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Research Article

Analyzing travelers' attitude towards ride-hailing services in developing countries: Case of Lahore, Pakistan

Syed Arif Hussain Shah [a,b,*], Kubota Hisashi [a]

[a] Department of Civil and Environmental Engineering, Graduate School of Science and Engineering, Saitama University, 255 shimo okubo, Sakura-ku, Saitama 338-8570, Japan
[b] Department of City and Regional Planning, University of Engineering and Technology, Lahore, Pakistan

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ABSTRACT

Ride-hailing services are gaining momentum to meet the urban travel demand in the absence of proper public transport in developing countries. To the best of our knowledge, research on passenger's behavior and attitude towards the service quality of ride-hailing services and certainly studies focusing on developing countries are quite rare. Ride-hailing services were launched to meet the travel demand of residents throughout the city of Lahore, Pakistan in 2015. A revealed preferences study of 865 respondents consisting their demographic, travel information and perceptions related to selected attributes of service quality was carried out to examine their attitude and behavior towards the use of ride-hailing services in Lahore, Pakistan.

Most of the users of these services are young, well-educated and have relatively high income. The travelers who were using Rickshaw services before are found to be the frequent users of these services and ride-hailing services have started replacing respondents' previous modes of travel. Exploratory factor analysis were employed on collected data to identify the factors effecting the traveler's perceptions regarding the use of ride-hailing services and structural model of users' satisfaction were constructed based on these factors later.

The results exploratory factor analysis (EFA) and structural equation modeling (SEM) revealed that significant determinants of passenger's satisfaction with ride-hailing services are coverage and accessibility attributes (CAA), instrumental attributes (IA), service attraction attributes (SAA) and safety attributes (SA). The number of trips, trip purpose, income, education, time since the use of these services, profession and household size are also significant parameters in the determination of traveler's behavior and attitude towards the use of ride-hailing services in Lahore city. The commuter's overall satisfaction with service quality of app-based services have positive association with travelers intentions to continue use of app-based services and their believe that these services have filled the gap of public transport in the city and replacing previous modes of travel. The further improvements in attributes will enhance the traveler's satisfaction with these services. Insight into the attitude and perceptions of travelers would be useful for the transport planners, ride-hailing companies and policy makers for making appropriate improvements in the services and giving them space in existing transport system.

1. Introduction

With unprecedented growth of new technologies, advancement in information and communication technologies has enabled people to use real-time and app-based services of online cabs for their trips. Companies such as Uber, Lift, Careem, Didi, Sidecar and others have provided the users with smartphone applications to connect the commuters with their community drivers. Further, these apps are featured with a rating system so that users as well as drivers can rate each after their ride [1]. There remains no doubt that these app-based services have greatly impacted upon the traditional public transport and offered commuters with better travelling options. They no longer need to wait along the roadside until their bus arrives and now can order their private cabs within minutes using their smartphones.

In these apps, the companies provide users with pick-up and drop-off locations, the users have complete freedom in choosing locations of their choice. It is a fact that the existing transport systems are unable to meet the public transport demand, ride-sharing services are covering user demand to some extent. It is true in cases of most developing countries that have poor public transport systems due to various reasons,

* Corresponding author: Department of Civil and Environmental Engineering, Graduate School of Science and Engineering, Saitama University, 255 shimo okubo, Sakura-ku, Saitama 338-8570, Japan
E-mail addresses: syed.a.h.s.023@ms.saitama-u.ac.jp (S.A.H. Shah), hisashi@mail.saitama-u.ac.jp (K. Hisashi).
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these online taxes have become prevalent [2] and been recognized an informal component of public transport mode [3,4].With their numerous advantages, app-based taxi service are transforming the way people travel in their cities [5]. These services have in fact empowered the users as they can track the location of their driver, when the taxi will arrive as well as how much they will spend on a particular trip. Literature manifests that ride-hailing services have witnessed tremendous growth in the last decade. In North America, they attracted approximately 2 million users, where this number reached 5 million globally. More than 250 million people have used these services so far in the last five years of their existence [6].

A number of names are attributed to these companies that include "Transportation Network Companies (TNCs)," "real-time ridesharing," "parataxis," "ride matching," "on-demand rides," and "app-based rides." In this study, the term 'ride-hailing' will be employed for these companies, the reason being that users can book their rides and pay for the services using their smartphones with Transportation Network Companies (TNCs). There is no denying the fact that Pakistan is a developing country and resultantly public transport is grappled with grave problems failing to meet the user demand. There exist several issues of public transport in the Pakistan including low fleet, poor coverage, reliance on old technologies, increased waiting time, insufficient seating capacity, outdated buses and particularly no integration of Intelligent Transport System (ITS). Lahore Rapid Mass Transit System (LRMTS) study conducted by the JICA shows the existing and future forecast situation in Lahore city. It (Table 1) indicates that 63% transport mode comprises non-public transport which include rickshaws, bikes, personal cars, traditional taxis and others. This has led to a wider gap between the public demand and the public transport provided by the concerned authorities.

Taking advantage of the present gaps, ride-hailing companies launched their online taxi services in Pakistan. It began in Lahore where the companies such as Uber and Careem rose to popularity in a very short period. Within few months, Provincial Transport Authority (PTA) Punjab banned these services because of their failure to obtain a no-objection certificate and fitness certificate, and a route permit [8]. The authorities also cited that they had no information regarding ride-hailing travelers' characteristics, behavior, satisfaction with these services and studies that could provide guidelines and information regarding these services. However, due to social media backlash, the government allowed these services to resume their operations. As a matter of fact, the government is still in doubt and not clear about the ride-hailing services. Even in meetings with the author, Secretary Transport Punjab and the Senior Transport Planner, Transport Planning Unit (TPU) shared similar concerns. They are of the view that it is yet not known how these companies operate, the user characteristics, attitude, behavior and satisfaction towards these services and what protocols they follow.

There are many issues associated with app-based ride hailing services in Pakistan. The officials also shared with author that these services are operating in the city without any regulatory framework and they have serious concerns regarding the safety of travelers who using these services. They further stated that they are in contact with ride hailing companies to formulate some regulatory framework. There have been many protests against these services by the drivers of rickshaws and traditional taxi services as these services are attracting the passengers of those modes [9]. It is important to mention here that these services were also highly deregulated initially in San Francisco, however services were finally got registered under special Transportation network companies (TNC's) regulations [10].

Table 1
Estimated Daily Motorized Person Trips in Lahore [7].

