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PII: S0967-070X(23)00187-7

DOI: <https://doi.org/10.1016/j.tranpol.2023.07.013>

Reference: JTRP 3109

To appear in: *Transport Policy*

Received Date: 30 January 2023

Revised Date: 7 July 2023

Accepted Date: 12 July 2023

Please cite this article as: Lin, Y.-H., Wu, H., He, H., Tsui, K.W.H., Changes in perceptions of airport services' attributes: An assessment of the impacts of COVID-19, *Transport Policy* (2023), doi: <https://doi.org/10.1016/j.tranpol.2023.07.013>.

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Changes in perceptions of airport services' attributes: An assessment of the impacts of COVID-19

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Abstract

The aviation industry has faced the formidable and unprecedented impact of the COVID-19 pandemic since 2020. This is of particular interest, given the impact of the COVID-19 pandemic on air travel, which has potentially influenced passenger' perceptions of airport services on offer. By applying the construal level theory, this study used structural equation modelling to examine the perceptions of airport services' attributes among airport passengers before and during the COVID-19 era. The findings of this study showed significant differences among airport passengers regarding the perceptions of or preference for attributes within specific airport service categories (e.g., security, passport and personal ID control, and wayfinding) before and during the COVID-19 era. This study provides practical guidance and insights for airport managers to develop suitable airport services and products for passengers in different operating environments, and to cope better with passengers' needs in the post-COVID-19 era and in response to any future pandemics.

Keywords: Airport services' attributes; Construal level theory (CLT); Pre-COVID-19; Mid-COVID-19 era

1. Introduction

Airports are the first and last place where travellers and encounter visiting a destination (Bunchongchit & Wattanacharoensil, 2021). Several standardised processes take place at airports, such as check-in, baggage drop-off, security screening, passport control, and departure (Halpern & Mwesumo, 2021). Airport services involve extensive interactions between airport service providers and air travellers as a chain of services (e.g., check-in and boarding services) (Park et al., 2020). Nevertheless, recently, the aviation industry has faced the formidable and unprecedented impact of the COVID-19 pandemic since the first description of the outbreak as a pandemic on 12 March 2020. This caused a significant decrease in air passenger demand and flight movements, bringing many airports to the bottom limits of financial survival (Hassan & Salem, 2021; Serrano & Kazda, 2020; Štimac et al., 2021). In the current era, the airport service environment has become complex, so finding an effective process of measuring and analysing relevant information regarding passengers' expectations and requirements regarding airport services' attributes is not a simple task (Bezerra & Gomes, 2016). This is of particular interest, given the impact of the COVID-19 pandemic on air travel, which has potentially influenced travellers' expectations of airport services on offer.

The attributes of airport services can include different features and functions, which do not necessarily elicit customer satisfaction in a constant manner across different times. Therefore, the attributes of airport services have become a key area of interest to scholars and airport stakeholders (e.g., Airports Council International, 2021; Hong et al., 2020; International Civil Aviation Organisation, 2016; Kim et al., 2016; Pandey, 2016; Prentice & Kadan, 2019; Tseng, 2020; Trischler & Lohmann, 2018; Yeh & Kuo, 2003). However, Lamb et al. (2020) and Lin and Zhang (2021) suggested that the COVID-19 pandemic changed air passengers' travel motivation and behaviour. This is because airport customers' crisis-related experiences may influence their adaptive behaviours, for example, rising safety concerns following the terrorist attacks on 11 September 2001 and the COVID-19 pandemic (Dillon et al., 2011; Silver & Andrey, 2014). In addition, a significant body of studies investigated changes in travellers' perceptions of airport services during different pandemics, for example, the severe acute respiratory syndrome (SARS) (Cooper, 2006; Finkelstein & Curdt-Christiansen, 2003; Overby, 2004); bird flu (Costa Jordão, 2009; Lim, 2006; Sundrani, 2007), H1N1 (Clegg, 2010; Huimin, 2010), and Ebola (Cahyanto et al., 2016; Novelli et al., 2018). Construal level theory (CLT) can explain such behavioural changes in social psychology. The CLT was first proposed by Liberman and Trope (1998). It describes the relationship between psychological distance and the extent to which individuals' behaviour (e.g., airport passengers' travel behaviour) changes in response to abstract versus concrete construals. It is generally accepted that the COVID-19 pandemic severely impacted individuals' daily lives. The psychological distance between the COVID-19 pandemic and airport passengers should be close, thus producing a more concrete construal. The CLT theory posits that a concrete construal enhances the feasibility of adopting a certain behaviour (Trope & Liberman, 2010), suggesting that the occurrence of environmental shocks will prompt different desire and needs among individuals (e.g., airport passengers). Considering the gap in the extant literature on airport service quality after the COVID-19 pandemic, this study aimed to investigate the following two research questions:

- *Do airport passengers require different attributes of airport services before and during the COVID-19 era?*
- *Are some airport services' attributes more important than others before and during the COVID-19 era?*

In order to address the research questions above, this study used the structural equation modelling (SEM) approach to analyse 503 airport passengers in Taiwan with respect to their perceptions of airport

services' attributes before and during the COVID-19 era and extended existing knowledge on airport service quality. To contribute to transport and tourism research, this study provides a better insight of the effects of the COVID-19 pandemic on the perceptions for different airport services' attributes from airport passengers' perspectives (as well as in different passenger groups). To the best of authors' knowledge, this study is the first to investigate airport passengers' perceptions of the importance of airport services' attributes before and during the COVID-19 era. In addition, the results of this study enabled airport managers to understand airport passengers have different requirements and needs for airport services during their air travel in the post-COVID-19 era.

The remainder of this article is structured as follows. Section 2 reviews the literature on airport services' attributes and customer satisfaction (expected service and perceived service). Section 3 describes the sample's characteristics and the data collection process. Section 4 presents the research model and the methodology used in this study. Section 5 presents the results of the analysis. Finally, the concluding remarks in Section 6 outline the contributions of this research and a direction for future research.

