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# From Click to Collect: Exploring the Impact of Last-Mile Delivery Management on Customer Satisfaction in Urban Smart Pickup Systems of Bangladesh

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## ABSTRACT

**Objectives:** This study is intended to investigate the impact of last mile delivery management on customer satisfaction in the context of smart pickup system in urban area of the fast-growing e-commerce industry in the Republic of Bangladesh. In particular, it explores how five constructs route optimization (RO), delivery scheduling (DS), tracking transparency (TT), lack of security (LS) and speed of delivery (SD)) affect customer satisfaction (CS).

**Methods:** Cross-sectional research with quantitative approach was used and data collected from 455 respondents by multi-stage sampling method in major cities of Bangladesh. Both measurement and structural models were tested using structural equation modelling (SEM) conducted with the software SMARTPLS 4.0 with the assessment of path coefficients ($\beta$), p values and $R^2$ values.

**Results:** The model accounts for a considerable amount of customer satisfaction variation. There were four hypotheses that were supported: the strongest predictors were speed of delivery and route optimization, followed by delivery scheduling and transparency of tracking. Notably, the lack of security was not significant, suggesting that lacking security is not a major concern for urban customers in the smart pickup context, rather it is more important to achieve better operational efficiency.

**Conclusions:** This study contradicts the traditional LSQ-SERVQUAL argument that transparency and security are more important than speed and routing in the Bangladesh context of low regulation and scarcity of time in urban areas. Findings inform delivery providers of what they should be doing to optimize routes in real time and provide speed guarantees. Further studies are needed to investigate the moderating effects of pickup point density, order value and product type in various geographic locations.

**Keywords:** Last-Mile Delivery, Customer Satisfaction, Smart Pickup Systems, E-Commerce Logistics, Bangladesh

## INTRODUCTION

The e-commerce boom has indeed transformed global retail logistics, with delivery last mile management now a key factor for customer satisfaction in online shopping environments (Asawawibul et al., 2025). As the last and most customer-exposed segment in logistics operations, last-mile delivery greatly affects customers' perception of service quality, convenience, reliability, and overall online shopping (Vrhovac et al., 2023). Besides, in addition to timely delivery, smart delivery methods, and flexible collection options, consumers also want secure parcel handling and real-time tracking. Such demands have prompted e-commerce companies to implement smart, tech-enabled pick-up points and click-to-collect methods to increase efficiency and customer convenience (Wang, 2025).

Smart pick-up means offering customers a chance to collect their parcels from the automated lockers or from the designated pick-up points themselves as instead of being only dependent on home delivery they can use these options (Mogire et al., 2023). These systems also contribute to lowering the number of unsuccessful deliveries, enhancing delivery coordination, and reducing traffic-related disruptions while at the same time allowing for more customer flexibility (Vrhovac et al., 2023). As a result, aspects of logistics service quality such as route optimization, delivery scheduling, tracking transparency, delivery speed, and delivery security have been gaining in importance for defining customer satisfaction in urban fulfillment ecosystems (Turgut, 2025).

Bangladesh has become one of the fastest expanding e-commerce markets in South Asia, which also has led to a big strain on urban logistics systems. In line with the findings of Mordor Intelligence (2026), the Bangladesh freight and logistics industry size is estimated to rise from USD 32.92 billion in 2026 to USD 38.13 billion in 2031. Besides, Bangladeshi e-commerce sector was around US$9 billion in 2024 and is expected to exceed the US$13 billion level by 2027 (PCMI, 2024). Nevertheless, the urban logistics infrastructure and the last-mile delivery systems keeping pace with this growth have yet to be adequately developed. Heavy traffic congestion, the problem of lacking addressing systems, the delivery delays, inefficiencies in operations are quite serious challenges that urban fulfillment operations are facing in the cities of Dhaka and Chattogram (Mordor Intelligence, 2026). Besides, since over 50% of the population is still outside the banking sector, their main source of reliance is on cash-on-delivery, which means that the logistics coordination within e-commerce networks gets complicated (Bangladesh Bureau of Statistics, 2023).

These drawbacks in the operations result in a whole range of dissatisfaction on the part of customers due to issues such as route planning being poor, delivery times being inflexible, severely limited tracking visibility, delivery speed being slow, and security concerns at the time of package collection and delivery processes (Fouad et al., 2023). It has been demonstrated in earlier studies that the feature of delivery being reliable, having communication in real-time, tracking being accurate, and responsiveness to services greatly affects customer satisfaction and online buying behavior (Asawawibul et al., 2025; Tian et al., 2025). On the other hand, smart pickup systems have hardly been empirically studied in developing urban contexts like Bangladesh, while existing papers are mostly dealing with traditional home delivery systems or logistics environments in developed countries (Silva & Nilsson, 2025). In addition, few works have been done to collectively incorporate route optimization, delivery scheduling, tracking transparency, delivery speed, and security concerns within a framework explaining customer satisfaction in click-to-collect systems.

So, a major contextual and empirical research gap exists on how operational last-mile delivery management dimensions together impact customer satisfaction in urban smart pickup systems of Bangladesh. This study to fill the gap first of all asked these questions:

**RQ1:** What service quality issues and customer satisfaction challenges are associated with last-mile delivery management in urban smart pickup systems?

**RQ2:** What opportunities and operational challenges influence the effectiveness of smart pickup systems in enhancing customer satisfaction in Bangladesh’s e-commerce sector?

**RQ3:** What effects do route optimization, delivery scheduling, tracking transparency, lack of security, and speed of delivery have on customer satisfaction in urban smart pickup systems of Bangladesh?

The paper is based on two models: Logistics Service Quality (LSQ) by Mentzer et al. (2001) and SERVQUAL by Parasuraman et al. (1985). LSQ Model is primarily about measuring logistics performance by assessing aspects such as timeliness, quality of information, and condition of delivery (Ta et al., 2025); whereas SERVQUAL is a tool to measure customer perceptions of service in dimensions such as reliability, responsiveness, assurance, and tangibility (Sangkhiew et al., 2025). These two models, when combined, provide a strong theoretical foundation for investigating customer satisfaction in smart pickup systems that are supported by digital technologies (Faisal, 2024; Mỹ, 2023).

