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Factors Affecting Public Transportation Use during Pandemic: An Integrated Approach of Technology Acceptance Model and Theory of Planned Behavior

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Abstract: For preventing the spread of COVID-19, health authorities urgently turned their attention to urban public transportation. It is believed that virus transmission is more likely to occur in public transportation due to increased exposure to infected individuals in the closed and crowded spaces of public transport. This study aimed to model effective factors in the use of public transportation systems during a pandemic based on the technology acceptance model (TAM) and the theory of planned behaviour (TPB). The methodology used was structural equation modeling, with 358 Iranian passengers in Tehran participating and data collected through a questionnaire. The data underwent analysis by means of the partial least squares method with the assistance of SMARTPLS software. The results indicate that passenger satisfaction is affected positively and significantly by expectation and service quality. Behavioral control, subjective norm, attitude, perceived usefulness (PU), and perceived ease of use (PEU) each contribute positively and significantly to the formation of intention. Service quality, PU, and PEU positively and significantly affect attitude. Finally, expectation, intention, PU, and PEU positively and significantly affect the use of the public transportation system. Therefore, it can be inferred that amalgamating TPB and TAM can serve as a robust indicator of passengers' inclination towards using public transportation during pandemic situations, as well as their actual usage of it.

Keywords: pandemic conditions; TAM; TPB; use of public transportation system

1 INTRODUCTION

On December 31, 2019, it was reported that the first confirmed case of COVID-19 had emerged in Wuhan, China [1]. However, because of COVID-19's rapid transmission, the virus was estimated to have caused 4.75 million deaths and more than 232 million confirmed cases worldwide as of September 28, 2021. [2]. The transmission of the disease was immediately recognized as mainly occurring through respiratory droplets and contaminated surfaces within the first few days of the epidemic. There was evidence that respiratory droplets could reach nearby people if they were in close contact with an infected person (within one meter). In addition, preliminary evidence suggested that respiratory droplets and secretions could remain on surfaces and objects for prolonged periods. Therefore, it was also thought that the infection was transmitted indirectly when individuals touched contaminated surfaces and subsequently made contact with their mouth, nose, or eyes [3].

Efforts have been made by health officials to address the problem of urban public transportation with the aim of curbing the transmission of COVID-19. A high risk of virus transmission in public transportation can be attributed to the fact that in close and crowded spaces in public transportation, the chances of individuals being exposed to infected persons, insufficient ventilation, and recycled contaminated air are higher, as well as the efforts made to maintain basic hygiene standards [4]. Due to the increased risk of virus transmission in public transportation, there has been a significant decline in its usage, as noted by multiple observations worldwide, not only as a result of the reduced demand but also as a consequence of the regulations of health agencies to limit the number of passengers in public transportation [5, 6]. Now that people are familiar with self-care and coping methods in pandemic conditions and have experienced COVID-19, this study tends to predict in pandemic conditions. This paper utilizes two theories, namely the theory of planned behavior (TPB) and the technology acceptance model (TAM), in addition to service quality, to forecast the usage of public transportation.

1.1 TPB

It is believed commonly that the TPB is one of the most useful theories for predicting behavior. As a way of explaining human behavior, Ajzen [7] developed this theory. In line with this theory, people behave in a rational and motivated manner because of their motivations. In order to explain individual behavior, this theory focuses not only on voluntary control but also on involuntary control [8]. There are four major components of the TPB: attitudes, mental norms, perceived behavioral control, intention, and behavior. According to the TPB, the most important factor is individual intention, which provides the best indication of an individual's choice of actions [9-11]. A public transportation intention is defined as an intention to use public transportation in the study.

The TPB posits that an individual's behavior is a manifestation of their behavioral intentions, with the notion that one's behavior is influenced by their intentions. A mental norm is characterized as an individual's reaction to apparent social pressures, either in favor of or against engaging in a specific behavior, based on the perceived societal influence [12]. The perception of behavioral control reflects an individual's appraisal of the level of effort required to perform a particular behavior [9]. Because of perceived behavioral control, either one can determine behaviors indirectly, by influencing behavioral intentions, or directly, by determining precisely whether the behavior is controlled actually by the discussed behaviour [13]. It is important to understand that attitude towards behavior is a measure of how positive or negative one feels about one's behavior [14]. The factors described above, as well as attitudes toward behavior, subjective norms, and perceptions of behavioral

control, all play a significant role in the formation of a behavioral intention, which is also an immediate predeterminant of the actual behaviour, which follows [15-17]. Previous studies [15, 18-21, 59, 61, 66, 67] have used the TPB in the context of public transportation use. Several studies have shown that the TPB plays an important role in explaining the reasons why people use public transportation daily. Therefore, considering the findings of the conducted studies, it is assumed that:

H_1: Perceived behavioral control is effective on intention.
H_2: Subjective norm is effective on intention.
H_3: Attitude is effective on intention.

1.2 TAM

The introduction of new urban transportation can be regarded as a technological advancement from the perspective of passengers [63, 64]. The TAM is a widely used theory in the study of technology acceptance [22]. The TAM has been widely recognized for its specificity and cost-effectiveness, as well as its high predictive power when it comes to technology usage. Empirical research suggests that the TAM is successful in predicting around 40% of system use [23]. Because of the model, it is suggested that PEU and perceived usefulness (PU) of technology play an important role in explaining recent technology usage. PEU and PU are two distinct concepts, with the latter pertaining to an individual's perception that utilizing a particular technology will improve their performance, while the former relates to the degree of complexity associated with its usage [22, 24]. The widespread applicability of the TAM has been explored in various technology-oriented contexts [25], and our study aims to investigate how PEU and PU impact the use of public transportation systems from the perspective of transportation technology acceptance. Prior research has highlighted the significance of these two factors in influencing the utilization of public transportation [17, 24, 26]. As Taylor and Todd [27] have noted, the TAM and the TPB can be used to explain individual behavior related to new technology adoption. Accordingly, we assume that these models will be applicable to our study on technology use in public transportation.