2. Literature review

2.1 Service quality and the attributes of service at airports

Service quality can be defined as all of the explicit service components delivered by an organisation compared with the expectations of its customers (Eboli & Mazzulla, 2009). It was found that evaluating airport service quality should not solely rely on the outcomes of a service process, but also consider the process of service production, such as employee training and education, as well as their interaction with airport customers (Sricharoenpramong, 2018). Moreover, service quality helps an organisation to gain a competitive advantage and is often viewed as a driver of an organisation's profitability (Alexandris et al., 2002; Prentice & Kadan, 2019). In the airport environment, the quality of airport service can be thought of as the service perceived by airport passengers when travelling through airports or terminals. According to Bogicevic et al. (2013), passenger satisfaction in the airport environment is enhanced by a clean and hospitable atmosphere, whereas dissatisfaction arises from insufficient dining options, unclear signage and the security-check process. Allen et al. (2020) also confirmed that the factors with the greatest impact on the overall satisfaction of airport terminals are related to the environment and control. Fodness and Murray (2007) argued that the quality of airport service is one of the most important ways that airport managers can differentiate themselves in an intensely competitive environment. The assessment of airport service quality tends to improve when the airport is subject to market forces, such as competition in fares or the private sector involvement (Suárez-Alemán & Jiménez, 2016). In recent years, airports worldwide have paid increasing attention to passengers' perceptions and expectations of airport service quality for maximising non-aeronautical revenues, as it has been increasingly difficult for airports to control the level of aeronautical charges in the face of intense competition from rival airports (Fuerst & Gross, 2018; Tsai et al., 2011). Because of the importance of meeting airport passengers' needs to the overall attractiveness of an airport, the quality and attributes of airport services have gained substantial attention among academics and practitioners because of their critical role in understanding airport passengers' satisfaction (Bezerra & Gomes, 2016; Tsai et al., 2011).

Many researchers and industry professionals have attempted to use various dimensions to measure and evaluate airport service quality. For example, Yeh and Kuo (2003) described six dimensions of airport service quality, including comfort, processing time, convenience, courtesy of the staff, the visibility of information, and security. Fodness and Murray (2007) also deconstructed airport service quality into function, interaction, and diversion. Brida et al. (2013) identified the image perception of an airport as

the most crucial factor for assessing airport service quality based on the odds ratio. This construct comprises of key elements related to airport service quality, such as terminal innovation, security, passenger assistance, terminal maintenance and facilities for disabled passengers. Furthermore, airport services have been categorised into eight dimensions which all significantly influence passengers' perceptions and satisfaction, including access, airport environment, airport facilities, arrival services, check-in, passport and personal ID control, security and wayfinding (Bezerra & Gomes, 2015; Chonsalasin et al., 2020; Pandey, 2016). Pantouvakis and Renzi (2016) also conducted a service quality evaluation to measure its effect on customer satisfaction upon airport service, stressing the importance of considering national differences. Importantly, Airports Council International proposed a scale for measuring airport service quality, which has been frequently used by airports within the global airport industry for improving the quality of airport services (Airports Council International, 2022). It has been noted that many academics have also framed the quality and attributes of airport services in airport passenger service research on the basis of the dimensions of the Airports Council International's airport service quality survey (Bezerra & Gomes, 2016; Martin-Domingo et al., 2019; Tseng, 2020). In this study, the items used for measuring the quality of airport services are consistent with the attributes developed by the Airports Council International survey. A detailed examination of each measurement category and the items is provided in the Methodology section.

2.2 Impacts of COVID-19 on airport services

Prior to the COVID-19 pandemic, the growth of air travel prompted airports to optimise their existing infrastructure while seeking to offer high-quality products and services to various groups of airport passengers and customers (Bezerra & Gomes, 2016; Halpern & Mwesiumo, 2021). It is worth noting that having a good level of airport service quality could help airports achieve their commercialisation strategies, thereby substantially generating more non-aeronautical revenues (Jiang & Zhang, 2016; Pandey, 2016). More importantly, better service quality may also influence airport passengers' preferences when choosing their departure, stopover and destination airports, thus contributing to the economic and tourism development of the areas surrounding the airport (Allen et al., 2020; Prentice & Kadan, 2019).

However, the unprecedented and formidable COVID-19 pandemic has dramatically affected the business of airports, severely curtailing flights and creating an emergency situation for airport operations (Liu et al., 2021; Serrano & Kazda, 2020). All stakeholders in the air transport sector have also faced massive drops in air passenger numbers and revenues from this unprecedented health crisis, but still need to ensure flight safety (Cifuentes-Faura & Faura-Martínez, 2021; Serrano & Kazda, 2020). It is obvious that passenger satisfaction with safety is influenced by their perception of the airport's environment, as well as their overall transit experience (Ceccat & Masci, 2017). Undoubtedly, airports have been forced to optimise their normal operations to create a safe travel environment for air travellers and, more importantly, adapt to the "new normal" situation (Štimac et al., 2021). Similarly, Ma et al. (2013) found that passengers prioritised facility functionality, layout accessibility and cleanliness over facility aesthetics during the pandemic. Arguably, identifying and improving passengers' perceptions of and satisfaction with airport service standards and experiences in the post-COVID-19 era could be the key to airports' survival throughout the recovery period and beyond (Bunchongchit & Wattanacharoensil, 2021; Tuchen et al., 2020).

As air travel begins to recover, airports are required to install additional safety and hygiene procedures, including social distancing, quarantines, sanitisation, and new technologies, which may eventually affect airports' ability to enhance and improve their service standards and competitiveness (Choi, 2021; Halpern & Mwesiumo, 2021). In particular, Fodness and Murray (2007) suggested that the products

and services available to airport passengers while waiting at airports are critical to passengers' expectations of airport service quality. Deriving such expectations from airport passengers' perspectives and opinions may help airport managers to understand their real needs during the post-COVID-19 era, thereby strengthening airport passengers' sense of safety and confidence, and improving the overall quality of airport services (Chonsalasin et al., 2020). Moreover, the different recovery patterns observed in various aviation markets can be attributed to the significant heterogeneity in travellers' preferences during the COVID-19 pandemic across different regions (Chen et al., 2022). According to this review, achieving a sound understanding of passengers' perceptions of airport services' attributes is critical for airport operations during the post-COVID-19 era.

3. Methodology

3.1 Research design and hypotheses

A questionnaire about the attributes of airport services was developed with reference to the Airports Council International survey (Airports Council International, 2021). The attributes related to COVID-19 measures used in this study included the Airports Council International's COVID-19 safety measures for airports (Airports Council International, 2020b), the findings of Hong et al. (2020), and Halpern and Mwesiumo (2021). In total, 45 items describing the attributes of airport services were developed and grouped into eight categories, including access (four items), the airport environment (three items), check-in (three items), passport and personal ID control (four items), security (four items), wayfinding (six items), airport facilities (17 items), and arrival services (four items). The questionnaire also contained two additional sections: the demographic information of the participants and the variables of airport service. A five-point Likert scale was used to measure the participants' perspectives and opinions about the perceptions of or importance of the attributes of airport services before and during the COVID-19 era, where 1 indicated "Least important" and 5 indicated "Very Important". Perceived importance of airport service attributes refers to airport passengers' overall assessment of the value they receive in relation to what they give when utilising airport products or services (Zeithaml et al., 1990). Measuring perceived importance allows airport management to gain valuable insights into passengers' preferences and perceptions of airport services' attributes, enabling informed decision-making and improvements in the airport's overall service quality. In this study, the questionnaire was designed to capture passengers' opinions on their travel experiences both before and during the COVID-19 pandemic using the same survey instrument. This approach aligns with the concept of mental time travel, which suggests that humans possess the ability to mentally project themselves backward or forward in time to re-live or pre-live events (Suddendorf & Corballis, 2007). This theory has been previously applied in the context of tourists' travel experiences (Eletxigerra et al., 2021). By engaging in mental simulations, airport passengers (participants in this study) can access their memories of the pre-COVID travel experiences and compare them to their current experiences, enabling them to provide feedback on both types of experiences (the pre- and amid travel experiences) within a single survey questionnaire.