Travel Mode	2006		2011(Forecast)	
	Total (,000)	Proportion	Total (,000)	Proportion
Motorcycle	1292	18.5%	1532	18.3%
Rickshaw	1014	14.5%	1157	13.9%
Car/Taxi/\4WD	1991	28.4%	2561	30.7%
Public Transport	2699	38.6%	3100	37.1%
Total	6996	100%	8350	100%

Research suggests that travel behavior of passengers is changing with the arrival of ride haling services. The behavioral intentions and attitudinal studies towards travelers provide a vital direction [11,12]. Therefore, the study aims to determine passengers' attitude and behavior towards ride-hailing services with respect to coverage and accessibility, safety, instrumental, and service attraction attributes. It will also highlight the challenges which travelers are facing while using these services, modes replaced by these services and how these are changing customers perception towards these services. The findings will be helpful to the government authorities, transport planners and policy makers to understand the travelers' characteristics, perception and behavior, and make appropriate improvements to ride-hailing services in giving them a place in existing urban transport system. This research will also assist the companies managing the app-based services to identify the existing problems with their services, what steps must be taken for improvement and how these services can be made more effective to satisfy user expectations.

The remaining of research is organized as follows. The second section review the existing literature regarding ride-hailing services and how this study is unique than already conducted studies. Section 3 explains the survey design, data collection techniques and data analysis methods. The following section shows the basic statistics of the collected data and results of factor analysis and structural equational modeling (SEM) of traveler's intentions towards ride-hailing services. Section 5 discusses the results and how the findings are aligned with the existing infers from the available literature review. The research concludes with a discussion on the findings, limitations as well as suggestions for betterment of ride-hailing services and future research.

2. Literature review

The new advanced technologies have brought a number of new transport modes for the users. Ride-sharing taxi services are just one example that make use of the new technologies [13]. Lyft, Uber and Grab which are top ride-sharing services provide quick and easy transport services to the customers [5].Further, the ride-hailing services being an integral part of modern-day economy have gained popularity the world over. These are instantly popular as they provide more advantages to the travelers [14] .

The ride-hailing services are in limelight these days everywhere due to better education of people, increased internet use and easy access to the smartphones [15]. In this regard, San Francisco took the lead in adopting this innovative transport model. According to the data of 2014, the San Francisco Municipal Transportation Agency (SFMTA) found that 17% of the population was using these services once in a week whereas 25% used these once a month. SFMTA believes that the combination of taxi option, GPS technologies and app-based services have made it a success [10]. Currently, according to Chan and Shaheen, these services make a share of 8% in Canada and 11% in the US with probability of massive increase in the new future [16] .

Several studies indicate that these services are mainly used for casual trips and most people use these services not more than a few times every month [17–21].Researchers from the USA and Canada have found that users of these services are mostly young, relatively educated and wealthier people make use of these app-based transportation modes [17,19,22–27]. Moreover, many studies show that the ride-hailing services will increase the number of potential travel options, offer comfortable driving, increase public transport efficacy given that public transport transit at many places is not safely available [28–31].

Lyft, Didi, Sidecar and Carpool are the top ride sharing services in the US, Canada, China, and Europe whereas in Pakistan Careem and Uber are widely used. Careem operates in eleven cities whereas Uber has presence in seven cities of Pakistan. Careem also plans to expand its network to 30 more cities across the country [32].

Assessing the quality of an online transport service is inevitable to understand user attitudes, intensions, and satisfaction rate for any brand [33]. Knowing the needs of the users, behavior and expectations [34–36], as well as travel demand features [34,37,38] are imperative to sustain quality of a service. User perception about the system also has impact on its use [39–43]. Research also suggests that the user satisfaction is a key parameter in success or failure of any mode as its helps retain current customers as well as attract new ones [39,43,44]. A study carried out by Joewono and Kubota (2006) concluded that the user proves to be the vital party involved in safety and security aspects of public transportation [45].Various studies have been conducted to determine effectiveness, service quality and the user satisfaction of these app-based services. A study from India finds comfort, safety, internal environment, mobile system, reliability, efficiency, and security as well as billing as the key quality factors of any ride-sharing service [46]. Army Justitia et al. are of the view that interaction, detecting the route and quality are key parameters to determine passengers' perceptions with these services [47].

A study in Hong Kong adds that waiting time, professionalism of drivers and ease of using the service are the top factors which affect users' perception about these services .That included cleanliness, comfort and quality as the important components which affect how user rate the service [48]. Other research works from various countries found waiting time, access time from travel point, in-vehicle travel time, driver behavior, security, travel cost, knowledge of the drivers, punctuality and safety as the main reasons to use these services the significant indicators in determining user satisfaction [1,20,49–51]. However, Yayasan Lembaga Konsumen Indonesia in 2017 reported that customers still face issues and complain about the problems that include poor performance of apps, system errors, double orders and wrong locations [52].

The advancement in the field of information and communication technology (ICT) has led the development and expansion of these ride-hailing services. These services have the potential to cut down auto use, car ownership and associated environmental impacts if they manage to fill the existing gap in public transport networks [1,53,54]. On the contrary, the critics argue that these companies increase congestion, compete with public transport, mislead users through ambiguous pricing, serve only the young people, and compromise safety [55,56]. Lahore's population is increasing at an unprecedented rate and so the demand has also soured. These ride-hailing services can come in handy to fill this gap by offering affordable services to the people of Lahore.

It can be concluded from the literature presented above that introduction of these services might assist to fulfil the much-needed purpose of reducing the supply demand gap in developing countries. These ride-hailing services which are providing comfortable services to the residents have tendency to become more popular in coming days and months. However, it is important to note that it is not clear how far these services will affect travelers attitude and behavior in opting for these newer modes of transport when compared with traditional modes. Therefore, it becomes imperative to assess the impact of these services on the travel behavior and customers perceptions through surveys.

According to the best knowledge of the authors, no detailed and comprehensive study has been conducted in developing countries specifically Pakistan so far which investigated the ride-hailing users' characteristics attitudes and behavior towards these services in detail. This research study fills the gap in the existing body of the literature. In terms of theory, this study will enhance the fundamental knowledge about the users of ride haling services and the factors affecting the attitude of ride-hailing passengers in developing countries. Some policy recommendations will also be put forward to improve the quality and existing services considering the key findings of the research. Moreover, the study can be useful in providing guidelines to these companies as well as the transport to make appropriate improvements in these services.

3. Research design

3.1. Questionnaire design

The questionnaire was designed to get the information required to predict the passengers attitude towards to predict the passengers attitudes towards the use of ride-hailing services.991 travelers participated in the survey but only those respondents were included in the final analysis who used or have been using these ride-hailing services. They have been asked questions regarding their socio-economic backgrounds i.e. age, income, marital status, household size, profession, education, the ride-hailing services used, car ownership, smartphone ownership, number of cars per household, and intentions to continue using ride-hailing services in future . The second section of the questionnaire contains two sub sections and a total of 23 questions about the general travel characteristics and impact of ride-hailing services on travel behavior of the travelers. The first 12 questions were very basic such as; weekly travel frequency, preferred mode of often travelling with variable trip time, travelling purpose, total travel time, in-vehicle travel time, for whom you use the opted mode, waiting time, travel cost, travel distance, vehicle occupancy and satisfaction with preferred mode of travel on five point Likert scale. The next 11 questions were mainly focused on the impact of app-based taxi services on the travel and car purchasing behavior of the passengers. The respondents have been inquired about the time since they have been using Ride-hailing services, alternate trave mode in the absence of ride-hailing services, and challenges while using ride haling services.