H_4: PEU is effective on PU.
H_5: PEU is effective on attitude.
H_6: PEU is effective on intention.
H_7: PEU is effective on the use of public transportation systems in pandemic conditions.
H_8: PU is effective on attitude.
H_9: PU is effective on intention.
H_{10}: PU is effective on the use of public transportation systems in pandemic conditions.
H_{11}: Intention is effective on the use of public transportation in pandemic conditions.

1.3 Satisfaction

Satisfaction is one's pleasant or unpleasant feelings, which result from mental performance in comparison with expectations [28]. Due to the competitive environment, the challenge of achieving customer satisfaction is more reflected. In order to satisfy customers, institutions and companies should consider implementing new marketing strategies [29]. It is psychologically and emotionally important to satisfy the needs of customers that customers experience When comparing their pre-consumption expectations to the actual service performance experienced post-consumption, customers can evaluate the quality of service received [30, 31, 56, 59, 65]. Customer satisfaction can be increased significantly if they perceive the service performance and when it exceeds their initial expectations, customers tend to have a positive emotional response and are more likely to be satisfied with the service. It has been shown that the reasons for passenger satisfaction are determined by both expectations of the passengers as well as the quality of perceived services by Chou et al. [32] and Koklic et al. [33]. In methods of transportation such as buses, subways, high-speed trains, and aviation, the degree of passenger satisfaction is one of the most important mediators that link passenger expectations and perceptions of the quality of service with the intention of passengers to engage in certain behaviors [31, 34]. Therefore, it is reasonable to assume that:

H_{12}: Satisfaction is effective on intention.
H_{13}: Satisfaction is effective on the use of public transportation in pandemic conditions.

1.4 Expectations

According to Heidari et al. [29], customer expectations refer to the psychological requirements that customers have for reliable or personalized services before making a purchase. Shen et al. [36] discovered that passenger expectations are a crucial factor in determining passenger satisfaction. Furthermore, research has shown that there is a positive correlation between passenger expectations and satisfaction [31, 35]. In this study, expectations are viewed as predictors of satisfaction. Hence, it can be assumed that:

H_{14}: Expectation is effective on satisfaction.

1.5 Service Quality

In the past thirty years, service quality and its outcomes have been researched extensively in the service marketing literature. Service quality is considered a distinguishing factor and a potent competitive tool [37]. Services are perceived as the outcome of customer interactions with service providers, including employees, service environment and facilities, and equipment. Service quality is defined as a sustainable mindset towards achieving service excellence [38], or alternatively, it is described as the disparity between perceptions and expectations [39]. This concept has also been widely discussed in various fields, including public transport services, where it has played an essential role in policy formation aimed at enhancing public transportation services [40]. Numerous empirical studies have established a positive correlation between the quality of service offered by public transportation providers and the behavior of passengers who are more inclined to utilize these services in the future [41]. Emami et al. [42] introduced a GIS-based multi-criteria decision analysis robust framework by considering,

socioeconomic, transit ridership, and service frequency factors to improve the bus transit systems. According to Perez et al. [43], the concept of service quality can be divided into five components: tangible, reliable, adaptable, assured, and empathic. In another study conducted by Prasad et al. [44], it was found that the service quality of a railroad system is affected by eight key factors: assurance, empathy, reliability, responsiveness, tangibility, convenience, connectivity, and comfort. Chou et al. [45] discovered that passenger perception of service quality comprises four dimensions: tangibility, convenience, personnel, and reliability, which are also taken into consideration in this study. Several studies have shown in the past that the perceived service quality of public transportation services significantly impacts passenger satisfaction [46,47] as well as PEU and usefulness [48,49]. It is therefore reasonable to assume that the following statements are true:

H_{15}: Perceived service quality is effective on satisfaction.
H_{16}: Perceived service quality is effective on attitude.
H_{17}: Perceived service quality is effective on PEU.
H_{18}: Perceived service quality is effective on PU.

As highlighted in the theoretical literature, the role of TAM and TPB on behavioral intention and public transportation use has been studied extensively. However, a review of empirical research indicates that few studies have modeled the effective factors on the use of public transportation systems during pandemic conditions based on the TAM and TPB frameworks. In order to accomplish this primary objective, the focus of the study is to model the effective factors in the use of public transportation systems during pandemic conditions based on the TAM and TPB frameworks. The conceptual model of the study is developed based on the theoretical framework derived from the literature review, as illustrated in Figure 1. The independent variables in the model include expectations, perceived behavioral control, subjective norm, and perceived service quality. The mediating variables consist of satisfaction, attitude, PU, PEU, and intention, while the dependent variable is the use of public transportation systems during pandemic conditions.