In order to understand the effects of the COVID-19 pandemic on the perceived importance of the attributes of airport services for airport passengers, the following hypotheses were developed (see Figure 1):

H₁ (a...h): *The eight airport services' attributes have a positive influence on the passengers' perceptions of airport services during the pre-COVID-19 era individually.*

H₂ (a...h): *The eight airport services' attributes have a positive influence on the passengers' perceptions of airport services during the COVID-19 era individually.*

H₃: *There are differences in the passengers' perceptions of airport services' attributes before and during the COVID-19 era.*

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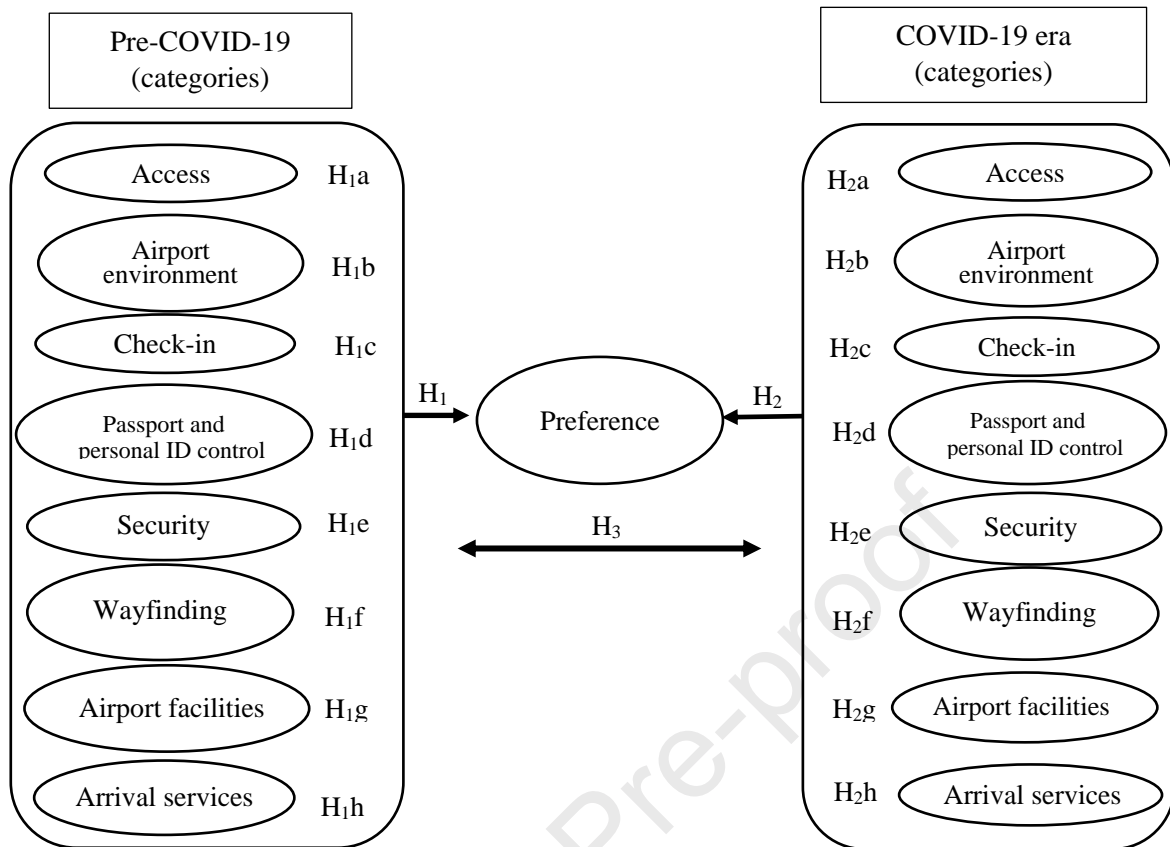


Fig. 1. The structural equation model of the perceptions of airport services' attributes before and during the COVID-19 era

The draft questionnaire was initially prepared in English, and then translated into Chinese by two bilingual authors. The Chinese version of questionnaire was piloted with 30 Taiwan residents with different backgrounds and flight experiences, which ensured that the Chinese version of the questionnaire was appropriately translated without any misleading implications or ambiguities. According to the comments from the Taiwanese respondents in the pilot study, Taiwan residents, the draft English version and Chinese version of the questionnaire were modified and improved. The English version of Questionnaire is shown in Appendix 1.

3.2 Sample and data collection

In light of the research aim presented in the Introduction, the survey data collected from airport passengers who had experience of flying during the COVID-19 pandemic enhanced the data's validity and reliability. All participants were recruited at Taichung International Airport passenger terminal in Taiwan using a convenience sampling technique in October 2021 by a group of five university students who were adequately trained for survey data collection. Both paper- and web-based questionnaires¹

¹ The Tencent questionnaire platform is one of the most popular online instruments used for surveys. It fitted the questionnaire format of this study, and it was easy for mobile users to access and complete the online questionnaire. <https://wj.qq.com/s2/9127801/641c>

were made available to the prospective participants at the airport terminal (check-in areas and departure hall), who had a choice to complete the paper-based English or Chinese version questionnaire onsite, or to scan a QR code via their mobile phones to access the online questionnaire. Students were able to assist with any queries to ensure that all sections in the questionnaire were properly completed with no missing data. A sample of 503 valid responses (445 paper-based and 58 web-based questionnaires) was collected from the participants for analysis.

3.3 Data analysis

First, both descriptive and inferential statistical analyses were applied to the survey data collected from the participants. A descriptive analysis of the demographic information of participants allowed us to look for trends and distributions, whereas inferential analysis, such as the Cronbach's alpha (α) value, can assist in determining the internal consistency reliability of the factor clusters. Second, the SEM approach was used to test all the hypotheses in Section 3.1. Bezerra and Gomes (2016) showed that the SEM approach is suitable for analysing complex relationships among the various aspects of airport service quality. In addition, many prior studies have proven the robustness of the SEM approach in examining the relationship between passenger attitudes and airport service quality (e.g., Allen et al., 2020; Bunchongchit & Wattanacharoensil, 2021; Halpern & Mwesiumo, 2021; Prentice & Kadan, 2019; Tam et al., 2005). Before estimating the SEM, a confirmatory factor analysis (CFA) was carried out first to test the model's measurements (the validity and reliability of the measurement items). For the SEM, the focus was on the relationship between the eight first-order latent variables (i.e., access, airport environment, check-in, passport and personal ID control, security, wayfinding, airport facilities, and arrival services) and the second-order latent variable (i.e., perceptions of airport services' attributes). Furthermore, a sub-group analysis was conducted to investigate the variations in perceptions of airport services' attributes between occasional travellers and frequent travellers, comparing the pre- and amid COVID-19 eras. This analysis aimed to gain insights into how the perceptions of airport services' attributes differed among these two sub-groups during different time periods.

