group & UNICEF, 2010
Cleaning Frequency of Latrines Per Week	
Inner Water Supply System	
Latrine Connection	
Getting Services from Concerned Authorities	
Proper Lighting System at Night	Alam and Mondal (2019)
Functionality of Latrines	
Regular Inspection for Sanitation Condition	
Latrine Structure	Pickford et al. (1998)
Pit Overflows	
Inner Hand Washing Facility	IAEG-SDGs (2016)
Latrine Facilities for Disable People	UNICEF (2018)
Responsibility for Cleanness	UN (2016)

3.7. Analytical phases

There are two analytical phases in this research. One phase aims to explore and assess the current sanitation service condition of Khema slum and Rananrmath slum. The other phase tries to extract the potential sanitation service gap from the first phase that can accelerate the pandemic situation. The first phase is focused on statistical and mathematical analysis using SERVQUAL Model. In the second phase, literature review and expert opinion-based indicator results have been done to identify the sanitation service gap for tackling COVID-19.

3.7.1. Sanitation service-based SERVQUAL model

Though the SERVQUAL model is a prevalent method of finding out the service and quality gap of business and products, for the sake of this research, it has been used as a research tool to find the sanitation service gap of slum areas. The 5 dimensions have remained unchanged, but the factors under them have been changed according to the sanitation service.

1. Tangibility: Tangibility explains the features that can be touched or seen, mainly physical features and appearance. In this research, it is about latrine types, the structure of the latrine, pit overflows, number of users per latrine etc.
2. Reliability: This dimension refers to how much correctly and steadily the services have been taken care of. This includes cleanness and cleaning frequency of latrine, inner water supply, inner handwashing facilities etc.
3. Responsiveness: This dimension indicates the response of the service provider about the welfare of the service. Factors like getting services from concerned authorities, selecting the specific type of latrine, and inspection regularity of the authorities are under this dimension.
4. Assurance: Security and trust of the customer; in this case, the slum dwellers, are the main factor of this dimension. The dimension includes women and children's security of the latrine, physical accessibility of the latrine, emptying process etc.
5. Empathy: Communication and understanding with the customer is an integral part of Empathy. It also includes how much the provider can do for the customer on an individual level. Segregation of sanitation, facilities for the disabled, the responsibility of cleanness is the major factors under this dimension.

3.7.2. Integrating LVI method with SERVQUAL

Customer Satisfaction Indexing (CSI) is the general method that can explain the SERVQUAL model and its dimensions. The conventional method is to collect perceptions and expectations of the customer through a Likert scale unit. But in this research, the data that has been used is not in Likert scale unite. The data has categorical and numerical values like different latrine types, the number of users per latrine etc. For this kind of data, a new modified indexing method has been adopted: the combination of the Human Development Index (HDI) and Livelihood Vulnerability Index (LVI). This balanced average weighted approach can transform the contribution from each major-components equal though the major components have different number of sub-components (Hahn et al., 2009). For this research, the major components are the 5 dimensions (Tangibility, Reliability, Responsiveness, Assurance and Empathy) of SERVQUAL model. The sub-components are the indicators that are assigned under these dimensions in terms of sanitation.

3.7.3. Calculating the sanitation service quality

The calculation process has been adopted from both the HDI and the LVI. As the variables under the dimensions have a different scale, the life expectancy index of HDI has been used to standardize the indicators as a general unit (Hahn et al., 2009; UNDP, 2013).

$$I_{ns} = \frac{I_n - I_{min}}{I_{max} - I_{min}} \tag{1}$$

Eq. (1) is showing the mathematical procedure for standardizing different kinds of units according to HDI. Here, the I_{ns} is the standard value for the indicator n. The I_n is the current value of the indicator. I_{min} and I_{max} is representing the minimum and maximum value for that indicator. In the case of percentage units, the minimum value is 0, and the maximum value is 100. For the average unit, the method is similar.