The 3rd section contains 27 attributes of service quality of ride-hailing services which were evaluated using a five-point Likert scale e.g. Strongly disagree (1), Disagree (2), Neutral (3), Agree (4), and Strongly Agree (5) and details of these attributes can been seen in section in Table 4.

3.2. Sample size and survey

The research was conducted in the city of Lahore, the 2nd largest city of Pakistan. Lahore's population has seen a massive increase in the past few decades. At present, population of Lahore is reported to be over eleven million. Lahore was selected as a case study owning to multiple factors. First and foremost, the public transport system in the city is in a shambles and is unable to satisfy the growing transportation demands of the people. Lahore was among first cities in Pakistan from where the ride-hailing companies began their services and this includes Uber and Careem. In addition, various socio-economic factors are also at play when it comes to the selection of this city as the case study.

Survey locations were selected carefully in order that research can be completed with the best of collected data. In this regard, the drivers working with ride-hailing services were approached to gather information of the areas from where they had the most number of rides. The areas thus identified through this process were marked to conduct surveys. Moreover, a grand pilot study was also carried out before the survey with a purpose of obtaining feedback of the masses which was later incorporated into the study.

Surveyors were also provided sufficient training to perform the surveys in professional manners. Global Positioning System (GPS) devices were provided to the surveyors which they used to note the exact locations of the people that they surveyed. Different approaches were part of the study to complete the survey process. The surveyors took response of the people on survey from bus stops, plazas, commercial

centers and other such places where large numbers of users can be found easily and questionnaires were filled this way. Further, some questionnaires were filled through the household technique. In this practice, questionnaires were dropped in houses and collected when the response was complete after few days.

Survey was carried out with the help of the students from the University of Engineering and Technology, Lahore. The surveyors were properly trained before the start of this survey. The questionnaires were distributed without the restrictions of the socioeconomic and demographic aspects of the travelers such as; age, marital status, income, occupation, and education. The data was collected between July and September 2020.

3.3. Data analysis methods

An exploratory factor analysis was employed on the collected data to examine the traveler's responses on service quality attributes of Ride-hailing services in Lahore. The method of Maximum Likelihood (ML) to calculate factors with Varimax rotation was applied for this purpose.

A factor loading value of 0.5 was used as a cut-of-point value for the extraction of factors [57]. The rotation was carried to obtain more appropriate and more interpretable solution. Cronbach's Alpha (α) test was done to investigate the internal consistency between travelers and check the reliability of the factors in evaluating the observed variables. Literature suggests that Cronbach's Alpha (α) value above 0.70 is acceptable and 0.80 or greater is preferred [58].The alpha test shows the good level of reliability of the factors and internal consistency among passengers as the values are greater than 0.80 for CAA,SA and IA, and above 0.70 for SAA attributes. The extracted factors were later used to construct Structural models using the structural equation modeling (SEM) technique. This is a multivariate statistical analysis allows researchers to include observed and latent variables in the model and reliability of analysis can be determine by goodness of fit parameters. The values of root mean square error of approximation (RMSEA) and RMR values ranging from 0.05 to 0.08 are considered acceptable, goodness of fit index (GFI), the adjusted goodness of fit index (AGFI), and comparative fit index (CFI), should cross the 0.9 for better adjustment of data in the model [59]. The different sources suggest that that the ratio of $\chi 2$ model-fit statistics by degrees of freedom is acceptable between 2 and 5.

4. Survey and analysis results

4.1. General information

A total of 991 people were surveyed out in total of which 865 people were found to be the users of ride-hailing services. Among them 86% are male whereas 14% are female. The female mobility in Pakistan is restricted due to some cultural, safety and social issues. A study carried out in Pakistan found that males account for approximately 80% of trips and 79% of the travel duration, while females only account for 20% of these trips and 21% of the travel duration and this could be the reason of low participation of females [60]. The data indicates that 13% of the people interviewed are below the age of 20, whereas 38% are between the ages of 20–30, 25% are those between 31 and 40, 18% are between 41 and 50 years and only 6% are above 50 years of age. From the analysis, it becomes evident that most of the respondents are young which many other studies concluded as well.. Furthermore, educated class and students and young ones use the app-base services most of the time due to better understanding of the mechanics of how the apps work. Another possible reason could be the high percentage of young population; that is about 64% people who have age less than 30 years in Pakistan [61].

When asked about educational qualifications, more than half of the respondents, 57%, shared that they had a Bachelor's degree whereas 17% are those with Masters and higher educational qualifications. Only 18% were those who had education till higher secondary school. Once again, this analysis also proves educated people are the users of the app-based services because of their better understanding and technical knowledge. The overall results of users age and qualification are compatible with the findings of multiple other studies showing majority users of app-based services are young and educated ones [1,22,23,25,62–64].

When it comes to the salary analysis, the data shows that 8% earn less than 25,000PKR a month, while 60% make between 25,000 and 50,000 PKR, 24% are those with earnings between 50,000–80,000 PKR and only 8% are able to make more than 80,000 PKR a month. From the salary brackets, it becomes obvious that majority of users are those who earn between 25,000 and 80,000 PKR whereas those with low salaries prefer other conventional modes of transport. In terms of marital status, half, 50%, of the respondents are married. The results are again compatible with the findings of multiple other studies that the more income you have or the more you earn, the more likely you are to use the ride-hailing services. Moreover, its use is also dependent on the age factor [21,23,25].

In terms of profession, it is observed that 33% are students, 9% are business people, 42% are private employees and 16% are those with government jobs. This category also indicates that most of the users come from two categories: students and private employees. It becomes imperative to mention here that students and private employees feel more comfortable with these services because of good understanding of the nature of the services. In addition, private employees have better earnings as compared to other sectors so they can afford using these services and students prefer these services due to flexibility in timings.

It is important to take into account the trip purpose of the users. It was asked from the respondents that what is their frequent use for these services, a single purpose for which they use these services on frequent basis. The data show that nearly half of the users, 47%, use app-based services mainly for shopping. In addition, 13% book such cabs mostly for recreational purpose, 14% use these services to visit relatives, 16% use primarily for educational usage and 10% are those who use app-based companies for going to work. In sum, it can be analyzed that majority uses includes shopping and recreational purposes. Possible reason for using app-based ride hailing services majorly for shopping and recreational purposes is that app-based taxi services can easily accommodate 4–5 people in a car which better suits to many families in Lahore. Some other studies also had the same findings that most people use such services for social purpose [60].In terms of weekly trips, it is evident from the data that 71% users have trips after 4–5 days, whereas 13% use it every 2nd or 3rd day and only 7% have one trip a week with these ride-hailing services.

The table also shows that in terms of household size, 68% people are those that have 2–4 family members at home, 22% have 5–7 family members, 6% have more than seven members and just 4% have one member in their families. Here it is also clear that, most users are those who have families. As already discussed that household with relatively more members have high probability for using these services. They may have children as well as parents and therefore feel more need to use these services for travelling. This also indicates they travel collectively in order to make their travel more cost-friendly. In the area of car ownership, 42% own cars whereas majority of 58% does not have any car. Even the respondents who had car at home were also using these services.