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Overall, this research is essential from both a theoretical and practical point of view. On the theoretical side, it refines and deepens the understanding of LSQ and SERVQUAL by taking urban click-to-collect systems and developing economy context as the focus of study. On the practical side, the results can guide e-commerce companies, logistics service providers, and government bodies in route planning, delivery flexibility, tracking system, security assurance, and delivery speed to enhancing customer satisfaction and operational performance in the digital economy of Bangladesh. Therefore, this paper has set itself up to explore the effect of route optimization, delivery scheduling, tracking transparency, lack of security, and speed of delivery on customer satisfaction in urban smart pickup systems of Bangladesh.

## LITERATURE REVIEW

### Theoretical Framework

### Logistics Service Quality (LSQ) Model

The LSQ model was initially designed by Mentzer, Flint, and Hult in the late 1990s after they discovered that conventional service quality models did not properly consider the distinctive operational aspects of logistics and distribution (Mentzer et al., 2001). Whereas earlier theories were mainly concerned with service personnel and customer interactions, the LSQ model features factors that are more closely associated with order fulfilment, the delivery of goods, and distribution (Khan, 2023). This situation becomes even more complicated in the major cities of Bangladesh where the growth of digital retail is very fast and, at the same time, the infrastructure development is lagging behind (Raihan et al., 2025). The LSQ model can help us understand the way in which customers make up their minds about buying from a logistics service provider in the case of a smart pickup system (Minh et al., 2024). The LSQ model consists of a few commonly linked aspects: timeliness (delivery within the time promised), information quality (correctness of delivery related communications), ordering procedures (ease of scheduling), and order condition (physical state of packages) (Tee et al., 2025). Ultimately, customers' satisfaction is the outcome of the customer evaluation of logistics service quality in urban smart pickup systems (Lin et al., 2023).

### SERVQUAL Model

In the late 1980s, Parasuraman, Zeithaml and Berry developed the SERVQUAL model to measure service quality with respect to five ranges – tangibles, reliability, responsiveness, assurance and empathy (Parasuraman et al., 1985). Prior logistics theories emphasized operational efficiency without adequately capturing the customer's subjective evaluation of service delivery. (Asamoah, 2025). SERVQUAL tries to close this gap by emphasizing the perceptual gap between service's benchmarks and realized execution (Mentzer et al., 2001). The tangibles are visible infrastructure such as digital interfaces and pickup facilities, reliability is reliable service execution, responsiveness is prompt service and proactive communication, assurance is trust and security and empathy are individual customer convenience (Masum, 2025; Aljohani, 2024). Tangibles is related to the condition of lockers and the usability of the application, Reliability is related to the ability to arrive at the correct location in time, Responsiveness relates to the ability to solve problems quickly, Assurance relates to the safety and identification of the parcel, and Empathy is about adapting to the needs of individual customers, such as extended holding periods (Islam, 2025).

These two models provide a comprehensive theoretical basis that includes operational and perceptual aspects of the service quality of an urban smart pickup system in Bangladesh (Mentzer et al., 2001; Parasuraman et al., 1985).

### Hypothesis Development

### Route Optimization (RO) and Customer Satisfaction (CS)

Route Optimization (RO) is one of the crucial components of last mile delivery systems as it optimizes delivery by reducing the distance, fuel consumption and operational costs, while also assuring timely service (Shuaibu et al., 2025; Zosu et al., 2024). Despite these efforts, traffic jams, sub-optimal routing, and variable road conditions persist, impacting delivery timeliness and customer satisfaction (Yerra, 2024; Sibarani et al., 2026). Additionally, Ünal et al. (2025), talked about the benefits of smart routing for customer satisfaction and environmental responsibility, emphasizing the need for traffic data in real-time for reliability. Dui et al. (2024) began research to tackle real-time traffic adjustment systems; Mohsen (2024) introduced the comparative importance of AI and IoT technologies in predicting route optimization. In line with the Logistics Service Quality (LSQ) Theory and the SERVQUAL model, Route Optimization is linked to timeliness and reliability aspects of delivering a better service quality and customer satisfaction in smart Pickup systems (Aqabneh, 2025). As a result, our proposed hypothesis is:

**H1: Route Optimization has positive effect on Customer Satisfaction in last-mile delivery services**

**Delivery Scheduling (DS) and Customer Satisfaction (CS)**

Delivery scheduling (DS) is an important part of the last-mile delivery process because it enables timely delivery of the orders, flexibility in operations, and ease of the customers (Ashraf & Bardhan, 2025). Delayed deliveries, inflexible delivery slots and lack of coordination, however, still decrease the delivery reliability and service quality (Ylitalo, 2023). Gerami and Gerami (2025) presented that effective scheduling improves operational efficiency and minimizes delays, while Patel and Rahimi (2026) have tried to explore whether AI-based scheduling enhances forecasting and load balancing. Lu (2025) also posed issues such as real-time disruptions and emphasized adaptive scheduling for delivery reliability. Amorim et al. (2024) studied on how customers perceive flexible delivery slots and discovered that flexible scheduling enhances customer convenience and satisfaction. Delivery Scheduling is consistent with the Logistics Service Quality (LSQ) Theory and SERVQUAL model, which addresses ordering procedures, responsiveness, and empathy that can enhance customer perceptions of smart pick-up services (Go et al., 2025; Li, 2023). So, proposed hypothesis:

**H2: Delivery Scheduling has positive effect on Customer Satisfaction in last-mile delivery services**

**Tracking transparency (TT) and Customer Satisfaction (CS)**

Tracking transparency (TT) is a real-time visibility of the delivery progress, which is based on the SERVQUAL’s information quality and responsiveness of LSQ (Ahmad & Aamir, 2026; Francis et al., 2025). Even with advanced GPS and AI-driven systems, customers continue to experience uncertainty, inaccurate ETA's and poor communication, which can lead to a loss of trust in last mile services (Asadollahi et al., 2025). Dwivedi and Dey (2025) reported that transparency in tracking leads to satisfaction and eradicates uncertainty. Shuaibu et al., 2025 have attempted to understand if there is any enhancement in the efficiency of the communication process by using AI and IoT tracking, but it has also raised questions like what about customer anxiety due to less frequent updates? Al-Srogy et al. (2025) started an investigation to control the routes when live GPS visibility is available, and they observed that improved route control is achieved. Xie et al. (2024) discussed the comparative importance of the estimated delivery time countdown systems for boosting the customer's confidence. So, we can propose the next hypothesis:

**H3: Tracking Transparency has positive effect on Customer Satisfaction in last-mile delivery services**

**Lack of Security (LS) and Customer Satisfaction (CS)**

Lack of Security (LS) indicates the vulnerabilities that may be encountered by customers, packages and personal information when in the process of delivery, which can cause, among others, theft, privacy violation and data leakage (Stefanova & Stoyanova, 2023). For last-mile logistics, security is now an emerging issue since customers are aware that during delivery, their physical safety and information security must be protected (Olsson et al., 2023). This construct reflects the main security vulnerabilities according to order condition dimension of the LSQ and the assurance component of SERVQUAL (Go et al., 2025). Queiroz and Abe (2024) demonstrated that poor security systems create risks of package damage, theft, and data breaches by customers. Faramarzi-Oghani et al. (2025) have attempted to investigate how package mishandling and inadequate data security affects customer trust. Similarly, Xiao (2024) asked questions about the unexpected shots taken by the camera and the discomfort of customers with delivery pictures or videos. To tackle these privacy issues associated with the last mile delivery, Leon et al. (2023) found that the violations of privacy have a significantly negative effect on customer comfort. Further, Tondolo et al. (2025) includes an analysis indicating that the visibility and lack of security of packages creates a fear of theft and reduced satisfaction. Therefore, proposed hypothesis:

**H4: Lack of Security has negative effect on Customer Satisfaction in last-mile delivery services**

**Speed of Delivery (SD) and Customer Satisfaction (CS)**

Speed of Delivery (SD) is the logistics service provider's ability to carry out order processing and delivery activities within a specific and short time frame in a reliable manner (Ha et al., 2023). As a leading indicator of customer satisfaction, trust, and return business, the speed of delivery is a crucial aspect of e-commerce logistics (Ngo et al., 2025). The construct under investigation is based on the timeliness dimension of the LSQ and the reliability dimension of the SERVQUAL and highlights efficient and responsive delivery processes (van der Schenk, 2021; Nguyen et al., 2026). Yet, there is still customer dissatisfaction due to delays in the order processing, long waiting time, and inefficient delivery completion (Vrhovac et al., 2024). Trung et al. (2025) reported that one of the major components which impacts the customer satisfaction in relation to convenience and reliability of the delivery is the delivery time. Yusoff et al. (2023) have attempted to see if the quick delivery service has positive effects on customer trust and repeat buying. Islam et al. (2024) also raised the problems of slow order fulfillment and highlighted that quick order fulfillment enhances the customer experience. Nagadeepa et al. (2024) explored new delivery models like the delivery network and the delivery using drones, which can help to shorten the delivery time. Furthermore, Aslam and Li (2026) research results have presented that the customer satisfaction level is automatically lowered when deliveries are delayed. Consequently, we propose hypothesis:

**H5: Speed of Delivery has positive effect on Customer Satisfaction in last-mile delivery services**

Following our discussions above, we proposed a comprehensive research framework (Figure 1) in the form of direct impacts of last-mile delivery management dimensions on customer satisfaction in urban smart pickup systems of Bangladesh:

## CONCEPTUAL FRAMEWORK

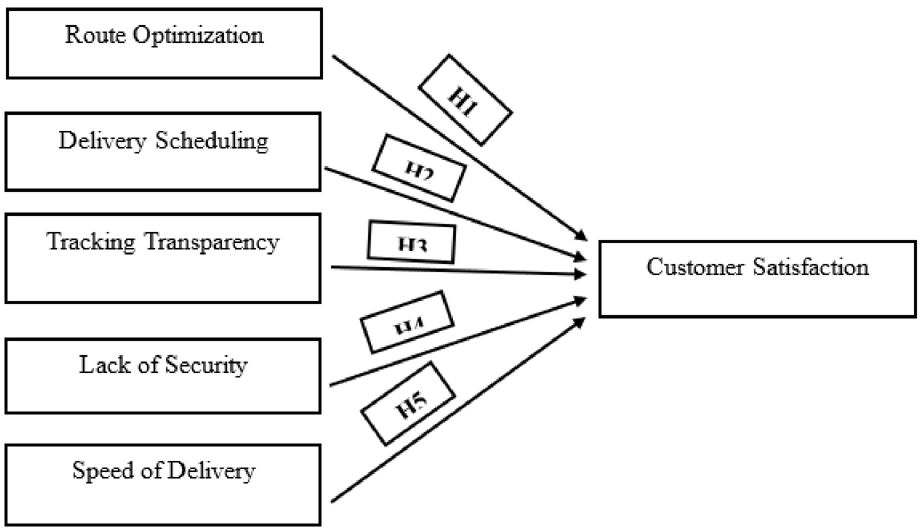


**Figure 1.** Framework of the study
**Source(s):** Developed by the Researchers

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# METHODOLOGY

## Sampling

The target population is those who actively use these smart pickup services in urban areas of Bangladesh. Hair et al. (2022) structural equation modelling (SEM) recommendations allowed for the effective sample of 455 respondents to be secured which ultimately led to the statistical validity, robustness, and generalizability of the results. In order to direct the consumers of smart pickup systems properly, a multistage sampling was implemented for the selection of the sample to ensure those who have a very direct exposure to smart pickup systems and thus be able to provide the most relevant knowledge and experience in answering the questionnaire (Ajayi, 2026).

The participants of the research were customers who were using the smart pick-up service in urban areas of Bangladesh (Islam et al., 2024). Three main centers (with varying last-mile delivery structures and number of self-service lockers adopted) were used as the primary sampling strata to capture geographic and operational diversity (Touloumidis et al., 2025). Stratified design in the form of multi-stage design was then employed (Özarık et al., 2024). The selection of five high traffic locker points from each center with high user ratings and multiple outlets were made purposively in the first stage, getting 10 outlets proportionally to show the density of smart locker (Islam et al., 2024). The above-mentioned strategy by area and time led to the sampling of 455 respondents who matched the estimated number of people using the areas on a daily basis (Özarık et al., 2024). Every 7th buyer was selected via systematic sampling in each outlet and incomplete or irrelevant responses were not included in the data to ensure it was of high quality (Jazairy et al., 2025). This multi-stage approach was comprehensive, with a cross-section of geographic coverage and user experiences (Ajayi, 2026).