After calculating the standardized value for each indicator, the value of the dimensions has been calculated by averaging the standardized values (Eq. (2)).

$$D_n = \frac{\sum_{i=1}^{n} I_{nsi}}{n} \tag{2}$$

Where, D_n is one of the dimensions of SERVQUAL (Tangibility, Reliability, Responsiveness, Assurance and Empathy). I_{nsi} represents the indicators indexed by i, and n is the number of indicators under each dimension. This equation has been used for each dimension.

In the last part of the calculation, a final index value has been found, representing one of the slum areas or both the slum areas together. Eq. (3) is showing the calculation of the final index value following LVI.

$$SERVQUAL_i = \frac{\sum_{i=1}^{5} w_{Di} D_{ni}}{\sum_{i=1}^{5} w_{Di}} \tag{3}$$

Here, $SERVQUAL_i$ represents the SERVQUAL index value which explains the current sanitation service quality of a single slum or

both slums together. w_{Di} is the weight for each dimension. The weight of the dimensions is the number of indicators that are under that corresponding dimension. This weighted value ensures that all the indicators are contributing equally to the *SERVQUAL$_i$* (Hahn et al., 2009; Sullivan, 2002). Higher SERVQUAL index value means that the sanitation service quality is better for that particular slum or that particular data set. Table 2 is showing the dimensions and indicators that have been used for this research. It is also describing the indicators in details, along with their unit and survey questions.

3.7.4. Identification of sanitation service gap

As the COVID-19 is a very recent disease and the current generation doesn't have any experience to face such a mass global pandemic, it is essential to find the sanitation service gap that can work as a catalyst for spreading the virus. In this case, the previous SERVQUAL analysis has been used to determine the indicators that are noticeably low index value and related to the COVID-19 spreading directly or indirectly. For this purpose, a rigorous literature review has been used to find out the indicators and their current condition.

4. Results

4.1. SERVQUAL index

Table 3 is showing the results of overall SERVQUAL indexing from both slums. The results reveal that the index value is highest for the dimension Assurance (index value of 0.58). The slum dwellers are finding equal opportunities for using the latrine and also, most of the slum dwellers are using latrines that are secure for women and children at night. But the problem they are facing is in the dimension of Responsiveness (index value of 0.23). They are not getting services from the concerned authority, which is a critical issue in this pandemic. Also, the lack of regular inspection and unawareness about selecting the specific latrine type makes the index value for that dimension low. Noticeably low standard values have been found for the indicators: types of the latrine, pit overflows, and place for pit/

Table 2

Dimensions and indicators.