In order to use the app-based services, smartphone is inevitable to book rides. Therefore, when asked about smartphone ownership, 91% owned a smartphone of their own while 9% did not have a smartphone. These people usually are older ones who get help from their friends or children to assist them in booking a ride so that they can travel with ease and comfort.. When asked about since how long they have been using these services, 53% had their answer of more than a year, 21% included those who started using these 10–12 months ago, 17% and 7% were using since 7–9 months and 4–6 months respectively,and 2% are those who are new to these services.

4.2. Challenges faced and modes replacement by ride-hailing services

When asked about what issues they came across with these ride-hailing services, the respondents shared multiple. Nearly 19% were of the view that poor conditions of the cars were the main problem for them.. 16% reported the delay in arrivals as the primary issue. Many drivers are unable to find the exact location to reach within the given time and this does not go well with the customers. In addition, 10% users said overcharging from users was a serious issue. The ride-hailing services use, sometimes, the surge-factor. This rule is applied in peak hours or in areas where users looking to book rides outnumber the available cars. 12% users are those who consider the rude behavior of the driver as a major issue.. Further, 17% respondents remarked that cancelation of rides was what they disliked the most about these services. Sometimes, when the driver feels he/she has to travel a few kilometers to pick up the customer, they usually cancel the ride. Another factor is the drop-off location and when it is more than average distance, drivers are hesitant to pick up such users and they end up canceling the rides. Other issues included poor response from companies and drivers did not know about the route and how to use GPS and poor vehicle maintenance.

The users were asked about which travel mode they would prefer if they were not using the app-based taxi services. The response was interesting and manifests some key conclusions. 45% were those who believed they would prefer rickshaw service. It should be mentioned that rickshaw was known as the Taxi Service of the City in Lahore before the ride-hailing services began working. Police officials and other concerned officials reported that majority of rickshaw drivers are unskilled and dangerous which make a sizeable contribution to road crashes across Pakistan and rickshaws lack safety features and are unstable and unsafe vehicles [65].

19% respondents were of the view that they would use a bike if they were not using these services. 15% are those who would own a car or already had one. In addition, 6% favored public transport, 8% would use the traditional taxes and 7% would not travel at all if these services were not available to them.. It becomes that these ride-sharing services also increased travelling. With induced trips, it can be analyzed that many people were not travelling previously but these services provided them a reason to make trips.

4.3. Exploratory factor analysis on travelers' responses

Section three of the questionnaire was used to conduct an exploratory factor analysis (EFA) on travelers' responses on selected service attributes of ride-hailing services. The analysis resulted in four factors which are presented in Table 3.The extracted factors were given name keeping in view the nature of their correlated variables .The factors included Coverage and Accessibility Attributes (CAA), Instrumental Attributes (IA), Service Attraction Attributes (SAA) and Safety Attributes (SA).The variance explained by each factor and estimated Cronbach's alpha values are also presented in Table 2. The variance explained by CAA, IA, SAA and SA are 19.17,14.098,15.73 and 10.62 respectively. It can be seen from the table that Cronbach's alpha values of all variables except SAA are more than 0.08 which is an indication of variables good reliability and internal consistency among travelers in evaluating the corresponding observed variables of each factor. Table 3 also includes variables Five-point Likert scales average score and standard deviation values.

The results of the first factor Coverage and accessibility attributers (CAA) show that the passengers gave high priority to coverage and accessibility attributes which include picking and dropping off from pin/exact locations,24/7 availability of these services and provision of more accessibility options. Factor loadings and average values shows that the coverage and accessibility of these services is quite better than previous modes of travel.

The results of the second factor of IA shows that the passengers' gave quite satisfactory values to the instrumental attributes which includes service comfort, reliability and convenience and driver's behavior,and skills. Travelers stated that ride-hailing services are quite refillable, affordable, and convenient as compared to previous modes of travel and they are quite satisfied while using these services. However, travelers also show some reservations regarding the drivers behavior as they faced some rudeness from drivers side.

The results of third factor of SAA depicts that passengers positively evaluated the attributes of service attraction as factor loadings of the factor are quite satisfactory. The variables include the transparent and fixed fare system, provision of receipt by App-based Ride-hailing services, the promotion schemes and discounts by app-based taxi services, vehicle cleanliness and availability of variety of vehicles. However, it is important to note here that some SAA attributes such as vehicle cleanliness and fare bargaining issues were not given higher values by respondents.

The results of the fourth and last factor safety attributes (SA) show that the passengers gave high priority to safety attributes which include provision of sufficient information, good physical condition of vehicles and improved sense of security.

Table 2
Descriptive statistics of the respondents.

Variable	Classification	Frequency	Percentage (%)
Gender	Male	744	86
	Female	121	14
Age (years)	<20	114	13
	20–30	329	38
	31–40	219	25
	41–50	153	18
	>50	50	6
Monthly Income (PKR)	<25,000	72	8
	25,000–50,000	519	60
	50,001–80,000	205	24
	>80,0000	69	8
Marital Status	Single	434	50
	Married	431	50
Profession	Student	285	33
	Businessman	78	9
	Private Employee	363	42
	Government Employee	138	16
Education	Primary Schooling	23	3
	Middle Schooling	62	7
	High Schooling	157	19
	Bachelor	496	57
	Masters and Higher	127	17
Trip Purpose	Work	82	10
	Education	142	16
	Visiting Relatives	117	14
	Shopping	413	47
	Recreational	111	13
Weekly Trips	Once a week	62	7
	2–3 days	112	13
	4–5 days	618	71
	Almost everyday	73	9
Household Size (members)	1	32	4
	2–4	593	68
	5–7	188	22
	More than 7	52	6
Car Ownership	Yes	363	42
	No	502	58
Smart phone	Yes	782	91
	No	83	9
Since how long you have been using these services?	Less than 3 months	14	2
	4–6 months	56	7
	7–9 months	147	17
	10–12 months	188	21
	More than one year	460	53

5. Structural model of travelers' perceptions of ride-hailing services

Three structure models were built using the results of factor analysis. A hypothesis was assumed that the traveler's overall satisfaction with

Table 3
Modes replaced and challenges faced.

Variable	Classification	Percentage (%)
If you were not using an app-based ride-hailing service, which travel mode would you have taken?	Own car	15
	Traditional Taxi	8
	Rickshaw	45
	Public Transport	6
	Would not have travelled	7
	Bike	19
Challenges faced while using ride-hailing services	Poor condition of car	19
	Overcharged	10
	Rude behavior of drivers	12
	Delay in arrivals	16
	Cancelation of rides by drivers	17
	Poor complaint response from company	9
	Driver does not know route and GPS	12
	Poor vehicle maintenance	5

app-based ride hailing services was influenced by commuter's' positive evaluation of various attitudinal attributes. Another assumption included in the study was that the travelers' intentions to use app base ride hailing services, their believe that ride-hailing services have stated replacing previous modes of travel and filled the gap of public transport in the city were influenced by the commuters overall satisfaction with app-based ride hailing services. It was also assumed that the extracted attitudinal factors of commuters have direct influence on their overall satisfaction with ride hailing services and may have indirect influence on their intentions to use these services in future and their believe that these services have started replacing previous modes of travel and filled the gap of public transport in the city.