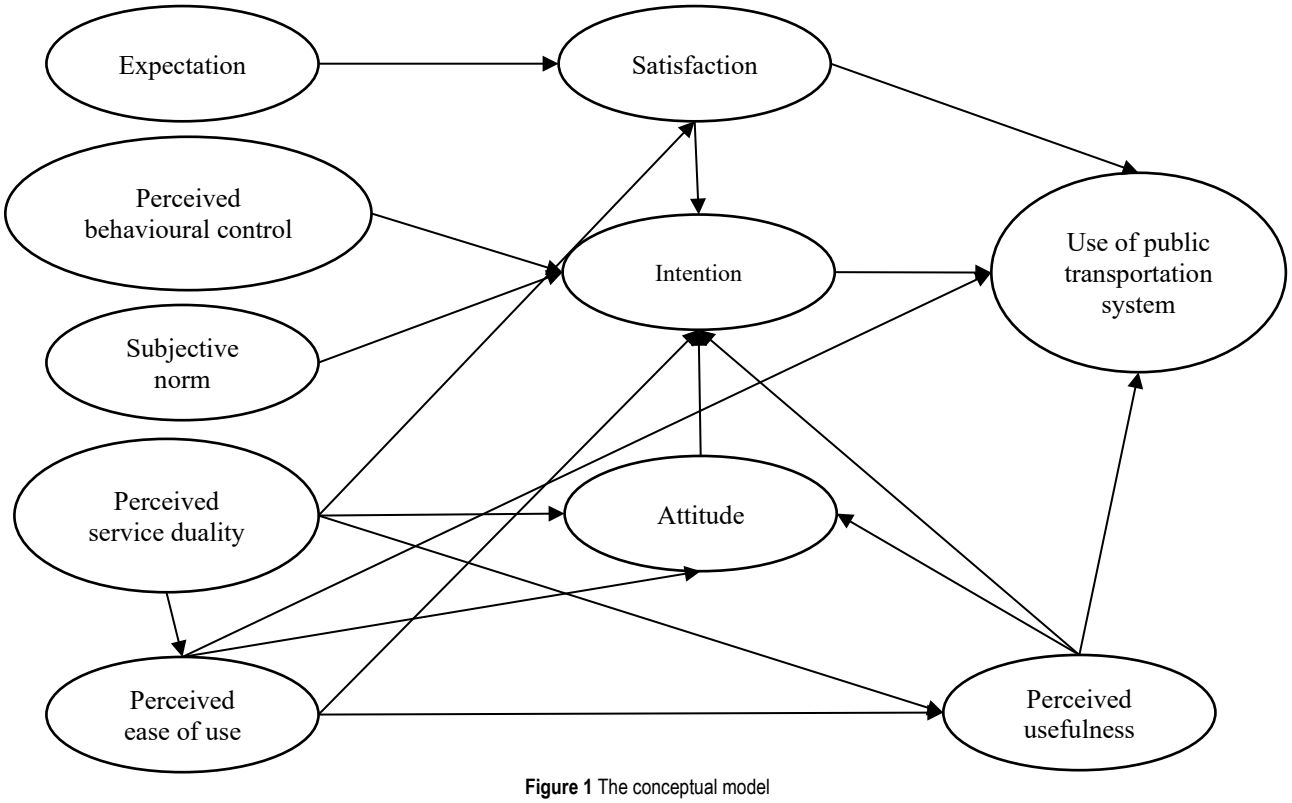

Figure 1 The conceptual model

2 RESEARCH METHODOLOGY

2.1 Statistical Population and Sample

The research was carried out in Iran. The data was collected in Tehran, which has high traffic and an active public transportation system. For this purpose, 500 questionnaires were distributed among citizens of Tehran, out of which 396 questionnaires were returned and 38 questionnaires were removed from analysis due to incomplete answers [57-58, 60]; finally, 358 questionnaires were analyzed. It was found that 69% of participants were males and 31% were females among the participants. It has been found that 34% of respondents were from the 20-30 age group, 31% from the 31-40 age group, 26% from the 41-50 age group, and 9% from the 50+ age group were interviewed.

2.2 Measures

The study employed a questionnaire consisting of 53 items to measure the variables. To measure expectations, the

study utilized Yuan et al.'s [31] questionnaire, which consisted of 3 items. Perceived behavioral control was measured using Chen et al.'s [50] questionnaire, which had 4 items. The attitude was also measured using Chen et al.'s [50] questionnaire, which consisted of 6 items. Subjective norm was measured using Chen et al.'s [50] questionnaire that had 3 items. Moreover, Chou et al.'s [45] questionnaire with 18 items was used to measure perceived service quality, including tangibility (4 items), convenience (6 items), personnel (4 items), and reliability (4 items). PU was measured using Chen and Chao's [17] questionnaire with 5 items, while ease of use was measured using the same questionnaire with 5 items. The intention to use the public transportation system during pandemic conditions was measured using Chen et al.'s [50] questionnaire, consisting of 3 items. On a five-point Likert scale, each item in the survey was rated from one to five, ranging from complete disagreement (1) to complete agreement (5).

3 RESULTS

3.1 Measurement Model Testing

To ensure the accuracy of measurement models, it is important to examine the internal consistency (reliability) and discriminant validity of the constructs and instruments involved in the study. In order to gauge the reliability of constructs, three standards were employed: the reliability of every item, the composite reliability of each construct, and the average variance extracted (AVE). The reliability of each item can be ascertained by examining the factor load of each item within its respective construct through confirmatory factor analysis. A factor load of 0.6 or above and statistical significance at a level of 0.01 or better are both indicators of adequate reliability [51, 52]. To obtain the t-values for factor loadings, a bootstrap test using 500 subsamples was employed to determine their significance. The Dillon-Goldstein coefficient (ρ_c) was employed to verify the composite reliability of each construct. To fulfill the third criterion, which requires adequate discriminant validity, an AVE value of 0.50 or greater is required; this indicates that the construct can account for 50% or more of the variance in its markers [53, 54]. Tab. 1 displays the factor loadings, composite reliability, and AVE values for the variables, indicating that the constructs possess adequate and strong reliability.