4 Empirical results

4.1 Descriptive statistics

The demographic information in Table 1 represents a diversified sample of participants, which satisfied the principles of sampling. In this sample, 49.1% and 51.9% of the participants were male and female, respectively. Participants in the 21–30-year-old age group accounted for approximately 35.4% of the sample², and those aged over 61 years old made up the smallest group, accounting for 2.2%. Tourists made up the predominant group (54.3%) within the participants, and 47.1% of them were travelling alone rather than by joining tour groups. Moreover, 64.6% of the participants travelled fewer than three times per annum before the COVID-19 pandemic, but only 9.2% of participants travelled more than 10 times annually. The majority of participants (72.8%) were currently employed, 1.8% were unemployed, and 1.6% were retired. Regarding their socioeconomic status, 45.9% of participants reported their monthly income between US\$1,001 and US\$2,000, followed by 34.2% of

² According to the Taiwan government's statistics bureau (2021), Taichung city has a relatively young population, with 30% of residents under 30. Besides, Taichung International Airport is located in central Taiwan, which is home to many universities and colleges. Therefore, a large number of young people are likely to travel for education, tourism, and business purposes during both the pre- and amid COVID-19 eras.

participants with a monthly income of US\$1,000 or less. All participants reported that they travelled to other domestic destinations/cities with Taiwan from Taichung international airport.

Table 1. Demographic profiles of the participants

Variables	Categories	Participants	Percentage
Gender	Male	242	48.1%
	Female	261	51.9%
Age	≤20	80	15.9%
	21–30	178	35.4%
	31–40	106	21.1%
	41–50	77	15.3%
	51–60	51	10.1%
	≥61	11	2.2%
Travel purpose	Business	28	5.6%
	Tourism	273	54.3%
	Visiting family and relatives	115	22.9%
	Others	87	17.3%
Travel style	Tour group	97	19.3%
	Individual	237	47.1%
	Family	169	33.6%
Travel frequency by flights per year before the COVID-19 pandemic	≤3	325	64.6%
	4–6	94	18.7%
	7–9	38	7.6%
	≥10	46	9.2%
Employment	Full-time	356	70.8%
	Part-time	10	2.0%
	Student	105	20.9%
	Retired	8	1.6%
	Unemployed	9	1.8%
	Other	15	3.0%
Income (USD) ³	≤1,000	172	34.2%
	1,001–2,000	231	45.9%
	2,001–3,000	66	13.1%
	≥3,001	34	6.8%

All of the Cronbach's α values exceeded 0.80, which met the conventional measurement criteria of reliability. The highest Cronbach's α values were for security (0.97) and arrival services (0.96), followed by airport facilities (0.94) for the pre-COVID-19 era. Moreover, arrival services (0.96), airport facilities (0.94), and security (0.93) also had the top three Cronbach's α values during the COVID-19 era.

Table 2 presents the descriptive statistics of the survey data. The mean of all categories of the attributes of airport services for the pre-COVID-19 era were greater than 3.72. The categories ranked first and last were 'Arrival services' and 'Security', with means of 4.41 and 3.72, respectively. However, the eight categories had a higher mean of more than 4.24 during the COVID-19 era. The categories ranked first and last were 'Security' and 'Access', with means of 4.69 and 4.24, respectively.

³ As for the monthly income, on average was USD\$1,100 (NTD\$32,344) per month in Taiwan in 2021.

Table 2. Descriptive statistics of eight categories and related measurement items

Categories	Pre-COVID-19			COVID-19 era			Measurement items		Pre-COVID-19		COVID-19 era	
	Cronbach's α	Mean	SD	Cronbach's α	Mean	SD			Mean	SD	Mean	SD
Access	0.83	4.08	0.695	0.81	4.24	0.673	AC01	Ground transportation (including taxis) to/from airport	4.07	0.838	4.28	0.803
							AC02	Availability of parking facilities	4.13	0.848	4.27	0.840
							AC03	Value for money of parking facilities	4.06	0.876	4.21	0.875
							AC04	Availability of baggage carts or trolleys	4.04	0.855	4.18	0.861
Airport environment	0.89	4.28	0.658	0.85	4.48	0.603	AE01	Terminal's comfort, ambience and design	4.23	0.739	4.37	0.734
							AE02	Terminal's cleanliness, floors, seating, and public areas	4.36	0.700	4.58	0.641
							AE03	Seating facilities throughout the terminal	4.26	0.747	4.48	0.679
Check-in	0.87	4.28	0.653	0.86	4.48	0.585	CI01	Waiting time in the check-in queue	4.25	0.738	4.46	0.669
							CI02	Efficiency of check-in staff	4.33	0.715	4.52	0.637
							CI03	Check-in facilities and seating	4.25	0.743	4.46	0.678
Passport and personal ID control	0.84	4.23	0.669	0.89	4.53	0.564	PC01	Waiting time for passport or personal ID inspection	4.29	0.755	4.49	0.700
							PC02	Courtesy and helpfulness of inspection staff	4.33	0.735	4.52	0.640
							PC03	Social distancing at security or immigration	4.06	0.948	4.62	0.597
							PC04	Immigration queuing times and system	4.22	0.786	4.51	0.662
Security	0.97	3.72	1.07	0.93	4.69	0.539	SE01	Face mask usage enforced	3.73	1.132	4.72	0.554
							SE02	Taking body temperature	3.74	1.129	4.73	0.539
							SE03	Social distancing markings or signage	3.76	1.090	4.67	0.617
							SE04	Enforcement of social distancing	3.66	1.142	4.64	0.650
Wayfinding	0.91	4.25	0.65	0.92	4.52	0.557	FW01	Ease of finding one's way through the airport	4.25	0.738	4.47	0.696
							FW02	Infectious disease and epidemic control information markings or signage	4.03	0.924	4.60	0.629
							FW03	Flight information screens – clarity and quality of information	4.40	0.720	4.62	0.619
							FW04	Walking distance inside the terminal	4.14	0.806	4.37	0.762
							FW05	Ease of making connections with other flights	4.28	0.755	4.50	0.665
							FW06	Clarity of boarding calls	4.38	0.731	4.58	0.600
Airport facilities	0.94	4.18	0.70	0.94	4.46	0.663	AF01	Visibility and availability of hand sanitiser	3.93	0.958	4.66	0.590
							AF02	Seating or food & beverage social distancing	3.84	0.978	4.62	0.590
							AF03	Hygiene procedures during security checks	4.07	0.878	4.67	0.599
							AF04	Language skills of airport staff	4.21	0.777	4.41	0.727
							AF05	Restaurants or eating facilities	4.03	0.832	4.16	0.864
							AF06	Value for money of restaurants or eating facilities	4.00	0.852	4.18	0.883
							AF07	Availability of banking or ATM facilities	4.11	0.792	4.26	0.783
							AF08	TV and entertainment facilities	3.62	0.988	3.82	1.036
							AF09	Shopping facilities	3.84	0.908	3.99	0.972
							AF10	Value for money of shopping facilities	3.85	0.940	4.00	0.974
							AF11	Internet access or Wi-fi	3.97	0.920	4.18	0.898
							AF12	Power charging facilities	4.02	0.881	4.19	0.879
							AF13	Telephone and fax locations	3.72	0.951	3.91	1.005
							AF14	Business and executive lounges	3.73	0.934	3.92	0.996
							AF15	Quiet areas, day rooms, hotel facilities, rest areas	4.00	0.907	4.15	0.944
							AF16	Smoking policy or smoking lounges	3.77	1.084	3.94	1.122
							AF17	Standards of disabled user access and facilities	4.17	0.837	4.36	0.776
Arrival services	0.96	4.41	0.648	0.96	4.56	0.605	AS01	Passport and personal ID inspection	4.40	0.690	4.57	0.627
							AS02	Speed of baggage delivery service	4.38	0.703	4.55	0.647
							AS03	Customs inspection	4.42	0.666	4.56	0.634
							AS04	Lost luggage services	4.44	0.697	4.57	0.661