## Data collection procedures

The responses was accumulated from 01st January to 31st April 2026, both online and offline. Google Forms were sent through e-mail and social media channels like Facebook Messenger, LinkedIn, WhatsApp groups of residential communities and paper-based questionnaires were issued offline at the pickup locker locations to collect responses from those who do not use social media. Ethical procedures were adhered to, which included informed oral consent, anonymity of responses, and overall confidentiality of participant information (Gupta, 2023). Hair et al. (2022) recommend a minimum sample size of at least 100 times the number of structural paths pointing to the endogenous construct that is the largest number of paths in the model. During the present study 455 valid responses were collected, which is more than the minimum requirement; therefore, it could be sufficiently employed for SEM analysis.

## Measures

The structured questionnaire was adopted and adapted from existing scales in the literature of last-mile logistics that were validated, with the constructs being Route Optimization (RO), Delivery Scheduling (DS), Tracking Transparency (TT), Lack of Security (LS), Speed of Delivery (SD), and Customer Satisfaction (CS) (Upadhyay et al., 2024). Each construct was measured with three items with a five-point Likert scale. A content validity, clarity of wording, and item reliability pre-test was administered to 30 logistics management academic experts who are frequent smart pickup users. Based on their feedback on readability, contextual appropriateness, and cultural relevance for urban Bangladesh, necessary improvements were made to the items.

**Table 1: Construct Table**

| Constructs | Items | Relevant literature |
|---|---|---|
| Route Optimization (RO) | No traffic delays | Veluru (2023); Ünal et al. (2025) |
| | Real-time traffic adjustment | Dui et al. (2024); Ünal et al. (2025) |
| | Shortest path selection | Shuaibu et al. (2025); Moghaddasi et al. (2023) |
| | Flexible delivery slot | Amorim et al. (2024); Lu (2025) |

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| | | |
|---|---|---|
| Delivery Scheduling (DS) | On-time scheduling | Gerami & Gerami (2025); Ashraf & Bardhan (2025) |
| | Real-time rescheduling | Lu (2025); Patel & Rahimi (2026) |
| Tracking Transparency (TT) | SMS/Email Tracking Updates | Dwivedi & Dey (2025); Shuaibu et al. (2025) |
| | Live GPS Order Visibility | Al-Srogy et al. (2025); Ahmad & Aamir (2026) |
| | Estimated Delivery Time Countdown | Xie et al. (2024); Asadollahi et al. (2025) |
| Lack of Security (LS) | Unexpected camera capture | Xiao (2024) |
| | Identity exposure risk | Faramarzi-Oghani et al. (2025); Leon et al. (2023) |
| | Personal property visibility | Tondolo et al. (2025); Stefanova & Stoyanova (2023) |
| Speed of Delivery (SD) | Fast order processing | Trung et al. (2025); Islam et al. (2024) |
| | Quick delivery completion | Nagadeepa et al. (2024); Ha et al. (2023) |
| | Minimal waiting time | Aslam & Li (2026); Vrhovac et al. (2024) |
| Customer Satisfaction (CS) | Safely package arrival | Queiroz & Abe (2024); Olsson et al. (2023) |
| | Minimal delivery hassle | Yusoff et al. (2023); Ngo et al. (2025) |
| | Satisfaction with speed | Trung et al. (2025); Aslam & Li (2026) |
| **Source(s):** Developed by the Researchers | | |

**Data analysis procedures**

Partial Least Squares Structural Equation Modelling (PLS-SEM) with SmartPLS software version 4.0 was used for analysis of collected data. The researcher chose PLS-SEM as the method due to its compatibility for predictive studies and in this study, there were relatively medium sample sizes, and in using multiple constructs and indicators. Prior to the testing of the hypotheses, the model was tested in terms of reliability, convergent validity, and discriminant validity, by using Cronbach's alpha, composite reliability (CR), and average variance extracted (AVE). It was considered that Cronbach's alpha and CR coefficients above the range of 0.70 and AVE above the range of 0.50 were acceptable. To make sure the indicators are not very strongly correlated with each other, Variance Inflation Factors (VIF) were computed and values of $< 3.0$ were considered as satisfactory. Heterotrait-monotrait (HTMT) ratio was implemented to determine discriminant validity and a ratio $< 0.85$ was deemed to have discriminant validity. Hypotheses on relationships were tested by bootstrapping with 5,000 resamples to calculate the standard errors, t-statistics and p-values and the significance of the path coefficients were investigated. The $R^2$ values of endogenous construct (Customer Satisfaction) were calculated to measure predictive accuracy of the model as follows: $R^2$ values of were considered as weak if the span is between 0.25, 0.50 and 0.75, moderate and strong predictive accuracy, respectively. Furthermore, the predictive relevance ($Q^2$) was calculated using blindfolding method, where $Q^2>0$ could be considered as signaling significance of the system for the intrinsic latent variable (Ghazali & Yaacob, 2025; Hair et al., 2022).

## ANALYSIS AND RESULTS

**Respondents' Demographic Characteristics**

**Table 2: Demographic Profile of the Respondents**

| Aspects | Classification | Frequency | Percentage (%) | Total Number | Total Percentage |
|---|---|---|---|---|---|
| Age | 18 to 24 years | 118 | 25.9 | 455 | 100% |
| | 25 to 34 years | 156 | 34.3 | | |
| | 35 to 44 years | 121 | 26.6 | | |
| | 45 to 54 years | 46 | 10.1 | | |

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| | | | | | |
|---|---|---|---|---|---|
| | 55 and above | 14 | 3.1 | | |
| Gender | Male | 241 | 53 | 455 | 100% |
| | Female | 214 | 47 | | |
| Education | Higher Secondary | 52 | 11.4 | 455 | 100% |
| | Undergraduate Degree | 224 | 49.2 | | |
| | Graduate Degree | 160 | 35.2 | | |
| | PhD/Doctorate | 19 | 4.2 | | |
| Occupation | Student | 82 | 18 | 455 | 100% |
| | Service Holder | 214 | 47 | | |
| | Business Owner | 91 | 20 | | |
| | Freelancer | 41 | 9 | | |
| | Other | 27 | 6 | | |
| Frequency of Online Shopping | Weekly | 173 | 38 | 455 | 100% |
| | Monthly | 201 | 44.2 | | |
| | Occasionally | 63 | 13.8 | | |
| | Rarely | 18 | 4 | | |
| Preferred Delivery Method | Home Delivery | 279 | 61.3 | 455 | 100% |
| | Smart Locker Pickup | 131 | 28.8 | | |
| | Retail Store Pickup | 45 | 9.9 | | |
| Experience Using Last-Mile Delivery Services | Less than 1 Year | 64 | 14.1 | 455 | 100% |
| | 1–3 Years | 208 | 45.7 | | |
| | 4–6 Years | 131 | 28.8 | | |
| | More than 6 Years | 52 | 11.4 | | |
| **Source(s):** Developed by the Researchers | | | | | |