In a research study, Chin [52] put forward two criteria for evaluating the validity and discriminant validity of constructs. To meet the initial criterion for establishing construct validity, items in a given construct should exhibit higher factor loadings for that construct than for other constructs, indicating that they are more closely related to their intended construct. Gefen and Straub [51] suggested that this difference in factor loadings should be at least 0.1. In order to satisfy the second criterion, it is necessary to confirm that the square root of a construct's AVE exceeds the correlation between that construct and other constructs studied. By meeting this criterion, it can be ensured that the construct is unique from other constructs and is precisely measuring the intended concept. In Tab. 2, details are given about the cross-sectional loads of items on constructs.

Table 1 Results of reliability

Variable	Item	Factor	α	*CR*	*AVE*
Expectation	1	0.742	0.781	0.868	0.688
	2	0.854			
	3	0.886			
Perceived behavioral control	1	0.857	0.873	0.913	0.724
	2	0.832			
	3	0.864			
	4	0.851			
Subjective norm	1	0.820	0.802	0.883	0.715
	2	0.847			
	3	0.868			
Tangibility	1	0.872	0.823	0.884	0.659
	2	0.712			
	3	0.90			
	4	0.747			
Convenience	1	0.874	0.896	0.921	0.661
	2	0.709			
	3	0.839			
	4	0.764			
	5	0.833			
	6	0.846			
Personnel	1	0.781	0.789	0.863	0.612
	2	0.833			
	3	0.744			
	4	0.770			
Reliability	1	0.763	0.798	0.868	0.623
	2	0.813			
	3	0.793			
	4	0.786			
Ease of use	1	0.826	0.877	0.910	0.669
	2	0.783			
	3	0.826			
	4	0.845			
	5	0.808			
PU	1	0.843	0.882	0.914	0.681
	2	0.844			
	3	0.844			
	4	0.842			
	5	0.747			
Attitude	1	0.878	0.933	0.947	0.750
	2	0.884			
	3	0.890			
	4	0.846			
	5	0.865			
	6	0.831			
Intention	1	0.917	0.874	0.923	0.799
	2	0.888			
	3	0.876			
Use of public transportation system in pandemic condition	1	0.847	0.850	0.909	0.769
	2	0.894			
	3	0.890			

In Tab. 2, we can see that the results indicate that each dimension has the highest factor loading on its intended construct, and there is at least a 0.1 difference between the factor loadings on their intended constructs compared to other constructs, indicating good validity of the constructs. Additionally, the second criterion for construct validity is presented in Tab. 3 together with the results from the correlation analysis.

AVE values of all variables in Tab. 3 exceed their correlations with other variables, confirming the satisfactory discriminant validity of the variables. Furthermore, the

correlation matrix below the diagonal provides information about the relationships between the variables being studied.