We also considered the ranking of the 45 measurement items of the eight categories of airport services' attributes separately. All categories' means were larger than 3.62 for the pre-COVID-19 era. The measurement item with the highest mean value within the category of 'Arrival services' was "lost luggage services (AS04)", with a mean of 4.44. The second highest mean was for "customs inspection (AS03)", with a mean of 4.42. Additionally, both "flight information screens – clarity and quality of information (FW03)" within the 'Wayfinding' category and "passport and personal ID inspection (AS01)" within the 'Arrival services' category were ranked with the third highest mean value of 4.40 for both. However, the five measurement items with the lowest means were "TV and entertainment facilities (AF08)" within the 'Airport facilities' category, and "enforcement of social distancing (SE04)", "face mask usage enforced (SE01)", "taking body temperature (SE02)", and "social distancing markings and signage (SE03)" within the 'Security' category, ranging from 3.62 to 3.76.

On the other hand, the means of all 45 items were greater than 3.82 during the COVID-19 era. The items "taking body temperature (SE02)" and "face mask usage enforced (SE01)" within the 'Security' category had the highest means (4.73 and 4.72, respectively). The item "hygiene procedures during security checks (AF03)" within the 'Airport facilities' category and "social distancing markings and signage (SE03)" within the 'Security' category had the third highest means (4.67 each). The item of "availability of baggage carts or trolleys" within the 'Access' category and "Internet access or Wi-fi" in the 'Airport facilities' category had a relatively lower mean (4.18 each). Lastly, "TV and entertainment facilities (AF08)", "telephone and fax locations (AF13)", "business and executive lounges (AF14)", "smoking policy and smoking lounges (AF16)", and "shopping facilities (AF09)" within the 'Airport facilities' category had means between 3.82 and 3.99.

4.2 First-order factor model

Koufteros (1999) stated that CFA can be used to estimate one or more hypothesised models of a factor structure, each of which proposes a set of latent variables to account for covariance within a set of observed variables. Table 3 reports all the statistics of the first-order factor model for all participants. The fitting statistics of the measurement model for the pre-COVID-19 era in this study had the following values: $\chi^2/df = 2.593$, $p \leq 0.0001$, SRMA = 0.071, GFI = 0.824, AGFI = 0.790, CFI = 0.931, RMSEA = 0.056, NFI = 0.893, RFI = 0.878, and IFI = 0.931. The fitting statistics of the measurement model for the COVID-19 era also indicated a good fit ($\chi^2/df = 2.626$, $p \leq 0.0001$, SRMA = 0.093, GFI = 0.825, AGFI = 0.795, CFI = 0.926, RMSEA = 0.057, NFI = 0.886, RFI = 0.872, and IFI = 0.926). As the values for most of the fitting statistics were inside the cut-off/threshold limit (see Table 4), showing acceptable goodness of fit, these two measurement models were judged to be appropriate. The models' adequacy was again confirmed by the fitting indices suggested by Hair et al. (2009). More importantly, the convergent validity of the CFA results were supported by measurement items' reliability, CR, and AVE, as each item exceeded the critical ratio at the 0.05 level of significance. Thus, all measurement items are statistically significantly related to their respective latent variables (i.e., categories) because these conditions have been met. In addition, the CR estimates exceeded the critical value of 0.60, ranging from 0.82 to 0.96 for the pre-COVID-19 era and from 0.81 to 0.96 for the COVID-19 era (Bagozzi & Yi, 1998). These statistics suggested that the survey data in this study have high internal reliability. The AVE also indicated the percentage of the variance of the construct (categories of airport services) that could be explained by an individual measurement item. The AVE of all the categories in this study ranging between 0.49 and 0.86 for the pre-COVID-19 era, and between 0.48 and 0.85 for the COVID-19 era, with the majority above the suggested value of 0.50 (Koufteros, 1999).

Table 3. Statistics of the measurement model, ranking, and changes between the pre-COVID-19 and COVID-19 eras