A total of 455 respondents filled in a structured questionnaire on the influencing factors of the consumer's preference for last-mile delivery services, which it was confirmed to be valid. The gender distribution of those who responded to the survey was roughly equal, with 53% male and 47% female (Table 2). It is observed that the age group 35-44 years accounted for 26.6% of the total respondents while the age group 18-24 years accounted for 25.9% of the total respondents and 10.1% of the participants were from the age group between 45 and 54 years old. The sample consisted of only 3.1% of respondents aged 55 and older. For education section, highest percentage of the interviewees had a Undergraduate degree with 49.2%, while 35.2% had a Graduate degree. Most of the survey population (11.4%) had received a secondary education and 4.2% a PhD or doctorate. When it comes to occupation, the service-holders were the biggest group (47%), followed by business owners (20%) and students (18%). The percentage of freelancers and others were 9% and 6%, respectively. The study also looked at how often the respondents shop online, with 44.2% shopping monthly, 38.0% shopping weekly, 13.8% shopping occasionally and 4.0% shopping rarely. As for preferred delivery methods, 61.3% said that home delivery is their preferred option; 28.8% said smart locker pickup is their preferred method; and 9.9% said retail store pickup is their preferred method. Lastly, 45.7% of the participants had 1–3 years of experience, 28.8% had 4–6 years, 14.1% had less than a year, and 11.4% had more than 6 years, when asked how many years they had been using last-mile services.

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## Measurement Model

### Validity and Reliability of the Constructs

**Table 3. Validity and Reliability of the Constructs**

| Constructs | Item(s) | Loadings | Cronbach's Alpha | Composite reliability (rho_a) | Average Variance extracted | VIF values |
|---|---|---|---|---|---|---|
| Route Optimization | RO1 | 0.935 | 0.928 | 0.928 | 0.875 | 3.629 |
| | RO2 | 0.936 | | | | 3.691 |
| | RO3 | 0.935 | | | | 3.707 |
| Delivery Scheduling | DS1 | 0.922 | 0.911 | 0.911 | 0.849 | 3.049 |
| | DS2 | 0.921 | | | | 3.063 |
| | DS3 | 0.921 | | | | 3.085 |
| Tracking Transparency | TT1 | 0.923 | 0.913 | 0.916 | 0.852 | 3.204 |
| | TT2 | 0.917 | | | | 3.045 |
| | TT3 | 0.929 | | | | 3.172 |
| Lack of Security | LS1 | 0.931 | 0.922 | 0.923 | 0.865 | 3.552 |
| | LS2 | 0.928 | | | | 3.243 |
| | LS3 | 0.931 | | | | 3.481 |
| Speed of Delivery | SD1 | 0.946 | 0.934 | 0.938 | 0.884 | 4.49 |
| | SD2 | 0.927 | | | | 3.427 |
| | SD3 | 0.948 | | | | 4.324 |
| Customer Satisfaction | CS1 | 0.906 | 0.905 | 0.906 | 0.841 | 2.692 |
| | CS2 | 0.911 | | | | 2.892 |
| | CS3 | 0.934 | | | | 3.513 |

**Sources (s)**: Developed by the Researchers

Numerous researchers have proposed guidelines for the interpretation of the results of measurement models. For instance, a cut-off of 0.70 or above is acceptable, and 0.60 or above can be acceptable in exploratory research (Hair et al., 2022). All factor loadings in this study were from 0.906 to 0.948. Thus, reliability of all measurement items and appropriateness of each of the measurement items to represent the respective constructs are confirmed. All the factor loadings of the items on the latent variables in the PLS model were identified to be greater than the recommended threshold significance.

To evaluate internal consistency, Cronbach's alpha, Composite Reliability and rho_A values were calculated to ensure the consistency and dependability of the items being measured. The values of 0.60 to 0.70 were considered acceptable for exploratory studies, 0.70 to 0.90 satisfactory to excellent and any value of >0.95 would be regarded as evidence of item redundancy in previous studies (Cheung et al., 2024).

The Cronbach's Alpha values and Composite Reliability (rho_A) values ranged from 0.905-0.934 and 0.906-0.938, respectively, for all constructs as shown in Table 3: Route Optimization (RO), Delivery Scheduling (DS), Tracking Transparency (TT), Lack of Security (LS), Speed of Delivery (SD), and Customer Satisfaction (CS). The recommended level for measurement model internal consistency and reliability was 0.70 and all values were above this cut-off score.

Convergent validity was calculated from Average Variance Extracted (AVE). Hair et al. (2022) provided that the value of the AVE of 0.50 or above means that the construct accounts for at least 50% of the variance in its indicators. For this study, AVE values are in the range of 0.841 – 0.884, which are all greater than the threshold value. Thus, the constructs showed good convergent validity (Cheung et al., 2024).

The relationships between the indicators of structural model were examined using the Variance Inflation Factor (VIF) and the indicator multicollinearity was checked. Hair et al. (2022) stated that VIF values in the range of 1 to 5 are generally good, with values around 3 as ideal values. The VIF values for all items included in this study were in the span of 2.692 to 4.490. No multicollinearity problem was found among the construct indicators as all the VIF values were under the threshold value of 5.

**Table 4. Discriminant Validity (HTMT Ratio)**

| | RO | DS | TT | LS | SD | CS |
|---|---|---|---|---|---|---|
| **RO** | | | | | | |
| **DS** | 0.792 | | | | | |
| **TT** | 0.768 | 0.629 | | | | |
| **LS** | 0.83 | 0.686 | 0.646 | | | |
| **SD** | 0.818 | 0.631 | 0.635 | 0.724 | | |
| **CS** | 0.753 | 0.659 | 0.631 | 0.649 | 0.701 | |
| **Note(s):** RO, Route Optimization; DS, Delivery Scheduling; TT, Tracking Transparency; LS, Lack of Security; SD, Speed of Delivery; CS, Customer Satisfaction | | | | | | |
| **Sources (s)**: Developed by the Researchers | | | | | | |

**Discriminant Validity (HTMT Ratio)**

In measurement models one of the common criteria is measured is Heterotrait-Monotrait Ratio (HTMT). If HTMT values are less than 0.90, which is the proposed value by Cheung et al. (2024), then the discriminant validity is considered satisfactory.