Table 2 Cross-sectional factor loading

	Attitude	Intention	Expectation	Satisfaction	Behavior control	PEU	PU	Service quality	Subjective norm	Use of public transport in pandemic conditions
APT1	0.878	0.470	0.387	0.478	0.543	0.564	0.554	0.462	0.329	0.520
APT2	0.884	0.414	0.346	0.419	0.534	0.522	0.531	0.379	0.342	0.461
APT3	0.890	0.408	0.363	0.474	0.558	0.522	0.502	0.392	0.335	0.463
APT4	0.846	0.464	0.361	0.422	0.466	0.506	0.567	0.372	0.298	0.419
APT5	0.865	0.466	0.359	0.399	0.493	0.494	0.504	0.385	0.288	0.469
APT6	0.831	0.558	0.385	0.429	0.453	0.526	0.429	0.417	0.298	0.579
IPT1	0.583	0.917	0.362	0.499	0.484	0.505	0.489	0.411	0.414	0.426
IPT2	0.466	0.888	0.375	0.483	0.432	0.570	0.499	0.398	0.419	0.449
IPT3	0.453	0.876	0.356	0.508	0.434	0.567	0.538	0.351	0.420	0.544
PBC1	0.508	0.589	0.280	0.362	0.857	0.471	0.530	0.443	0.348	0.555
PBC2	0.447	0.565	0.324	0.388	0.832	0.440	0.500	0.397	0.338	0.431
PBC3	0.407	0.573	0.359	0.439	0.864	0.474	0.526	0.453	0.383	0.559
PBC4	0.420	0.621	0.373	0.467	0.851	0.520	0.486	0.439	0.307	0.452
PE1	0.271	0.280	0.742	0.338	0.257	0.352	0.170	0.239	0.140	0.329
PE2	0.302	0.270	0.854	0.405	0.295	0.238	0.196	0.244	0.197	0.346
PE3	0.438	0.425	0.886	0.613	0.394	0.351	0.355	0.355	0.408	0.453
PEU1	0.482	0.536	0.355	0.330	0.430	0.826	0.346	0.390	0.274	0.475
PEU2	0.409	0.423	0.297	0.288	0.343	0.783	0.284	0.356	0.263	0.402
PEU3	0.436	0.438	0.281	0.348	0.396	0.826	0.267	0.309	0.282	0.449
PEU4	0.575	0.581	0.302	0.392	0.544	0.845	0.410	0.349	0.337	0.528
PEU5	0.405	0.504	0.307	0.348	0.542	0.808	0.442	0.292	0.299	0.515
PS1	0.350	0.399	0.570	0.796	0.350	0.285	0.317	0.347	0.373	0.382
PS2	0.518	0.567	0.522	0.903	0.496	0.426	0.442	0.421	0.272	0.565
PS3	0.337	0.358	0.274	0.727	0.316	0.295	0.325	0.335	0.216	0.411
PU1	0.474	0.547	0.258	0.357	0.532	0.339	0.843	0.414	0.434	0.474
PU2	0.542	0.543	0.237	0.352	0.527	0.420	0.844	0.327	0.345	0.493
PU3	0.475	0.528	0.196	0.327	0.484	0.357	0.844	0.385	0.383	0.449
PU4	0.504	0.503	0.282	0.392	0.474	0.348	0.842	0.379	0.387	0.495
PU5	0.460	0.532	0.308	0.430	0.451	0.329	0.747	0.362	0.417	0.487
SN1	0.276	0.359	0.248	0.306	0.307	0.310	0.411	0.366	0.820	0.258
SN2	0.267	0.358	0.270	0.259	0.316	0.273	0.381	0.302	0.847	0.311
SN3	0.368	0.454	0.315	0.326	0.390	0.322	0.415	0.341	0.868	0.352
SQ1	0.219	0.218	0.164	0.234	0.234	0.134	0.309	0.872	0.298	0.247
SQ2	0.282	0.249	0.111	0.234	0.325	0.174	0.274	0.712	0.196	0.331
SQ3	0.205	0.175	0.213	0.256	0.218	0.125	0.282	0.900	0.266	0.215
SQ4	0.231	0.245	0.222	0.309	0.249	0.285	0.257	0.747	0.279	0.260
SQ5	0.174	0.169	0.272	0.313	0.251	0.208	0.196	0.709	0.201	0.234
SQ6	0.322	0.301	0.288	0.329	0.343	0.318	0.335	0.839	0.320	0.332
SQ7	0.315	0.323	0.278	0.382	0.368	0.352	0.314	0.764	0.268	0.359
SQ8	0.386	0.356	0.294	0.422	0.453	0.367	0.364	0.833	0.334	0.456
SQ9	0.285	0.305	0.307	0.347	0.351	0.309	0.283	0.846	0.311	0.351
SQ10	0.345	0.346	0.297	0.399	0.405	0.365	0.334	0.874	0.297	0.420
SQ11	0.305	0.290	0.242	0.301	0.346	0.312	0.293	0.781	0.283	0.331
SQ12	0.306	0.269	0.228	0.295	0.316	0.249	0.283	0.833	0.251	0.334
SQ13	0.350	0.278	0.255	0.231	0.350	0.268	0.319	0.744	0.248	0.340
SQ14	0.362	0.293	0.238	0.286	0.351	0.236	0.286	0.770	0.243	0.369
SQ15	0.476	0.457	0.294	0.328	0.511	0.454	0.381	0.763	0.303	0.492
SQ16	0.412	0.418	0.251	0.344	0.394	0.288	0.378	0.813	0.284	0.473
SQ17	0.317	0.278	0.120	0.275	0.361	0.325	0.344	0.793	0.219	0.374
SQ18	0.365	0.296	0.182	0.279	0.389	0.260	0.315	0.786	0.262	0.394
UPT1	0.657	0.587	0.378	0.439	0.636	0.501	0.519	0.443	0.275	0.847
UPT2	0.684	0.653	0.395	0.505	0.685	0.516	0.494	0.456	0.325	0.894
UPT3	0.689	0.641	0.446	0.540	0.685	0.521	0.520	0.463	0.361	0.890

3.2 Structural Model Modelling (SEM)

The study aimed to predict the use of public transportation systems under pandemic conditions through SEM. Because of partial least squares (PLS) calculations, the estimation of the model was carried out and the hypothesis was tested. It was determined that the path coefficients were significant by using the bootstrap method along with 500

sub-samples to test for significance. According to Fig. 2, there is a relationship between the variables that can be seen in the tested model, with numbers encapsulated in the circles representing the explained variance of each variable for the model as a whole. For each variable, Tab. 4 provides information regarding the path coefficients and the explanations of variance based on the path coefficients.

Table 3 Correlation matrix

	Attitude	Intention	Expectation	Satisfaction	Behavior control	PEU	Perceived usefulness	Service quality	Subjective norm	Use of public transport
Attitude	0.866									
Intention	0.510	0.894								
Expectation	0.423	0.408	0.829							
Satisfaction	0.505	0.556	0.574	0.812						
Perceived behavior control	0.518	0.691	0.393	0.488	0.851					
PEU	0.622	0.613	0.378	0.420	0.561	0.818				
PU	0.596	0.643	0.311	0.450	0.599	0.436	0.825			
Service Quality	0.464	0.433	0.349	0.455	0.509	0.414	0.452	0.685		
Subjective norm	0.364	0.467	0.331	0.353	0.403	0.358	0.476	0.397	0.845	
Use of Public Transport	0.572	0.616	0.464	0.565	0.463	0.584	0.582	0.518	0.367	0.877
Note: The diagonal elements in the correlation matrix is the square root of AVE for each construct										