Categories	Item codes	Pre-COVID-19							Covid-19 era						Changes between the pre-COVID-19 and COVID-19 eras	
		SFI	Ranking within category	S.E.	C.R.	R ²	CR	AVE	SFI	Ranking within category	S.E.	C.R.	R ²	CR		AVE
Access	AC01	0.715	3			0.511	0.82	0.53	0.551	4			0.304	0.81	0.83	-0.164
	AC02	0.728	2	0.085	12.144	0.530			0.841	2	0.131	12.240	0.707			0.113
	AC03	0.748	1	0.093	11.808	0.560			0.871	1	0.141	12.206	0.759			0.123
	AC04	0.708	4	0.075	13.516	0.501			0.594	3	0.104	11.146	0.353			-0.114
Airport environment	AE01	0.798	3			0.637	0.89	0.73	0.766	3			0.587	0.86	0.66	-0.032
	AE02	0.889	1	0.048	22.151	0.790			0.808	2	0.051	18.065	0.653			-0.081
	AE03	0.872	2	0.051	21.717	0.760			0.868	1	0.055	19.212	0.753			-0.004
Check-in	CI01	0.787	3			0.619	0.85	0.66	0.788	2			0.621	0.84	0.63	0.001
	CI02	0.823	2	0.044	23.083	0.677			0.773	3	0.043	21.766	0.598			-0.050
	CI03	0.831	1	0.057	18.751	0.691			0.823	1	0.058	18.232	0.677			-0.008
Passport and personal ID control	PC01	0.814	2			0.663	0.86	0.60	0.836	2			0.699	0.90	0.69	0.022
	PC02	0.809	3	0.048	20.162	0.654			0.850	1	0.041	22.820	0.723			0.041
	PC03	0.633	4	0.073	13.442	0.401			0.833	3	0.045	18.774	0.694			0.200
	PC04	0.825	1	0.051	20.618	0.681			0.813	4	0.043	21.376	0.661			-0.012
Security	SE01	0.894	4			0.799	0.96	0.86	0.931	2			0.867	0.92	0.75	0.037
	SE02	0.918	3	0.019	53.313	0.843			0.965	1	0.025	40.869	0.931			0.047
	SE03	0.954	1	0.028	36.227	0.910			0.804	3	0.037	25.914	0.646			-0.150
	SE04	0.950	2	0.030	35.835	0.903			0.747	4	0.042	22.383	0.558			-0.203
Wayfinding	FW01	0.804	4			0.646	0.91	0.63	0.831	3			0.691	0.92	0.65	0.027
	FW02	0.614	6	0.066	14.447	0.377			0.745	6	0.044	18.582	0.555			0.131
	FW03	0.849	3	0.047	21.928	0.721			0.813	4	0.041	21.135	0.661			-0.036
	FW04	0.748	5	0.055	18.367	0.560			0.766	5	0.052	19.342	0.587			0.018
	FW05	0.862	2	0.049	22.399	0.743			0.841	2	0.043	22.450	0.707			-0.021
	FW06	0.863	1	0.047	22.457	0.745			0.842	1	0.045	19.571	0.709			-0.021
Airport facilities	AF01	0.573	17	0.066	12.964	0.328	0.94	0.49	0.415	16	0.044	8.896	0.172	0.94	0.48	-0.158
	AF02	0.584	16	0.067	13.193	0.341			0.430	15	0.048	9.240	0.185			-0.154
	AF03	0.638	14	0.060	14.593	0.407			0.389	17	0.045	8.345	0.151			-0.249
	AF04	0.763	3	0.051	18.225	0.582			0.717	9	0.055	15.515	0.514			-0.046
	AF05	0.770	2			0.593			0.713	11			0.508			-0.057
	AF06	0.760	4	0.041	24.247	0.578			0.767	6	0.043	25.461	0.588			0.007
	AF07	0.793	1	0.046	21.047	0.629			0.788	2	0.059	17.127	0.621			-0.005
	AF08	0.710	9	0.067	16.317	0.504			0.773	5	0.078	16.717	0.598			0.063
	AF09	0.714	8	0.061	16.611	0.510			0.775	3	0.073	16.792	0.601			0.061
	AF10	0.738	5	0.063	17.271	0.545			0.795	1	0.073	17.198	0.632			0.057
	AF11	0.653	13	0.062	15.013	0.426			0.695	12	0.067	15.050	0.483			0.042
	AF12	0.737	6	0.059	17.245	0.543			0.755	8	0.066	16.269	0.570			0.018
	AF13	0.689	11	0.064	15.831	0.475			0.774	4	0.075	16.604	0.599			0.085
	AF14	0.707	10	0.063	16.408	0.500			0.756	7	0.078	15.632	0.572			0.049
	AF15	0.722	7	0.061	16.808	0.521			0.717	10	0.071	15.492	0.514			-0.005
	AF16	0.627	15	0.075	14.224	0.393			0.593	14	0.085	12.616	0.352			-0.034
	AF17	0.672	12	0.057	15.491	0.452			0.649	16	0.059	13.961	0.421			-0.023
Arrival services	AS01	0.909	3			0.826	0.96	0.85	0.919	2			0.845	0.96	0.85	0.010
	AS02	0.945	1	0.028	37.494	0.893			0.919	2	0.029	35.402	0.845			-0.026
	AS03	0.929	2	0.028	35.622	0.863			0.931	1	0.028	37.177	0.867			0.002
	AS04	0.897	4	0.031	32.309	0.805			0.918	3	0.030	35.413	0.843			0.021

Note: SFI, standardized factor loading; S.E., standard error; C.R., critical ration; CR, construct reliability; AVE, average variance extracted.

Table 4. The first-order model fit statistics for all participants

Goodness-of-fit	Threshold	Pre-COVID-19		Covid-19 era	
<i>P</i> -value	<0.05	0.0001	Accept	0.0001	Accept
χ^2/df	<3.0	2.593	Accept	2.626	Accept
SRMR	<0.1	0.071	Accept	0.093	Accept
GFI	>0.9	0.824	Can accept	0.825	Can accept
AGFI	>0.9	0.790	Can accept	0.795	Can accept
CFI	>0.9	0.931	Accept	0.926	Accept
RMSEA	0.05–0.08	0.056	Accept	0.057	Accept
NFI	>0.9	0.893	Can accept	0.886	Can accept
RFI	>0.9	0.878	Can accept	0.872	Can accept
IFI	>0.9	0.931	Accept	0.926	Accept

Interestingly, the results of the change in difference for the 45 items' SFI between the pre-COVID-19 and COVID-19 eras show that the five measurement items with the largest increases in the mean were "social distancing at security and immigration (PC03)", "infectious disease and epidemic control information markings and signage (FW02)", "value for money of parking facilities (AC03)", "availability of parking facilities (AC02)", and "telephone and fax locations (AF13)", which changed by 0.200, 0.131, 0.123, 0.113, and 0.085, respectively. On the other hand, the five measurement items with the largest decrease in the mean were "hygiene procedures at security (AF03)", "enforcement of social distancing (SE04)", "ground transportation (including taxi) to and from the airport (AC01)", "visibility and availability of hand sanitiser (AF01)" and "seating and F&B social distancing (AF02)", which changed by -0.249, -0.203, -0.164, -0.158, and -0.154, respectively.