Three endogenous observed variables were identified to develop structural model, and these include 1) I think that ride-hailing services have started replacing previous modes of travel in the city.2) I think ride-hailing services have filled the gap of public transport in the city and 3) I have a plan to continue using ride-hailing services in future.

Four extracted factors i.e., CAA, SA, SAA and IA were used to develop these structural models. The values of R-square and factor scores can be seen in Figs. 1, 2 and 3. It is important to mention here that value of R2 in most of the cases is above 0.5 which shows that variability explained is more than 50% in majority of the cases. The correlation among many factors is significant at 1%,5% and 10% level of significance which shows a great association between the factors.

The 1st and 3rd endogenous variables were on 5-point Likert scale whereas the variables 2nd was coded as yes = 1, otherwise 0. Some socioeconomic and travel behavior related variables were also included to better predict the attitudes of passengers towards ride haling services and the response was replaced with 1,0 coding. For example, if income range is between 25,000–50,000 PKR =1, otherwise 0; if profession is private job holder =1, otherwise 0; if number of weekly trips 4–5 = 1, otherwise 0; if trip purpose is shopping =1, otherwise 0; if household size 2–4 = 1, otherwise 0; if using services for more than one year = 1, otherwise 0 and if respondent's education is bachelor or above =1, otherwise.

Table 4
Rotated Factor Loadings for Travelers Responses on attributes of Ride-hailing Service.

Observed variables	Mean	SD	Factors			
			Coverage and Accessibility Attributes	Instrumental Attributes (IA)	Service Attraction Attributes (SAA)	Safety Attributes (SAA
I believe that picking and dropping off from pin/exact locations is an important factor in the use of App-Based Ride-hailing Services.	3.91	0.884	0.951			
I believe that 24/7 availability of Ride haling services have made my travelling easier as compared to other modes of travel ((Traditional Taxi / Rickshaws / Public transport).	3.98	0.879	0.913			
I believe that Ride-hailing services provide more accessibility options to commuters than traditional transport (Traditional Taxi / Rickshaws / Public transport)	3.973	0.942	0.538			
I think that Ride-hailing services are more convenient than previous modes of travel (Traditional Taxi / Rickshaws / Public transport).	3.73	0.926		0.786		
I believe that Ride-hailing services are more affordable than previous modes of travel (Traditional Taxi / Rickshaws / Public transport).	3.79	0.889		0.742		
I believe that that Ride-hailing services are more reliable than previous modes of transport (taxi / rickshaws / Public transport) modes?	3.83	0.864		0.730		
I believe that that driver skills and behavior of Ride-hailing services are good as compared to other modes of transport (Traditional Taxi / Rickshaws / Public transport).	3.71	0.912		0.743		
I believe that Ride-hailing services have helped users get rid of fare bargaining issues and travel with a transparent and fix fare system.	3.76	0.951			0.804	
I believe that provision of receipt by Ride-hailing services through email and phone encouraged me to use these services.	3.90	0.883			0.714	
I believe the promotions schemes and discounts provided by the Ride-hailing services is a major reason I use these services.	3.79	0.944			0.785	
I believe that vehicle cleanliness is a great factor to use Ride-hailing services	3.68	0.996			0.660	
I believe that Variety of vehicle types (UberX, UberGo, UberMini, CaeemGo+, Careem Business, and CareemGo) are also a great factor to use Ride Haling services	3.79	0.860			0.744	
I believe that these Ride-hailing services provide sufficient information about the waiting time, total travel time, and routing system.	3.98	0.986				0.770
I think that Ride-hailing services have provided users with an improved sense of security regarding himself/herself as well as about the belongings.	4.00	1.35				0.765
I think that vehicle exterior look and physical condition is a great factor to use Ride-hailing services	3.99	0.909				0.515
% variance explained			19.17	14.098	15.73	10.62
Cronbach's Alpha (α)			0.846	0.849	0.721	0.869