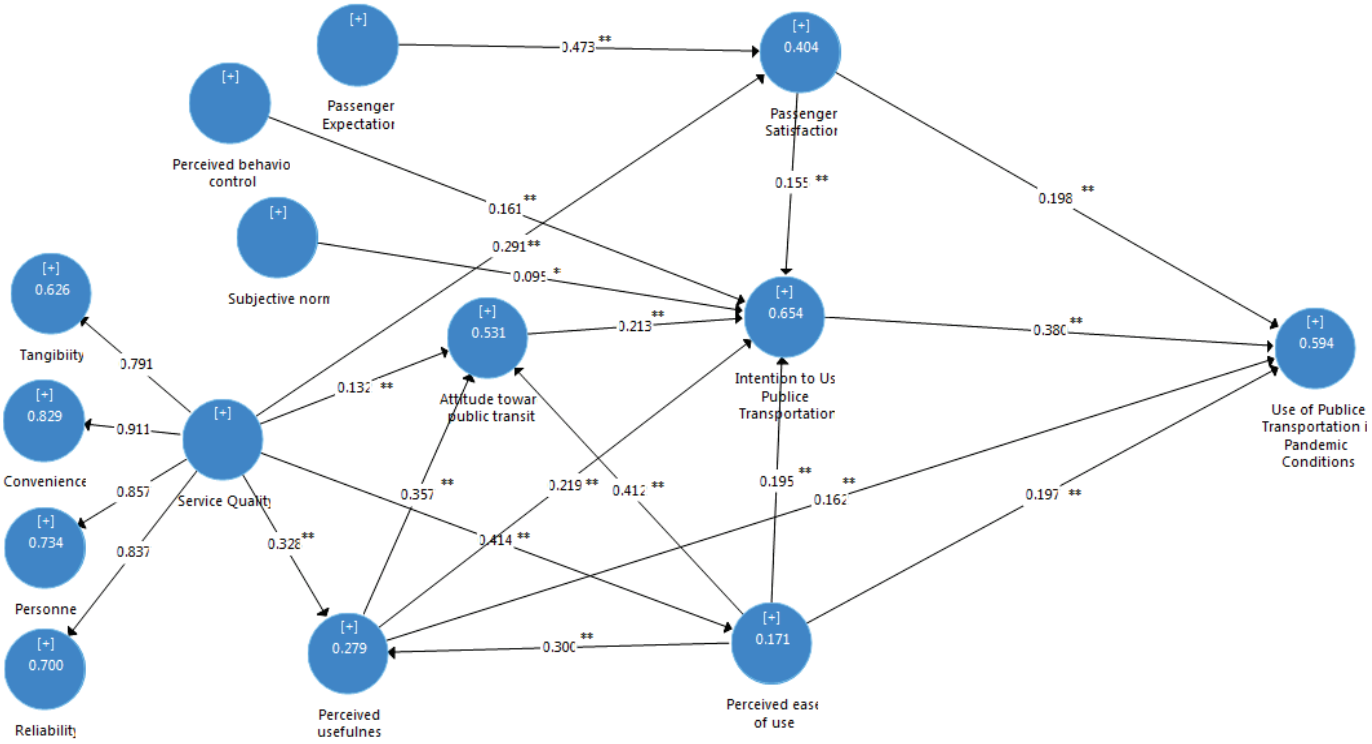

Figure 2 The tested model

Tab. 4 highlights a significant effect of expectations and service quality, indicating that both factors positively and significantly impact satisfaction. Perceptions of behavioral control, subjective norms, attitudes, PU, and PEU are also positively and significantly associated with intention. Additionally, a favorable perception of service quality, PU, and PEU has a positive and significant impact on attitude. Finally, expectations, intention, PU, and PEU significantly influence the effectiveness of the public transportation system. The proposed model accounts for 59% of the variation in public transportation usage during pandemics, 65% of the variance in intention, 53% of the variance in attitude, 40% of the variance in satisfaction, and 17% of the variance in PEU. Tab. 5 presents the indirect coefficients as well.

A mediation analysis is presented in Tab. 5, indicating that PEU and PU have a positive and significant mediating effect on the relationship between service quality and attitude, which is consistent with the results of the mediation analysis. It should be noted that PU has a positive and significant mediating effect on the effect of PEU on attitude in addition to PU. In addition to a positive and significant impact on the intention that service quality can have on attitude, satisfaction, PEU, and PU, these variables also play a positive and significant role in the mediating effect. Lastly, intention plays an important role in the perception of usefulness and PEU of public transportation during pandemic

conditions as well as predicting attitude, satisfaction, PU, PEU, subjective norms, and perceived behavioral control. As shown in Tab. 6, the results of hypothesis testing have been reported.

Table 4 Path coefficients and explained variance

Variable	β	*t*-value	*P*-value	Explained variance
On the use of public transport system in pandemic conditions via:				
Intention	0.38**	6.697	0.001	0.594
Satisfaction	0.198**	4.294	0.001	
PU	0.162**	3.065	0.002	
PEU	197**	4.411	0.001	
On intention via:				
Perceived behavioral control	0.161**	3.106	0.002	
Subjective norm	0.095*	2.399	0.017	
Satisfaction	0.155**	3.250	0.001	0.654
PU	0.219**	4.504	0.001	
PEU	0.195**	3.726	0.001	
Attitude	0.213**	2.964	0.003	
On attitude via:				
PU	0.357**	6.893	0.001	0.531
PEU	0.412**	8.397	0.001	
Service quality	0.132**	2.688	0.007	
On satisfaction vie:				
Expectation	0.473**	9.717	0.001	0.404
Service quality	0.291**	5.471	0.001	
On PU vie:				
PEU	0.30**	5.472	0.001	0.171
Service quality	0.328**	5.823	0.001	

**$p < 0.01$

As a way to assess the validity and quality of a PLS model, the goodness-of-fit index is often used as an indicator of the model's validity. As opposed to the GOF index, which determines whether the tested model is able to successfully predict the endogenous variables, the GOF index measures the overall predictive ability of the model. GOF value of 0.61 was achieved for the tested model in the current study, which indicates that the model is well fitted for the data. For a model to be considered adequate and acceptable for quality, the GOF value has to be higher than 0.36.