Dimensions	Indicators	Unit	Descriptions
Tangibility	Types of latrine	Percentage	Between the category of private toilet and community toilet, the percentage of people using the private toilet has been taken as the quality of this toilet is safer.
	Latrine structure	Percentage	Between the category of pucca, semi-pucca and kaccha, the percentage of people using pucca has been taken as this is the best quality of toilet.
	Pit overflows	Percentage	Between the category of never, often and regular, the percentage of household using latrine that never has pit overflows has been taken.
	Number of users per latrine	Average	The average number of user household in all the available latrines.
	Proper lighting system	Percentage	The percentage of household who are using latrine that has proper lightning system has been taken.
	Place for pit/septic tank sludge dump	Percentage	The percentage of households using the sludge dump connected to the municipal sewerage network has been taken.
Reliability	Functionalities of latrine	Percentage	Percentage of household who are using well-functioned latrine has been taken.
	Cleanness of latrine	Percentage	Percentage of household who are using no fleece/totally clean latrine has been taken.
	Cleaning frequency of latrine	Percentage	Percentage of household using a latrine, which has cleaning frequency more than twice a week, has been taken into account.
	Inner water supply	Percentage	Percentage of household who are using latrines that have an internal water supply.
	Inner hand washing facility	Percentage	Percentage of household who are using latrines that have inner hand washing facility.
	Latrine connection	Percentage	Percentage of household who are using latrines which the outlet is not connected to outside
	Payment for cleaning latrines	Percentage	Percentage of household that pays for cleaning the latrine as a community basis.
Responsiveness	Getting service from concerned authorities	Percentage	Percentage of household that uses latrine, which gets service from concerned authorities.
	Selection of specific type of latrine	Percentage	Percentage of household who used latrine that has been selected by the NGOs and the community's participation.
	Selection of the specific site for installment of the latrine	Percentage	Percentage of household that uses latrines that has site selected by the people of the community.
	Regular inspection of sanitation condition	Percentage	Percentage of household who uses latrines that are under regular inspection.
Assurance	Latrines are secured for women and children at night	Percentage	Percentage of household that uses latrine, which is secured for women and children at night.
	Distance of latrines form water bodies	Average	The average distance of latrine from water bodies.
	Latrines physically accessible	Percentage	Percentage of household that uses physically available latrines.
	Equal opportunities for using latrine	Percentage	Percentage of household that uses latrine which has an equal opportunity for everyone.
	Emptying process	Percentage	Percentage of latrine that uses an automatic emptying process
Empathy	Segregation of male and female	Percentage	Percentage of household who uses latrine that has segregation for male and female.
	Facilities for disable people	Percentage	Percentage of household that uses latrine which has facilities for disabled people.
	Responsibility of cleanness, O&M	Percentage	Percentage of household who uses latrine that has caretaker for operation and maintenance.
	Initial financial and technical support to finish the latrine.	Percentage	Percentage of household who uses latrine that has financial and technical support from NGOs.

Table 3
Overall index table.

Dimensions	Indicators	Units	Current value (I_n)	Standard value (I_{ns})	Index value (D_n)
Tangibility	Types of Latrine	Percentage	8.04	0.0804[a]	0.296
	Latrine Structure	Percentage	93.75	0.9375	
	Pit Overflows	Percentage	17.86	0.1786[a]	
	Number of Users per Latrine	Average	30.08	0.510943	
	Proper Lighting System at Night	Percentage	6.25	0.0625[a]	
	Place for Pit/Septic Tank Sludge Dump	Percentage	0.89	0.0089[a]	
Reliability	Functionality of Latrines	Percentage	8.04	0.0804[a]	0.27
	Cleanness of Latrines	Percentage	2.68	0.0268[a]	
	Cleaning Frequency of Latrines Per Week	Percentage	17.86	0.1786[a]	
	Inner Water Supply System	Percentage	0	0[a]	
	Inner Hand Washing Facility	Percentage	1.79	0.0179[a]	
	Latrine Connection	Percentage	82.93	0.8293	
	Payment for Cleaning Latrines	Percentage	76.79	0.7679	
Responsiveness	Getting Services from Concerned Authorities	Percentage	10.71	0.1071[a]	0.23
	Selection of the Specific Type of Latrine	Percentage	0.89	0.0089[a]	
	Selection of the Specific Site for Installation of Latrines	Percentage	66.07	0.6607	
	Regular Inspection for Sanitation Condition	Percentage	16.07	0.1607[a]	
Assurance	Latrines are secure for women and child at night	Percentage	87.5	0.875	0.58
	Distance of Latrines from Waterbodies	Average	13.46	0.211186	
	Latrines Are Physically Accessible	Percentage	83.04	0.8304	
	Equal Opportunity for Using Latrines	Percentage	100	1	
	Emptying Process	Percentage	0	0[a]	
Empathy	Segregation for Male & Female	Percentage	64.29	0.6429	0.37
	Latrine Facilities for Disable People	Percentage	16.96	0.1696[a]	
	Responsibility for Cleanness	Percentage	4.46	0.0446[a]	
	Initial financial & technical support to install the latrine	Percentage	62.5	0.625	

[a] Noticeably low index value.