This study further created two sub-sample groups to investigate the different levels of participants' perceptions of airport services' attributes, namely occasional travellers (travel frequency ≤ 3 , $N = 325$) and frequent travellers (travel frequency ≥ 4 , $N = 178$)⁴. Their first-order models' statistics and model fit can be seen in Appendices 2 and 3. The results of two sub-sample groups showed acceptable goodness of fit, and measurement models were judged appropriate. The results of the change in difference for the 45 items' SFI between the pre-COVID-19 and COVID-19 eras from the occasional traveller group, which showed that the three measurement items with the largest increases in mean were "social distancing at security and immigration (PC03)", "availability of parking facilities (AC02)" and "infectious disease and epidemic control information markings and signage (FW02)", which changed by 0.2, 0.181 and 0.164, respectively. On the other hand, the three measurement items with the largest decrease in mean were "hygiene procedures at security (AF03)", "enforcement of social distancing (SE04)" and "ground transportation (including taxi) to and from the airport (AC01)", which changed by -0.259, -0.194 and -0.165, respectively. Moreover, the results of the change in difference for SFI between the pre-COVID-19 and COVID-19 eras from the frequent traveller group, which showed that the largest increases items were "social distancing at security and immigration (PC03)", "value for money of parking facilities (AC03)" and "telephone and fax locations (AF13)", which changed by 0.181, 0.148 and 0.142, respectively. On the other hand, the three measurement items with the largest decrease were "seating or food & beverage social distancing (AF02)", "enforcement of social distancing (SE04)" and "hygiene procedures at security (AF03)", which changed by -0.255, -0.224 and -0.221, respectively (see Appendix 2). The first-order model fit statistics for the pre-COVID-19 and during COVID-19 eras for occasional and frequent travellers are shown in Appendix 3.

⁴ The travel frequency for occasional and frequent travellers was determined based on the demographic information of Taichung City (age and income), as well as the travel purposes of airport passengers.

4.3 Second-order factor model

A SEM approach was used to validate the causal relationships among the variables of interest in the study. For estimation of the model, it is necessary to correctly examine the suitability of the model first by adding the correlation paths, and then assessing the overall model by means of the goodness-of-fit measures. The fitting statistics of the second-order factor model of the pre-COVID-19 era in this study had the following values: $\chi^2/df = 3.423$, $p \leq 0.0001$, SRMR = 0.092, GFI = 0.725, AGFI = 0.694, CFI = 0.887, RMSEA = 0.070, NFI = 0.848, RFI = 0.838, and IFI = 0.887. The statistics showed that all the goodness-of-fit measures were within acceptable levels, except that the values of AGFI (0.694) and GFI (0.725) were not within the normal range in the pre-COVID-19 era, although they can be accepted (Hair et al., 2009). The fitting statistics of the second-order factor model of the COVID-19 era had the following values: $\chi^2/df = 2.382$, $p \leq 0.0001$, SRMR = 0.094, GFI = 0.832, AGFI = 0.818, CFI = 0.931, RMSEA = 0.052, NFI = 0.888, RFI = 0.884, and IFI = 0.932, showing an acceptable goodness of fit. After the measurement model was confirmed, the final model had the optimal solution values and the modulus estimates reported in Table 5. The SEM analysis was also performed after satisfying the requirements of the measurement model. In addition, the final model estimation results of two sub-sample groups (i.e., occasional and frequent travellers) were reported in Appendix 4. The values of χ^2/df for both sub-sample groups were all under 3 and $p \leq 0.0001$. Also, the statistics of both models showed that GFI, AGFI, CFI, RMSEA, NFI, RFI, and IFI were inside the cut-off/threshold limit. Figure 2 shows the result of the SEM model for all participants, and the results for occasional travellers and frequent travellers are shown in Figures 3 and 4, respectively. Both Hypotheses 1 and 2 listed in Section 3.1 were accepted and validated with a p -value less than 0.001.

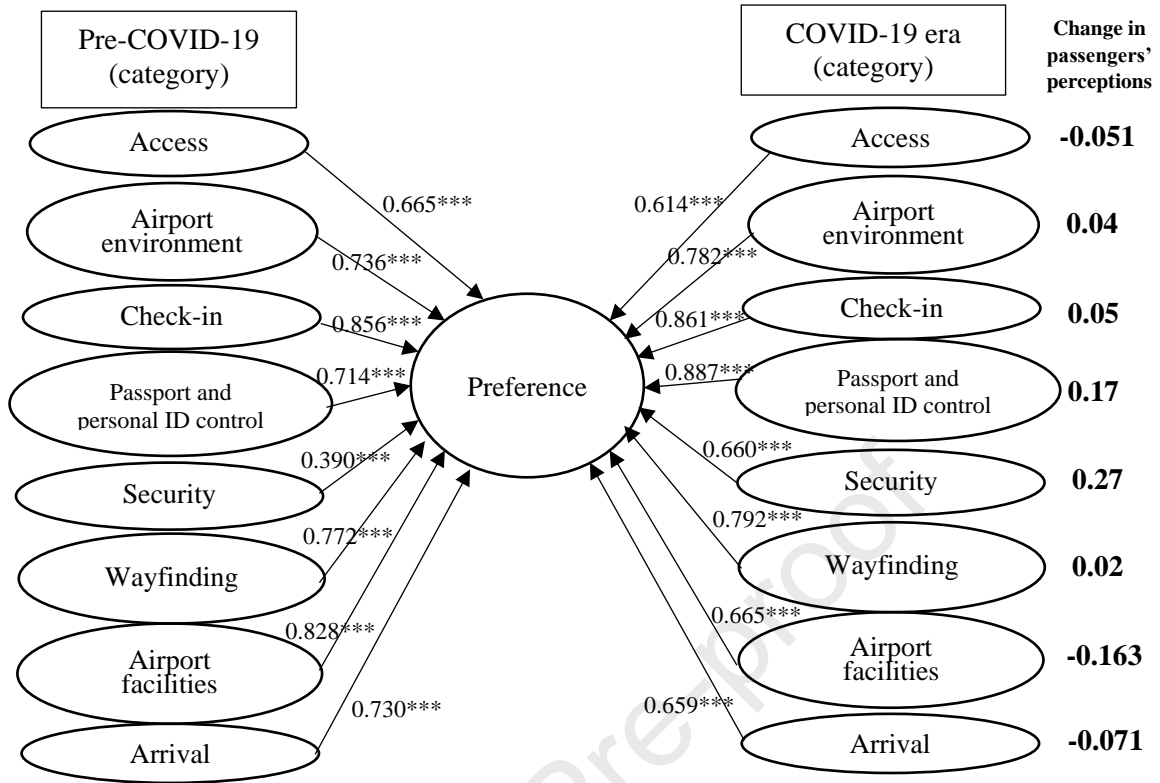


Fig. 2 The SEM model of the preference for airport services' attributes during the pre- and amid COVID-19 (all participants)