4 DISCUSSION

The objective of this study was to investigate the factors influencing the usage of public transportation amidst the COVID-19 pandemic, utilizing SEM and TAM as analytical tools. Our analysis revealed that the proposed model was a suitable fit for the data, accounting for a considerable proportion of the variance in public transportation use during the outbreak (59%). Moreover, it explained a significant portion of the variation in the intention to use public transportation (65%), attitude towards it (53%), satisfaction levels (40%), and PEU (17%).

Our study has revealed that perceived behavioral control, subjective norm, and attitude significantly and positively impact intention to use public transportation. These findings align with previous research conducted by Bamberg et al. [15], Gardner and Abraham [18], Erickson and Forward [19], Mahmoudabadi [55] and Zailani et al. [20]. Moreover, these results are consistent with the TPB, which suggests that behavior is directly influenced by behavioral intention, shaped by attitudes, subjective norms, and perceived behavioral control.

Table 5 Indirect coefficients

Indirect paths	Indirect effects	*t*-value	*P*-values
Service quality → PEU → Attitude	0.171	5.319	0.000
PEU → PU → Attitude	0.107	4.193	0.000
Service Quality → PU → Attitude	0.117	4.542	0.000
PEU → Attitude → Intention	0.088	2.782	0.006
PU → Attitude → Intention	0.076	2.794	0.005
Service quality → Attitude → Intention	0.028	1.999	0.046
Expectation → Satisfaction → Intention	0.073	2.852	0.005
Service quality → Satisfaction → Intention	0.045	2.829	0.005
Service quality → PEU → Intention	0.081	3.344	0.001
PEU → PU → Intention	0.066	3.544	0.000
Service quality → PU → Intention	0.072	3.604	0.000
Service quality → PEU → PU	0.124	4.360	0.000
Attitude → Intention → Use of public transport	0.081	2.514	0.012
Satisfaction → Intention → Use of public transport	0.059	2.962	0.003
Perceived behavior control → Intention → Use of public transport	0.061	2.689	0.007
PEU → Intention → Use of public transport	0.074	3.506	0.000
PU → Intention → Use of public transport	0.084	4.157	0.000
Subjective norm → Intention → Use of public transport	0.036	2.253	0.025
Expectation → Satisfaction → Use of public transport	0.094	4.267	0.000
Service quality → Satisfaction → Use of public transport	0.058	3.392	0.001
Service quality → PEU → Use of public transport	0.082	3.509	0.000
PEU → PU → Use of public transport	0.049	2.582	0.010
Service quality → PU → Use of public transportation	0.053	2.772	0.006

To explain the impact of perceived behavioral control on intention, it can be argued that people's intention to use public transportation will increase during a pandemic if they believe that they have the ability to use public transportation as intended. This includes perceiving themselves as capable of using public transportation, having access to adequate facilities and time to utilize this mode of transportation, possessing a strong inclination towards using public

transportation, having numerous opportunities to do so, and feeling in control of their use of public transportation. If individuals have strong beliefs regarding the factors that facilitate a particular behavior, they are more likely to perceive themselves as having greater control over that behavior. Conversely, if their control beliefs are weak, they may perceive themselves as having less control and be less likely to engage in the behavior. This perception can be influenced by various factors such as past experiences, predictions of future events, and attitudes shaped by societal norms within their environment.

Table 6 Results of hypothesis testing

Hypothesis	Result
H1: Effect of perceived behavioral control on intention	Confirmed
H2: Effect of subjective norm on intention	Confirmed
H3: Effect of attitude on intention	Confirmed
H4: Effect of PEU on PU	Confirmed
H5: Effect of PEU on attitude	Confirmed
H6: Effect of PEU on intention	Confirmed
H7: Effect of PEU on the use of public transportation in pandemic conditions	Confirmed
H8: Effect of PU on attitude	Confirmed
H9: Effect of PU on intention	Confirmed
H10: Effect of PU on the use of public transportation in pandemic conditions	Confirmed
H11: Effect of intention on the use of public transportation in pandemic conditions	Confirmed
H12: Effect of satisfaction on intention	Confirmed
H13: Effect of satisfaction on the use of public transportation in pandemic conditions	Confirmed
H14: Effect of expectations on satisfaction	Confirmed
H15: Effect of perceived service quality on satisfaction	Confirmed
H16: Effect of perceived service quality on attitude	Confirmed
H17: Effect of perceived service quality on PEU	Confirmed
H18: Effect of perceived service quality on PU	Confirmed

To clarify the impact of subjective norms on intention, it can be argued that if societal expectations dictate that individuals use public transportation during a pandemic, there is a greater likelihood that they will engage in this behavior. Consequently, if people hold the belief that those around them possess positive attitudes towards using public transportation in pandemic conditions, their intention to utilize this mode of transportation will likely increase. As per Fishbein and Ajzen's theory [9], subjective norms reflect the social pressures that individuals perceive surrounding a specific behavior. Therefore, when specific reference groups or individuals hold expectations regarding public transportation use, these perceived expectations can motivate people to utilize this mode of transportation.