As per the results depicted in Table 4 it is found that all constructs have an HTMT value ranging from 0.629 to 0.830. Specifically, the values of the HTMT for Route Optimization (RO), Delivery Scheduling (DS), Tracking Transparency (TT), Lack of Security (LS), Speed of Delivery (SD), and Customer Satisfaction (CS) were all below 0.90. This indicates that the highest HTMT value is between Route Optimization (RO) and Lack of Security (LS) with a value of 0.830, while the lowest value is between Delivery Scheduling (DS) and Tracking Transparency (TT) with a value of 0.629. This indicated that all the HTMT were less than the recommended HTMT value, so constructs of the measurement model had a discriminant validity.

**Model-Fit**

**Table 5. Model-Fit Summary**

| | Saturated model | Estimated model |
|---|---|---|
| **SRMR** | 0.033 | 0.033 |
| **d_ULS** | 0.190 | 0.190 |
| **d_G** | 0.297 | 0.297 |
| **Chi-square** | 815.972 | 815.972 |
| **NFI** | 0.900 | 0.900 |
| **Sources (s)**: Developed by the Researchers | | |

Model fit values of overall model including the SRMR, d_ULS, d_G, Chi-square and NFI values (Hafeez & Siddiqui, 2025) are examined to determine the level of fit with the observed data for the proposed model. The Standardized Root Mean Square Residual (SRMR) of the saturated model is 0.033 when compared with the recommended value of 0.08 and also the estimated model has a value of 0.033 for SRMR, which also shows good and satisfactory model fit. This indicates that there was not much difference between the observed and predicted correlation matrices.

Furthermore, the difference between the data and the model-implied covariance matrix was small, that is, d_ULS and d_G were 0.190 and 0.297 respectively. The differences in the overall data set are shown by the Chi-square value, both the saturated model and the estimated model, which are 815.972.

The Normed Fit Index (NFI) value was also 0.900 with the recommended value of 0.90, which shows the proposed model was of acceptable level of explanatory power and overall goodness-of fit when compared to a null model (Elektra et al., 2024). All the fit indicators of the model indicated that it was statistically acceptable, reliable, and suitable for further hypothesis testing and predictive analysis because the fit indicators of the model were within recommended values.

**Structural Model Analysis**

**Table 6. Path Coefficients**

| Hypothesis | Path(s) | Beta | Standard Deviation | T-Statistics | p-values | Supported |
|---|---|---|---|---|---|---|
| H1 | RO → CS | 0.247 | 0.076 | 3.242 | 0.001 | YES |
| H2 | DS → CS | 0.165 | 0.052 | 3.201 | 0.001 | YES |
| H3 | TT → CS | 0.125 | 0.052 | 2.408 | 0.016 | YES |
| H4 | LS → CS | 0.058 | 0.063 | 0.918 | 0.359 | NO |
| H5 | SD → CS | 0.249 | 0.05 | 4.988 | 0.000 | YES |
| **Note(s):** RO, Route Optimization; DS, Delivery Scheduling; TT, Tracking Transparency; LS, Lack of Security; SD, Speed of Delivery; CS, Customer Satisfaction | | | | | | |
| **Sources (s):** Developed by the Researchers | | | | | | |

Several statistical values are presented to represent the direct effect of path coefficients for testing the hypotheses, such as p-values, beta values, standard deviation and t-statistics for each structural relationship (Ngah et al., 2025; Elektra et al., 2024). Two tailed t-tests were used to compute significance of the hypotheses. The following table shows the path coefficients of the direct effects (Bhagat & Jha, 2024).

The path coefficient analysis showed that Route Optimization (H1), Delivery Scheduling (H2), Tracking Transparency (H3), and Speed of Delivery (H5) played significant and positive role in Customer Satisfaction. All p values were less than 0.05 which is the recommended value. Hence, these hypotheses were confirmed.

The results revealed that the most significant positive influence on customer satisfaction was Speed of Delivery (SD → CS) with a value of 0.249 in beta. Another strong positive relationship was observed between the variables of Route Optimization (RO → CS) and a beta value of 0.247. The results highlight the importance of the delivery speed and effectiveness, in conjunction with route management, in improving customer satisfaction.

It was also found that Delivery Scheduling (DS → CS) also had a positive impact on customer satisfaction. This means that customers value accurate, reliable and convenient delivery times. Likewise, Tracking Transparency (TT → CS) had a substantial impact on customer satisfaction. This outcome indicates that customers appreciate timely track and trace details as well as ongoing communication during the shipping process.

Lack of Security (LS → CS), however, failed to have a significant effect on customer satisfaction. The p-value obtained was 0.359, which is more than the recommended range of 0.05. As such, H4 was not upheld. While security concerns may have a slight impact on the customer satisfaction, the results of this study suggest that security was not a major factor in customer satisfaction.

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**Table 7. F-square and R-square value**

| Hypothesis | Path(s) | F-square | R-square | R-square adjusted |
|---|---|---|---|---|
| H1 | RO → CS | 0.029 | 0.537 | 0.532 |
| H2 | DS → CS | 0.027 | | |
| H3 | TT → CS | 0.016 | | |
| H4 | LS → CS | 0.003 | | |
| H5 | SD → CS | 0.053 | | |
| **Note(s):** RO, Route Optimization; DS, Delivery Scheduling; TT, Tracking Transparency; LS, Lack of Security; SD, Speed of Delivery; CS, Customer Satisfaction | | | | |
| **Sources(s):** Developed by the Researchers | | | | |

When there is no collinearity, Hair et al. (2022) suggested alternative measures to determine the explained variance of dependent variables by the independent variables to be R-squared value of endogenous construct (Elektra et al., 2024). The $r^2$ value is always between 0 and 1. The value of R-squared for Customer Satisfaction (CS) was 0.537 and the value of adjusted R-squared was 0.532 based on the results presented in the table 7. This indicates that the framework explains around 53.7 % of the variance in the Customer Satisfaction, indicating that the independent variables in this study (Route Optimization (RO), Delivery Scheduling (DS), Tracking Transparency (TT), Lack of Security (LS) and Speed of Delivery (SD) contributes to the satisfaction of customers.