Note: SD: standard deviation

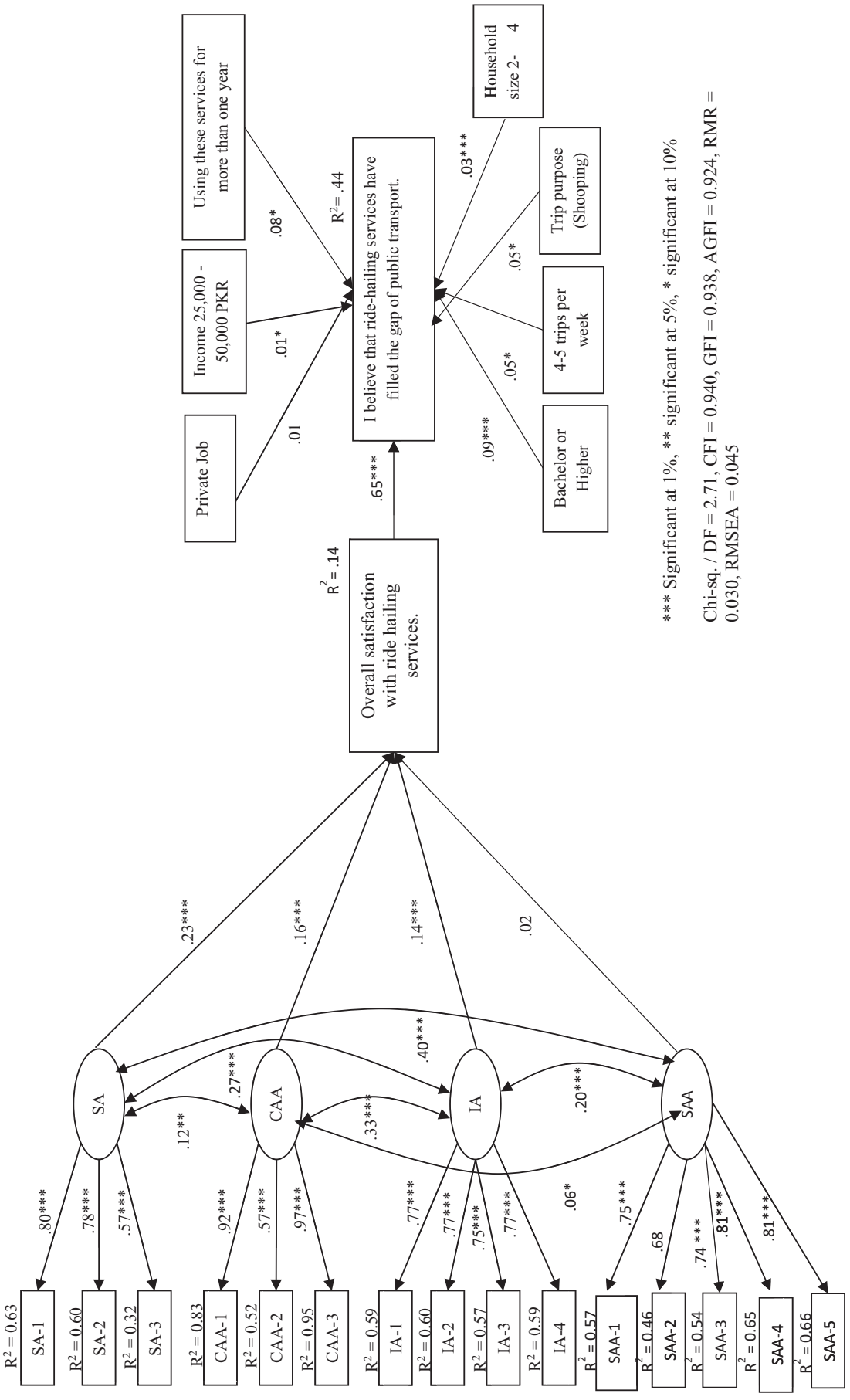

Fig. 1. Structural models of travelers' perceptions towards app-based ride hailing services.

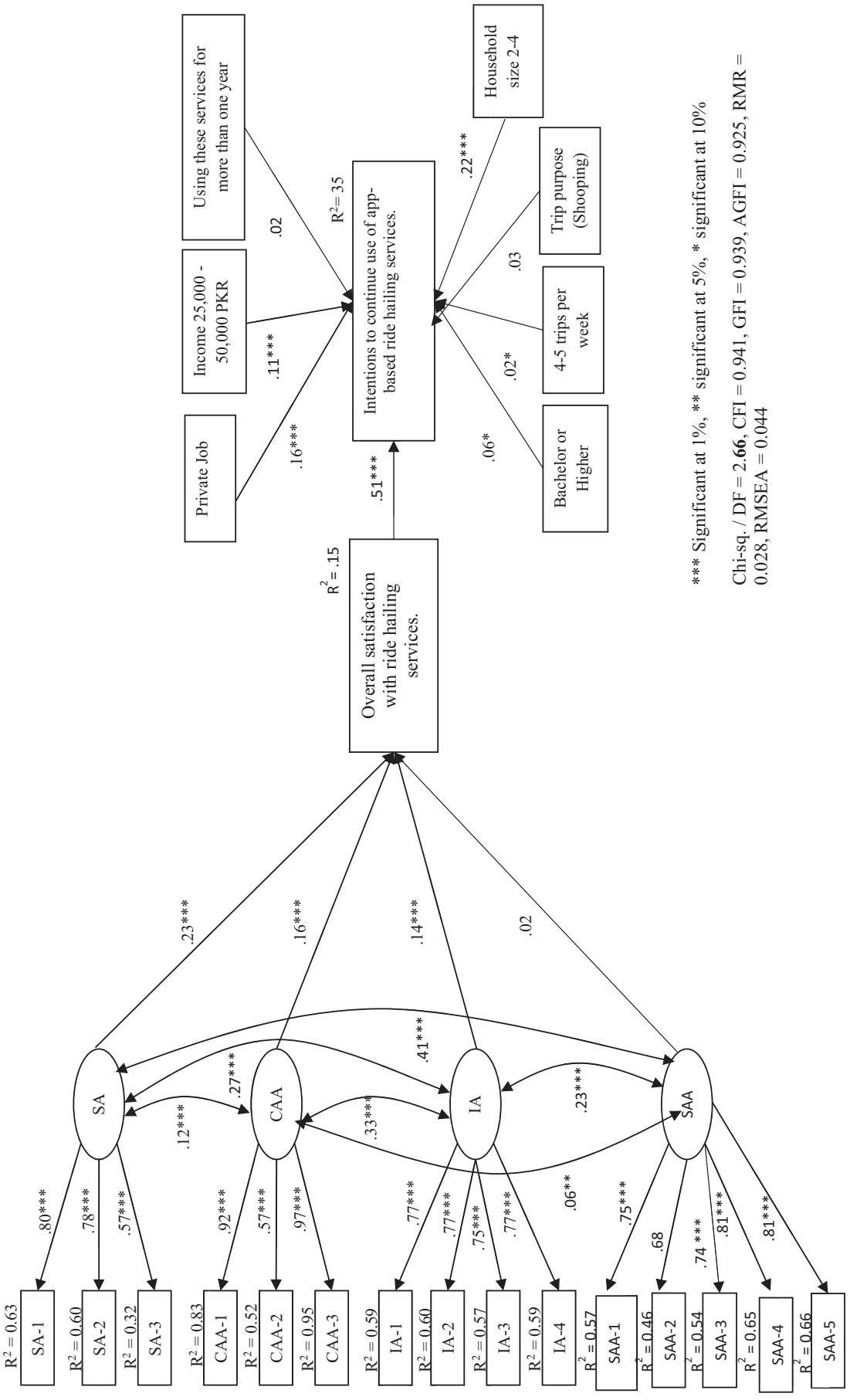

Fig. 2. Structural models of travelers' perceptions towards app-based ride hailing services.