In order to explain the impact of attitude on intention, it can be argued that individuals will be more likely to utilize the public transportation system during a pandemic if they have a positive predisposition towards using this mode of transportation and typically rely on it while traveling. Additionally, factors such as short travel times to public transportation stations, ease of transitioning between different stations, acceptable transport schedules, clear timetables, and overall satisfaction with the environment of public transportation during travel may also contribute to increased inclination towards using this mode of transportation.

According to this study, one of the main findings was that people's perceptions of the usefulness and ease with which they can use public transportation during pandemic conditions were significantly correlated with their attitude, intention, and actual use of public transport during such conditions. It should be noted that this finding is consistent with earlier studies conducted by Chen and Chao [17], Muenrit et al. [26], and Ahn and Park [24], which also highlighted the importance of PU and PEU in determining the behavior of people. It can be concluded from these results that they are consistent with the findings of the TAM, which indicates that people who perceive public transport as convenient and easy to use during a pandemic are more likely to take advantage of it regularly.

The findings indicate that passengers' expectations influence significantly their satisfaction levels. There is good agreement between the results of this study and the previous studies conducted by Heidari et al. [35] and Yuan et al. [31]. One explanation for this finding is that when passengers have high expectations of the public transportation system, and these expectations are clearly communicated, it motivates the system to deliver better services. Consequently, when passengers receive the expected services, there is a smaller gap between their expectations and the actual service provided, leading to higher levels of passenger satisfaction during pandemic conditions.

One of the key findings of this study is that satisfaction influences significantly the intention to use public transportation during pandemic conditions. The results of this study are similar to those obtained in previous studies conducted by Shen et al. [36], Farooq et al. [34], and Yuan et al. [31]. To provide an explanation for this finding, it can be argued that if passengers are satisfied with their experiences while using the public transportation system during pandemic conditions, such as having a pleasant feeling and responsive services, they are more likely to use it. Satisfaction is typically associated with achieving desired goals and demands, which leads to a comfortable situation. When passengers achieve their desired goals and demands and feel satisfied, public transportation is more likely to be perceived positively by them and therefore, will have a higher tendency to use these services during pandemic conditions.

In addition, the study revealed that service quality significantly influenced passenger satisfaction, attitude, as well as perceived ease and usefulness of public transportation. In addition to these results, previous studies conducted by Wang et al. [46], Nguyen-Phuoc et al. [47], Yuan [31], and AL-Nawafleh et al. [48] have also found similar results. There are a few possible explanations for this finding, one of which is that passenger satisfaction, positive attitude toward using public transportation, PEU, and usefulness of public transportation will increase when the goal of public transportation companies is to provide proper services to passengers and operate on a service-oriented basis. They establish better interactions with passengers, try to solve passengers' problems, and help them while providing

better services in pandemic conditions. Besides, they should be polite and respectful towards passengers. Their services should be available, and they should provide clean public transportation space. A sincere and friendly conversation with passengers can give them the right guidance. Therefore, service quality is a determining factor in the use of public transportation in pandemic conditions, which clearly influences the response of passengers.

5 MANAGERIAL IMPLICATIONS

When considering the variables of the TPB, it is suggested that the public transport service system provides high-quality services during pandemic conditions while also meeting the expectations of passengers and complying with health guidelines. This approach can help cultivate a positive attitude amongst passengers towards the use of public transport services during pandemic conditions. Additionally, friends and acquaintances can influence behavior as one of the significant factors, and therefore promoting the use of public transportation services in pandemic conditions can be encouraged through peer recommendations.

When considering the variables of the TAM, it is recommended that public transportation service systems prioritize easy access and usage for passengers during pandemic conditions. By promoting the role of public transportation in improving performance and providing quick access to desired destinations, passengers may be more willing to use these services.

Regarding passenger expectations and satisfaction when using public transportation service systems during a pandemic, it is suggested that service providers influence passenger behavior by offering fast, round-the-clock, and cost-effective services. Meeting customer expectations, complying with health guidelines, and offering health facilities can also encourage customers to use public transportation services during a pandemic.

Furthermore, service quality can play a significant role in determining the intention to use public transportation systems during a pandemic. It is recommended that service providers induce commitment from passengers by observing health guidelines and paying attention to their needs. Responding quickly to passenger problems, guaranteeing available and clean services, and providing a safe environment are also crucial factors in encouraging passengers to use public transportation services during a pandemic.

6 CONCLUSION

The study has demonstrated that both the TPB and TAM theories are robust predictors of public transportation usage during pandemic situations. Additionally, PEU and PU play a crucial role in mediating the impact of service quality on attitudes towards public transportation. Moreover, PU is instrumental in mediating the impact of PEU on positive attitudes towards public transportation. The effect of service quality on the intention to use public transportation is further mediated by attitudes towards public transportation, passenger satisfaction, PEU, and PU. Furthermore, public transportation intention serves as a critical mediator in determining how attitudes towards public transportation, subjective norms, perceived behavioral control, passenger satisfaction, PEU, and PU affect actual public transportation usage during pandemics. Therefore, to increase the intention to use public transportation systems during pandemics, it is vital to consider the variables of TAM, TPB, and service quality.

7 LIMITATIONS

It is important to take note of the fact that this research was limited to a sample of Tehran citizens, and therefore the generalization of findings may be restricted. Additionally, the results are based on self-report data, which may have some limitations. To gain a more comprehensive understanding of the effective factors on the intention to use public transportation systems during pandemic conditions, future studies should consider using qualitative, mixed research methods, and machine learning and artificial intelligence [68-73] as well.

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