septic tank sludge dump, which is very important for ensuring the Tangibility (index value of 0.296) of sanitation service. Reliability, one of the most important dimensions, has only an index value of 0.27, which is extremely poor. Most of the latrines are not well functioned, and the latrines' cleaning frequency is shallow. Inner water supply and inner handwashing facilities are also making a burden to this dimension's index value. Empathy's index value is better than Tangibility, Reliability, and Responsiveness, but lack of
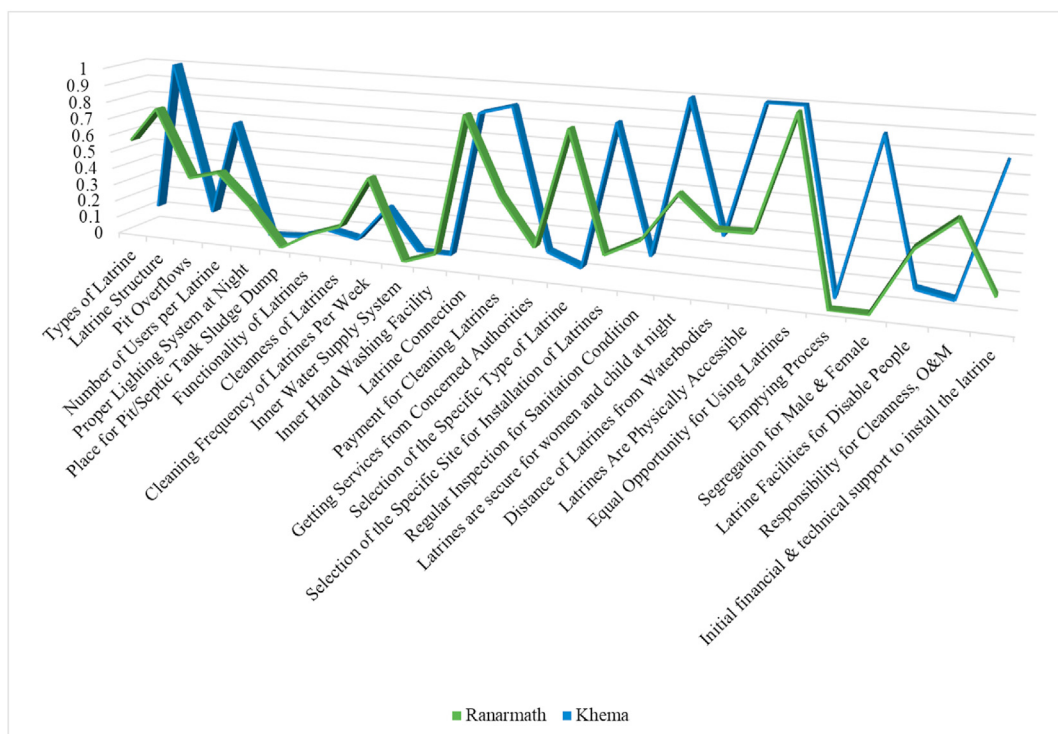

Fig. 2. Index value comparison of indicators (Ranarmath and Khema slum).

facilities for disabled people and responsibility for cleanness is the weakness of this dimension. The overall SERVQUAL index value for both these slums is 0.347, which is below average.

4.2. SERVQUAL comparison between the two slums

Fig. 2 is showing the comparison between the index value of indicators for Ranarmath and Khema slum. The line chart indicates that though there are some cases where the value is better for Ranaramath slum, most of the time, Khema slum is surpassing Ranarmath slum. The comparison has also been illustrated in Fig. 3. The index value of dimensions has revealed that Ranarmath slum has better sanitation service quality according to Tangibility, Reliability and Responsiveness. Latrine types, latrine structure, cleaning frequency, and responsibility of cleaning the latrine are better in Ranaramath slum than in the Khema slum. But segregation of male and female, payment for cleaning the latrine and financial and technical support is noticeably strong and effective in Khema slum. These crucial indicators contribute significantly to the Assurance and Empathy which is the reason behind the difference between these two slums. As the Khema slum is like a refugee camp for a meager ethnic group (Bihari), it is expected that they have more financial and technical support from the NGOs and the concerned authorities. But the overall SERVQUL index value is 0.35 for Ranarmath slum and 0.39 for Khema slum, which is deficient in terms of sanitation service quality.