Furthermore, the effect size ($f^2$) values were used to give an understanding of contributions of each exogenous construct to the endogenous construct (Ngah et al., 2025). The results reflected that Speed of Delivery (SD) variable resulted $f^2$ value of 0.053, which is the maximum value of the variables measured, hence the highest effect on Customer Satisfaction variable. The effect sizes for Route Optimization (RO) and Delivery Scheduling (DS) were very small (0.029 and 0.027, respectively), and Tracking Transparency (TT) had a relatively low effect size (0.016). Lack of Security (LS) showed the smallest impact on Customer Satisfaction with an effect size of 0.003 during this study, which means that this factor had a rather weak impact.

**PLS-predict**

**Table 8. PLS-predict**

| Variable | Items | $Q^2$ | PLS-SEM RMSE | LM RMSE |
|---|---|---|---|---|
| Customer Satisfaction | CS1 | 0.442 | 0.834 | 0.843 |
| | CS2 | 0.428 | 0.852 | 0.852 |
| | CS3 | 0.453 | 0.832 | 0.837 |
| **Note(s):** CS, Customer Satisfaction | | | | |
| **Sources (s):** Developed by the Researchers | | | | |

The relevance of the model was then tested based on the $Q^2$predict, and by comparing the RMSE¬_PLS and RMSE_LM (Kassim et al., 2026). The Q values of the > 0 indicate that this model has predictive relevance for the indicators of the endogenous construct according to previous research. All the $Q^2$predict values are greater than zero as can be seen in the table; the Customer Satisfaction and the three Customer Satisfaction values, CS1 with value 0.442, CS2 with value 0.428, CS3 with value 0.453, were higher than zero. This indicates the structural model had good predictive relevance for all the indicators of Customer Satisfaction (Ngah et al., 2025).

It was also estimated to predict the performance of the PLS-SEM model by comparing the root mean square error (RMSE) values for the PLS-SEM model with the linear model (LM) (Hair et al., 2022). The findings showed that the RMSE values for CS1 (0.834) and CS3 (0.832) were slightly lower than the RMSE value of LM (0.843 and 0.837 respectively). It implies that the PLS-SEM model is more accurate in predicting these indicators than the linear model. The PLS-SEM model also showed similar predictive performance with the linear model, in which the RMSE value for both models is the same (PLS-SEM RMSE = 0.852, LM RMSE = 0.852) for CS2.

The results show that overall, the model has good out-of-sample predictive ability and satisfactory predictive ability for the construct of Customer Satisfaction. The results further showed that the independent variables applied in this research were also valid to predict the satisfaction results of the customers.

## DISCUSSIONS

The present study focuses on the issues of service quality, operational challenges and opportunities in e-commerce Smart Pickup system in Bangladesh. It also examines the effect of five factors on customer satisfaction. The model shows a significant amount of variance in customer satisfaction ($R^2 = 0.537$), and there are four significant predictors.

Speed of Delivery ($\beta = 0.249$, $p < 0.001$) and Route Optimization ($\beta = 0.247$, $p = 0.001$) emerged as the strongest determinants, followed by Delivery Scheduling ($\beta = 0.165$, $p = 0.001$) and Tracking Transparency ($\beta = 0.125$, $p = 0.016$). Study results have broadened the scope of the LSQ and SERVQUAL frameworks by showing that operational efficiency (speed and routing) is more significant than traditional service quality dimensions in the smart pickup context (Ta et al., 2025; Minh et al., 2024; Desmal & Madan, 2024). In line with earlier logistics studies, satisfaction is achieved through real time changes and reduced waiting time (Briana & Malindretos, 2025). Our findings, however, are unique because Tracking Transparency is not the primary criteria in western studies where visibility is key (Nagadeepa et al., 2024; Andrei et al., 2024).

Notably, Lack of Security ($\beta = 0.058$, $p = 0.359$) was not significant. This is a paradoxical situation as privacy issues reported in Bangladeshi ecommerce contradicts it (Rahman 2023). A potential reason is the fact that most smart pickup systems include common security features like OTP verification, QR code authentication, and secure pickup locations, which could have lowered customers' perceptions of security risks (Xiao, 2024). Additionally, customers might prioritize operational aspects like delivery timeliness, efficient routes, and visibility in their service quality assessment (Faramarzi-Oghani et al., 2025). In the context of Bangladesh, the speed is more important than the security to the smart pickup system, and the exposure of a camera is accepted by the customer in exchange for convenience, while showing his/her identity to the camera. More awareness of digital commerce could also be a driver of less sensitivity to issues of security in the urban context of Bangladesh.

In Bangladesh's logistics industry where digitalization is rapidly increasing, the investments in route optimization and speed generate higher satisfaction returns compared to investments in security (Hossain, 2024; Amin et al., 2025).

### Theoretical And Practical Implications

#### Theoretical Implications

The theoretical contribution of this research is related to the enhancement of Logistics Service Quality (LSQ) Theory and SERVQUAL framework in the smart pick-up systems. The Customer Satisfaction-Serv. Quality dimensions relation in general is relatively linear, but, in digital logistics conditions, the linearity is being distorted and some of the dimension's impact on Customer Satisfaction to a greater degree, as seen in our findings. (Aziz et al., 2025; Zhang & Rogers, 2026). In particular, route optimization and delivery scheduling seem to have a relatively higher influence, while the perception of security aspects appear to be more important but context-dependent (Moghaddasi et al., 2023; Patel & Rahimi, 2026). This means that customer satisfaction can be affected by the classical dimensions of service quality, but also by the coordination of the system using real time decision tools in the technology-supported logistics system (Kayikci et al., 2025; Sharma, 2026). Thus, in a limited way, this study extends the LSQ–SERVQUAL view by focusing on the positive impact of digital logistics systems on the reinforcement of reliability and responsiveness (Atulugama, 2025). This change can be primarily attributed to the growing automation and real-time data sharing that reduces reliance on manual coordination (Aslam & Li, 2026). These system-driven impacts could be further magnified for Bangladesh where digital proficiency and regulatory maturity is still developing (Ali et al., 2025). As such, it might be better understood that the LSQ–SERVQUAL relationship is not necessarily linear (Issa et al., 2026; Cavacece et al., 2026).