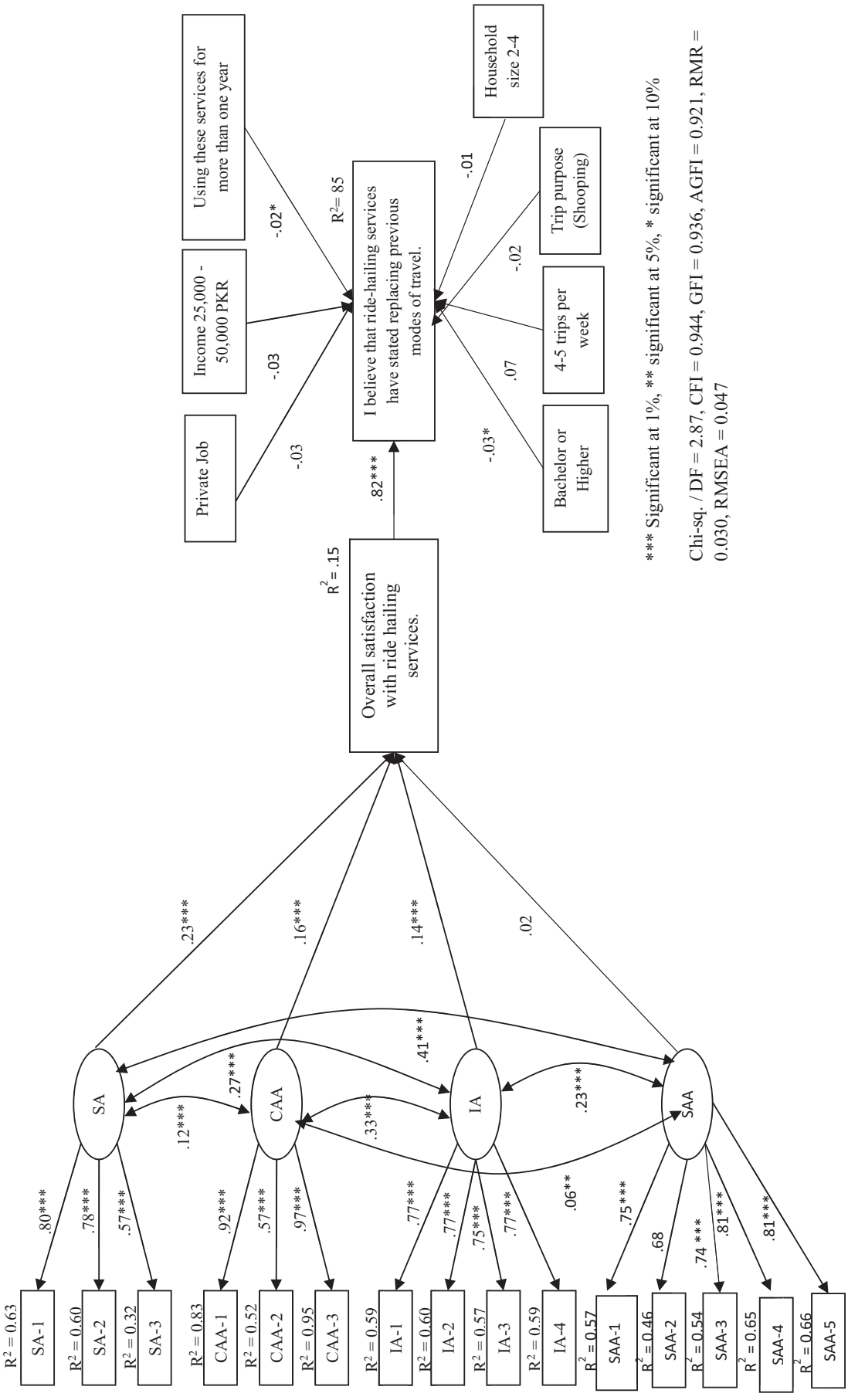

Fig. 3. Structural models of travelers' perceptions towards app-based ride hailing services.

5.1.1. Structural model of travelers believe that app-based services have started replacing previous modes of travel in the city

The results of exploratory factor analysis were used to develop four structural equational models with the help of AMOS software to examine the traveler's behavior and attitude towards ride-hailing services. The first model is presented in figure in Fig. 1. This first model shows that the structural relationships between extracted factors of CAA, SAA and IA with overall satisfaction using ride-hailing services are significant and positive at 100%.

It shows that travelers who positively evaluated SA, CAA and IA attributes are satisfied with overall performance of app-based ride hailing services. The positive coefficients also show that the betterment and improvements in these travel attributes would further enhance travelers satisfaction with app-based ride hailing services. The improvements may include service reliability and affordability, improved booking options, more accessibility options, improved pickoff and drop-off location, better coverage vehicle cleanliness and better security and safety.

The travelers overall satisfaction with app-based ride hailing services have positive association with their believe that that app-based ride hailing services have filled the gap of public transport in the city. It means that further improvements in quality of these services will encourage the travelers more to travel with these services.

The connection of household size and time since using these services with observed variable is positive and significant at 1% and 10% level of significance. It demonstrates that those household whose family size is 2–4 and using these services since last one year believe that these services are filling the gap of public transport in the city. Those respondents whose income is between 25,000–50,000 also hold the opinion that these services have somehow filled the gap of public transport in the city as these are providing them quite an affordable service. The travelers who are travelling with these services 4–5 times a week, having bachelor and above and education and using these services mostly for shopping purpose also believe that the presence of these services have provided them an alternate mode to travel with these services.

The results of the goodness of fit are convincing and quite satisfactory and all the values are under acceptable and permissible levels of significance based on the standard values. The ratio of $\chi 2$ model-fit statistics by degrees of freedom is 2.71 which is well under the acceptable value, goodness of fit index (GFI) is 0.938, the adjusted goodness of fit index (AGFI) is 0.924, comparative fit index (CFI) is 0.940, RMSEA is 0.045 and RMR is 0.030. The values depict that model is quite reliable in the prediction of the prediction of passengers' attitudes with ride-hailing services.

5.1.2. Structural model of travelers intentions to continue using app-based ride hailing services in future

A structural equational model of factors extracted from traveler's evaluation of ride haling services with overall satisfaction and intentions to use these services in future is presented in Fig. 2. The model depicts that the structural relationships between extracted factors of CAA, SAA and IA with overall satisfaction using ride-hailing services are significant and positive at 1% level of significance while the relationship between SAA and overall satisfaction is positive and non-significant.

The structural association between coverage and accessibility attributes with overall satisfaction depicts that improvements in picking up and drop off locations, accessibility and proper converge of whole city would further improve the commuter's overall satisfaction with app-based ride hailing services. In addition, further betterment and improvements may include better vehicle cleanliness, more educated drivers, more focus on drivers training, better safety and security and better routing information.

The extracted factors have quite significant indirect effect on travelers' intentions to continue the use of app-based ride-hailing services in future. Structural model also depicts the significant and positive association between overall satisfaction with these services and variable of 'intentions to continue use ride hailing services in future and it implies that more the travelers are satisfied with service quality of app-based ride hailing services, more commuters will to prefer use these services in future.

The relationship of passengers whose income is between 25,000 to 50,000 PKR, working in private sector and have 2–4 family members with the observed variable "intentions to continue the use of ride-hailing services in future" is positive and significant at 1% level of significance. It shows that travelers hold positive opinion to use app-based ride hailing services in future. Furthermore, travelers having bachelor or higher education, travelling 4–5 times a week, hold positive belief of using these services in future and their relationship with variable" intentions to continue these services in future" is also positive and significant at 10% level of significance.

The results of the goodness of fit are convincing and quite satisfactory and all the values are under acceptable and permissible levels of significance based on the standard values. The values depict that model is quite reliable in the prediction of passengers' attitudes with ride-hailing services.

5.1.3. Structural model of travelers believe that app-based services have started replacing previous modes of travel in the city

The last structural model of factors extracted from traveler's evaluation of app-based ride haling services with overall satisfaction and their believe that these services have started replacing their previous modes of travel is presented in Fig. 3. The model again depicts that the structural relationships between extracted factors of CAA, SAA and IA with overall satisfaction using ride-hailing services are significant and positive at 1% level of significance while the relationship between SAA and overall satisfaction is positive and non-significant.

The association between overall satisfaction with ride hailing services and extracted factors highlight that further betterment in these attributes will enhance commuter's satisfaction while using these services. The service providers may further improve the overall safety and security, fare structure, vehicle physical condition, cleanliness, driver behaviors and education so that travelers may use these services with more satisfaction.