4.3. Sanitation service gaps for tackling COVID-19

4.3.1. Identifying the sanitation service gaps

The SERVQUAL index is already pointing out the vital sanitation service lacking that are already existing in the slum areas. However, all the indicators are not responsible for intensifying the COVID-19 situation. Cleanness is one of the major factors that must be followed for lowering the spread of the pandemic. From the perspective of sanitation, inner handwashing facility and inner water supply under the Reliability dimension can contribute directly to tackle COVID-19. Hand hygiene is one of the core measures that has been suggested by the World Health Organization (WHO). In case of a pandemic, this particular measure is also important for most common diseases like Diarrhea, Cholera and Typhoid (Ray, 2020; World Health Organization, 2020). As it is clearly stated that consistent application and improvement of WASH (water, sanitation, and hygiene) can help prevent human to human transmission of COVID-19, the major sanitation service gap lies between these three components (WHO and UNICEF, 2020).

4.3.2. Evaluating the sanitation service gaps

Fig. 4 is showing the standard value of indicators that are contributing to the SERVQUAL index. These indicators are directly or partially interrelated with the spreading of COVID-19, as discussed in Section 4.3.1. The number of users per latrine is an important indicator as it is essential to keep social distancing at its best. Results indicate that Ranarmath slum is better in this case as the standard value is low means that the slum has less average user per latrine than the Khema slum (Ranarmath slum has an average of 5 people per latrine and Khema slum has an average of 40 people per latrine). Aside from this, it has been revealed that the core indicators inner water supply and inner handwashing facilities have in one word 0 for both slums, which can raise a severe complication of health hazard in the pandemic situation. Though Ranarmath slum is better at getting services from concerned authority and responsibility for cleanness, the nonexistence of segregation for males and females makes the slum more vulnerable to the pandemic. Overall, both slums are not in good shape for tackling this pandemic situation as the core sanitation services responsible for preventing the disease are currently facing a massive gap of unavailability.

5. Discussion and conclusion

This paper has tried to understand the limitations that slum dwellers face in the field of sanitation service. Though this research's primary focus is to find out the sanitation service gaps, incorporating the services that are directly or indirectly related to COVID-19 has made the research more reasonable in this current situation. The method that has been used in this paper is partially unique but following the SERVQUAL model directly. It is an effective and recognized way of assessing the service quality of sanitation, but the data is not representing the current situation. As it is risky to conduct field survey and people are tensed about the pandemic, unable to observe the current sanitation service quality in the slum areas is one of the major limitations of this research. But the study tries to overcome the limitation by using the available data at its highest limit to find out the gaps in the sanitation service that can significantly affect the urban slum dwellers.