**Practical Implications**

The results indicate that logistics managers, platform operators, and policymakers can use them as a basis to take steps to enhance customer satisfaction in urban smart pickup systems in Bangladesh in a phased manner (Leon et al., 2023). Initially, the key aspect is to focus on efficient route planning and delivery scheduling in real-time as these tactics help to minimize delays and enhance reliability in the last-mile operations (Yerra, 2024; Ylitalo, 2023). Secondly, in order to reduce customer uncertainty and send the correct message between both parties, logistics providers can increase their service transparency by providing users with simple GPS updates, SMS notifications, and delivery time estimates (Francis et al., 2025; Vrhovac et al., 2024). Thirdly, it is essential to take delivery security measures into consideration, such as the use of safer drop-off points and handling the orders in a privacy-conscious manner to keep users' confidence (Queiroz & Abe, 2024). At the same time, such measures can be nicely combined with inexpensive AI-led logistics tools and rolling out digital adoption that is done step-by-step, especially for areas where the infrastructure and level of digital literacy are still at the development stage (Ogah et al., 2026).

**Limitations And Future Research**

Last mile delivery management and customer satisfaction factor in urban area smart pick up system in Bangladesh has been discussed in the research, which are valuable inputs. However, there are a few drawbacks that need to be considered (Dias et al., 2022; Asawawibul et al., 2025).

A significant proportion of the sample were from the major urban areas of Bangladesh where the pickup of smart phones was readily available (Vrhovac et al., 2023). Thus, the results are not necessarily representative of customer experiences in rural or semi-urban areas where logistics infrastructure, technology and delivery may vary significantly (Mogire et al., 2023). Further studies are needed on customer experiences in rural and semi-urban settings to determine if determinants of customer satisfaction differ by location. Additionally, in order to examine how the geographic and infrastructural differences moderate the observed relationships, cross-regional and/or cross-national comparisons are suggested (Kawa & Zdrenka, 2023).

Second, the present study has a cross-sectional research design, which reflects the respondents' perceptions at one moment in time (Ilieva et al., 2022). Findings therefore only suggest relationships between variables and do not establish cause-and-effect links. As the e-commerce industry in Bangladesh continues to embrace digitization, longitudinal studies would be valuable for understanding the dynamics of customer satisfaction as smart pickup systems become more common and customers adjust to the shifting preferences in tracking transparency, delivery speed, and security compromises (Harter et al., 2024; Tian et al., 2025).

Third, the constructs that affect the perceptions of customers, for example, customer satisfaction, are properly measured using self-reported questionnaires, but the answers may be subject to social desirability bias, personal interpretation, or customer's recent service experiences (Vasić et al., 2020). Therefore, the results should be interpreted with caution. To enhance results and to confirm findings, future studies should consider using behavioral data through actual pickup times, repeat purchase frequency or even system-generated operational logs for triangulation (Fouad et al., 2023).

Fourth, although this study found that security concerns were not a significant factor in customer satisfaction, this study was not able to investigate the underlying causes of this surprising result (Rashid & Rasheed, 2024). This could be due to the fact that customers might feel that current smart pickup security protocols are sufficient and focus more on operational considerations, like delivery timeliness, route optimization, and visibility. But this is a speculative interpretation. Qualitative methods, such as interviews, focus groups, or case studies, should be utilized in future research to delve into the perceptions of customers and to elucidate the importance of security issues in smart pickup systems (Hao et al., 2021; Cui et al., 2023).

Finally, in addition to customer demographic profiles, this study did not include potentially important variables in the model, like the density of pick-up points, delivery distance, order value, and product type, whether high-value electronics or low-value commodities (Nagadeepa et al., 2024; Hao et al., 2021). These factors can impact customers' choices of delivery services based on speed, convenience, or security (Cui et al., 2023; Paluzzi et al., 2024). In addition, the differences in delivery by sector were not considered as mentioned by Cheng (2024) and Dang (2020) for fashion, grocery and electronics. The factors addressed would help build a more holistic and context-aware framework to gauge satisfaction for last-mile delivery in emerging digital economies (Rashid & Rasheed, 2024; Vrhovac et al., 2023).

# CONCLUSION

This study links last-mile delivery management process and its impact on customer satisfaction in urban smart pickup system from the perspective of ecommerce in Bangladesh (Mogire et al., 2023). Results suggest that delivery assurance, pick-up convenience, tracking transparency and security are key aspects which contribute to customer satisfaction. On the other hand, when delivery times are delayed, pick up points are scarce, or the quality of service is inconsistent, users' faith in smart pick up systems (Rashid & Rasheed, 2024) can be undermined.

Improving last mile should not just be considered as an operational goal, it is also a strategic customer experience project (Dias et al., 2022). This is especially significant in the case of the urban area, where a high population density means that efficiency, saving time and service consistency has a great effect on digital consumption patterns, and customer expectations (Asawawibul et al., 2025).

Though the study is limited to cross-sectional studies of urban consumers, the results offers insights into the key factors in the last-mile delivery which affect customer satisfaction in a smart pickup ecosystem in Bangladesh (Nagadeepa et al., 2024). The study is significant as it explores the management of last-mile delivery in a developing economy and explores the link between the smart pickup and logistics and customer satisfaction in Bangladesh (Cheng, 2024).

Future research could focus on comparing rural and urban areas, using behavioral data and real-time logistics information, analyzing various product categories and order values (Harter et al., 2024), examining the influence of moderating variables, and analysis of the evolution of customer satisfaction of smart logistics systems over time based on the maturity stage of these systems (Tian et al., 2025).

Overall, e-commerce companies, logistics service providers, and policymakers need to work together to optimize the smart pickup systems, standardize the services, and upgrade digital tracking and security systems (Turgut, 2025). These initiatives can help foster long-term adoption and customer trust in innovations for last-mile delivery (Situmorang et al., 2025).

**Ethical Statement:** Respondents were well informed about the objectives of this study, and their participation was completely voluntary.

**Conflict of Interest:** No conflicts of interest to declare.

**Data Availability Statement:** The data will be made available upon reasonable request.

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