The extracted factors extracted factors of CAA, SAA and IA have quite a significant indirect effect on travelers believe that these services have started replacing the previous modes of travel in the city. Structural model also depicts the significant and positive association between overall satisfaction with these services and variable of 'I think ride-hailing services have started filling the gap of public transport in the city and it implies that more the traveler's satisfaction with service quality of app-based ride hailing services more commuters will start using app-based ride hailing services than previous modes.

The association of all socio-economic and demographic varaibles except education and time since using these services are non-significant. It is important to discuss here that though travelers are satisfied with service quality of app-based ride hailing services, but they still believe that these services are not yet replacing their previous modes of travel. It also shows though commuters are using these services quite often, but these services have not yet reached to the point where previous modes of traveler's can be totally replaced. The findings suggest that the ride hailing companies need further improvement in their services to attract the commuters and replace their previous modes of travel.

The results of the goodness of fit are again convincing and quite satisfactory and all the values are under acceptable and permissible levels of significance based on the standard values. The values depict that model is quite reliable in the prediction of passengers' attitudes with ride-hailing services.

6. Discussion on results

The study examined the travelers' attitude and perception towards the use of ride haling services which has not been well studied in the existing literature of travel behavior in developing countries scenario.

Exploratory Factor Analysis (EFA) and Structural Equational Models (SEM) were conducted using data obtained from a passenger questionnaire survey of ride-hailing services in Lahore city. Identifying and Exploring factors affecting the attitude and perceptions of travelers towards ride-hailing services is essential, particularly in the context developing countries like Pakistan where ride-hailing services are considered as a better substitution for the current public transport systems. This study is quite unique from previous ones in using **SEM analysis** to examine the passengers attitude and intentions towards the adoption of on-demand ride-hailing services in developing countries.

Four extracted factors including instrumental attributes, coverage and accessibility attributes, service attraction attributes and safety attributes have positive influences on traveler's satisfaction towards app-based ride-hailing services.

The analysis shows that travelers showed positive beliefs on the service quality attributes of ride-hailing services despite facing some challenges while using these services. The structural relationships between extracted factors of CAA, SAA and IA with overall satisfaction using ride-hailing services were significant and positive at 100%. Analysis also shows that travelers overall satisfaction with app-based ride hailing services have positive association with travelers intentions to continue using these services in future, believe that ride-hailing services have stated replacing previous modes of travel and filled the gap of public transport in the city. Some other researchers have also stated that ride-hailing services having started replacing previous modes of travel [1,17,50,51,66–68].

Analysis also shows that travelers who positively evaluated SA, CAA and IA attributes are satisfied with overall performance of app-based ride hailing services. The improvement in travel attributes these services would further enhance traveler's satisfaction with app-based ride hailing services. The improvements may include service reliability and affordability, improved booking and accessibility options, improved pickup and drop-off location, better spatial coverage, improved vehicle cleanliness and condition, educated and trained drivers,and better security and safety. Some other researchers have also concluded that improvements in these attributes will influence the attitudes of the commuters towards [69,70] [71,72].

The positive evaluation of service attributes by the customers whose trip purpose is shopping, private employees, having 2–4 family members and those commuters whose education level is bachelor or above and using these services quite often suggest that app-based ride hailing services potential to attract these segments of travel market. The office timings of private employees are usually flexible, and these services help them to better adjust their timings during travelling.

However, the travelers whose education level is bachelors or above and using these services since last 12 months believe that these services have not fully replaced their previous modes of travel. The findings suggest that the ride hailing companies need further improvement in their services to attract the commuters and replace their previous modes of travel.

Since the public transport is not meeting the travel demand requitements in Lahore, so the growing demand in ride hailing services' popularity indicates very serious future implications on transport system in Lahore. It is pertinent to mention here even though ride-hailing services are operating in the city without any regulatory framework, these services are expanding their network and gaining public acceptance due to huge gap between supply and demand. The overall satisfaction of commuters and their positive intentions to use these services in future indicate that these services will further gain grounds in the city. App-based ride hailing services are operating through smart phone apps and customers and drivers are required to share their personal information to ride sourcing companies prior starting their journey, data sharing to these companies raises serious concerns regarding passenger's data [73,74]. It is highly recommended that regulations may be derived regarding real-time ridesharing and information technology-based involving the data of passenger's privacy and its theft preventing after having a thorough overview of such regulations of other developed and developing countries. Therefore, the concerned authorities and ride hailing companies must work together to make appropriate improvements in these services and provide them a place in existing transport system.

7. Conclusions

This study investigated the passenger's attitude and intentions towards the ride-hailing services in developing countries with a special focus on Lahore, Pakistan. This is the first study exploring this attitude in detail using data from a developing country I.e., Pakistan where ride-hailing service are replacing previous modes of travel and fulfilling the gap of public transport in the city. The factors extracted through EFA are significant determinants of the travelers' attitudes towards on demand ride-hailing services. The passenger's income, profession, number of trips, trip purpose, family size, education and service using time are identified as underlying factors determining travelers' attitudes towards these services. Cancelation of rides by drivers, poor conditions of vehicles, poor GPS knowledge, over charging and delay in arrivals are found to the significant challenges which the users of ride-hailing services are facing and majority of travelers who were using rickshaw before are switching to these services. The service providers should focus on improving the spatial coverage, drivers' attitude and behavior, drivers training, fare, accessibility, affordability, promotional schemes, safety, security, and compliant redressal system of ride-hailing services. The SEM analysis highlighted the positive association between service attributes and overall satisfaction which might encourage the people to continue using these services in future. However, improvements are needed in many domains to make these services more popular among the citizens.

This research relies on the findings from a questionnaire study carried out in one Pakistan. It is still hypothesized that the overall findings of this study might be useful and applicable to other developing countries with same socioeconomic and demographic characteristics and where similar transport system, overall travel pattern and mode choices exist. The findings might be applicable in South Asian countries i.e., Srilanka India, Afghanistan, and Bangladesh. The study might also have some similarities with the cities of other developed countries; however, care must be taken while applying these results on such cities and further in-depth studies are recommended. Authors believe that this research has some limitations. Major limitation of the study is a smaller number of female participants owing to various cultural norms and safety concerns. Furthermore, this study is focused mainly on users of ride-hailing services as their percentage among the respondents was very high (87%) so a future study may be conducted addressing the non-users and female participants to better understand their attitudes and behavior towards app-based ride hailing services. In addition, majority of respondents had age between 20 and 30 years with education level bachelors or above probably owing to their more understanding of smart phones and latest technology so the results of this study should eb applied to regions with same socio-demographic characteristics. It is important to consider the institutional and regulatory aspects of the app-based ride hailing services before having a discussion to give them a space in existing transport system. The future research should also take into account the impact of these services on congestion, parking, and environment. With stated limitations, it is believed that insight into the attitude and perceptions of travelers would be useful for the transport planners, ride-hailing companies, and policy makers for making appropriate improvements in the services and giving them space in existing transport system.

Declaration of Competing Interest

No conflict of interest

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