The slum dwellers and low-income groups have always been lacking in finding proper sanitation service, which is a critical issue in the time of a global pandemic. The Coronavirus can be deadlier with the changing weather of Southeast Asia. The rapid temperature variation in the coastal area of Bangladesh can be dangerous as the virus affects by an influenza type Corona disease. Several pieces of research concluded that an increase in temperature decreases the mortality rate of the virus, which indicates that the virus can be deadlier in the coming winter season in Bangladesh with a sudden decrease in temperature (Demongeot et al., 2020; Ma et al., 2020). The winter season has always been a pathetic time of the year for these low-income people who don't afford to buy winter clothes. Moreover, the lack of direct preventing measures like handwashing facilities, water supply availability and overcrowded latrines make the upcoming situation worse than ever. So, the authority needs to emphasize the sanitation service gaps that trigger the pandemic's spreading indicated in the research and take adequate measures to mitigate the future challenge.
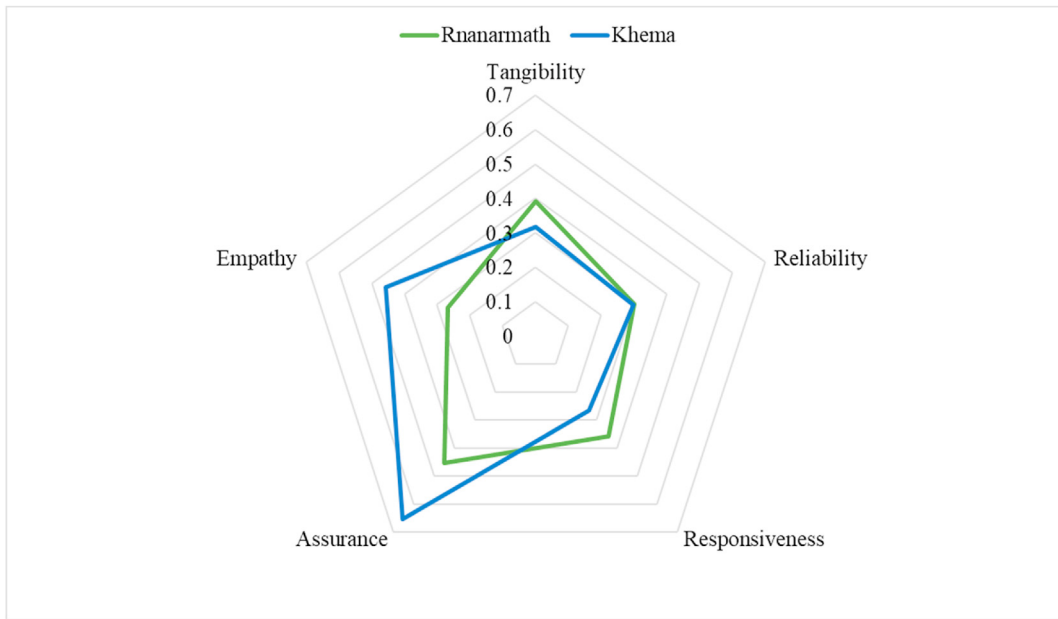
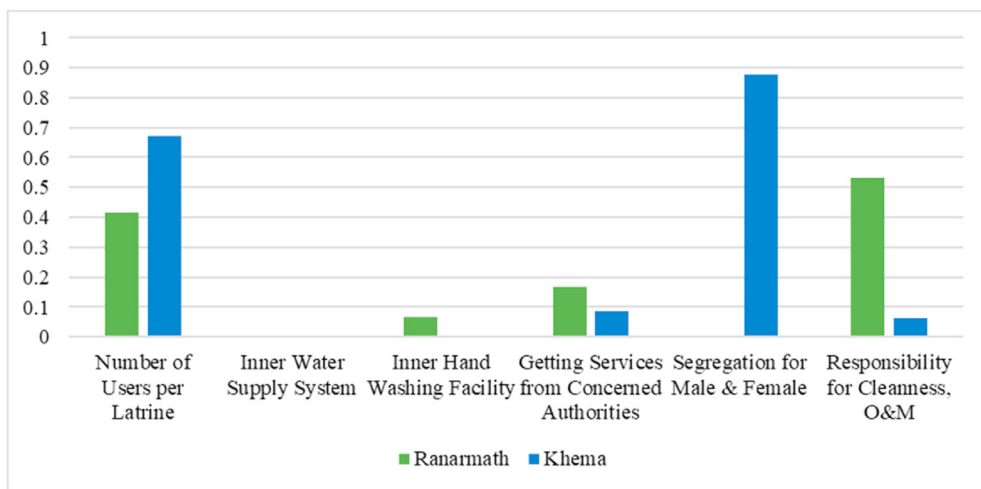**Fig. 3.** Index value comparison of dimensions (Ranarmath and Khema slum).

Fig. 4. Condition of sanitation services that are related with COVID-19 spreading.

Declaration of competing interest

The authors confirm that there is no established conflict of interest involved in this research paper.

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