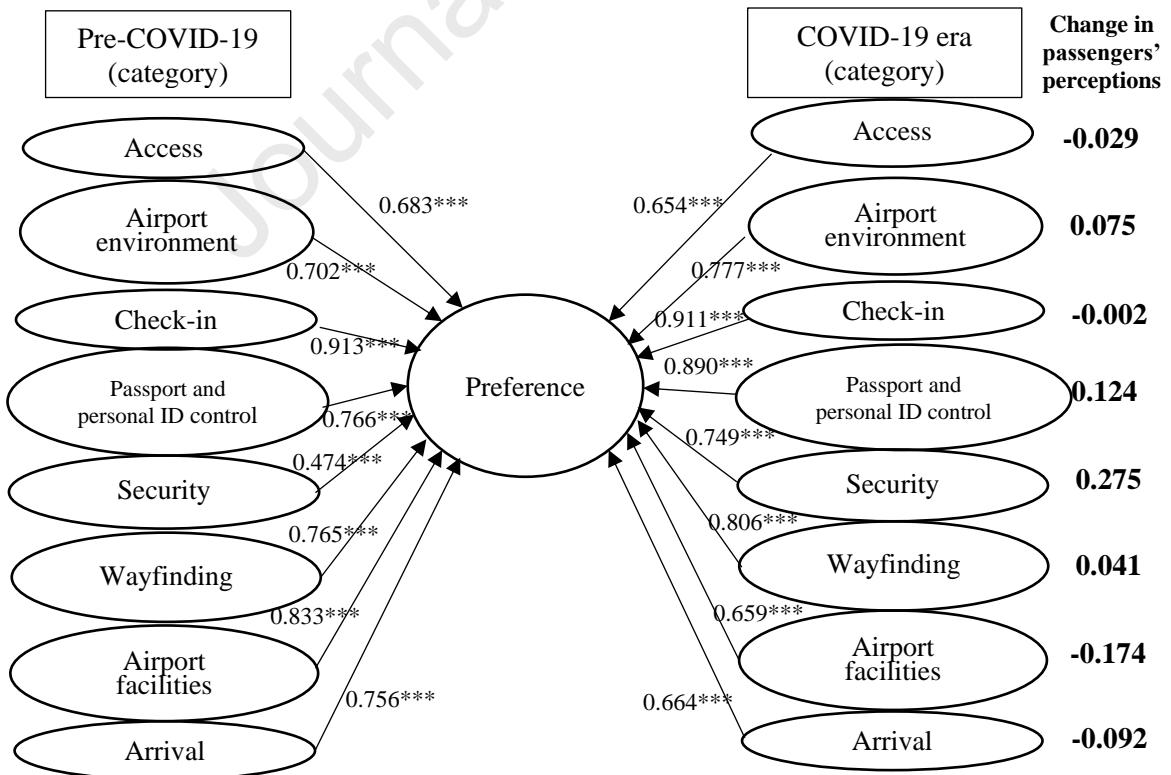


Fig. 3 The SEM model of the preference for airport services' attributes during the pre- and amid COVID-19 (occasional travellers)

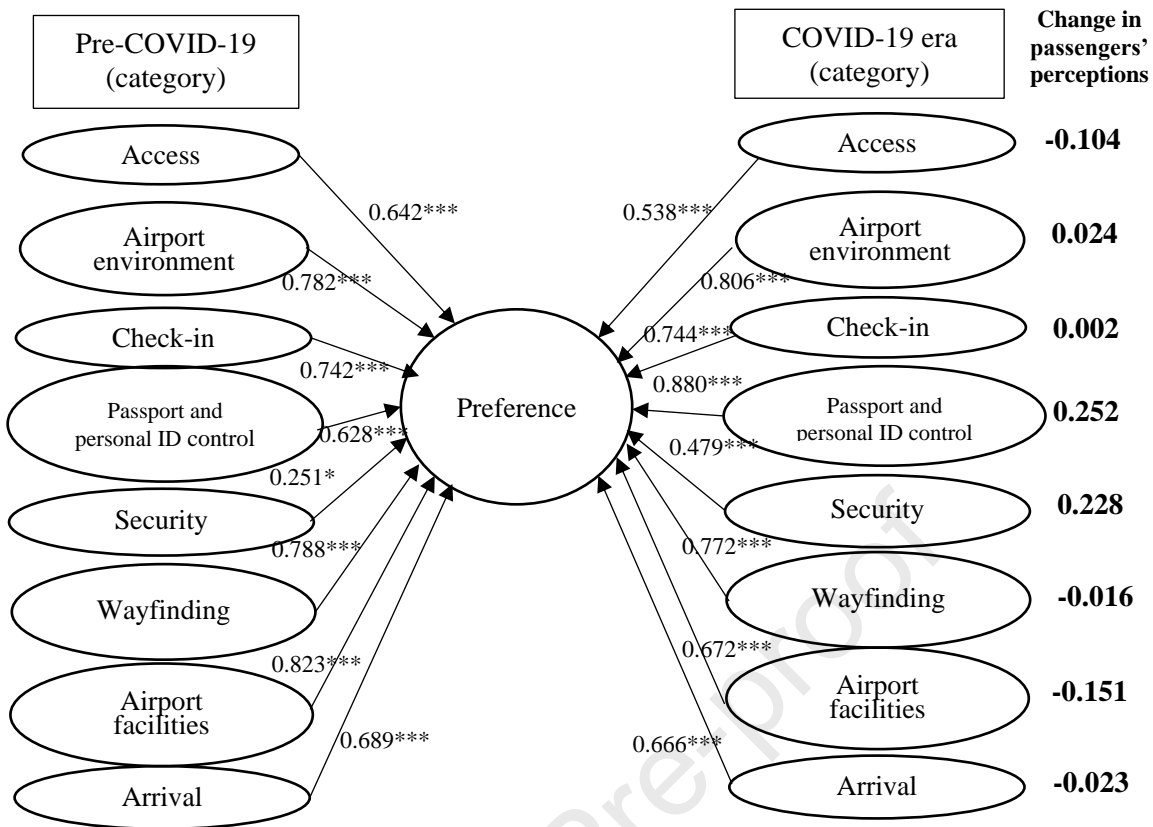


Fig. 4 The SEM model of the preference for airport services' attributes during the pre- and amid COVID-19 (frequent travellers)

As mentioned above, this study aimed to determine whether the influences on and changes in the perceptions of or perceived importance of airport services' attributes between the pre-COVID-19 and amid COVID-19 eras. The results showed that the p -values of all path coefficients were less than 0.001, and the path coefficient of the 'Check-in' category (0.856) was strongly correlated with the perceived importance of airport services' attributes during the pre-COVID-19 era, followed by the categories of 'Airport facilities' (0.828) and 'Wayfinding' (0.772). Additionally, the eight categories' path coefficients during the pre-COVID-19 era ranged from 0.390 to 0.856, but the smallest path coefficient, for the category of 'Security', was 0.390. The top three categories during the COVID-19 era with the strongest correlations with the perceptions of airport services' attributes were 'Passport and personal ID control' (0.887), 'Check-in' (0.861), and 'Wayfinding' (0.792). It should be noted that all the path coefficients of the eight categories during the COVID-19 era were larger than 0.614. More importantly, two largest positive changes in path coefficients between the pre-COVID-19 and amid COVID-19 era were 'Security' (0.270) and 'Passport and personal ID control' (0.173). Similarly, the two largest negative changes in the path coefficients between the pre-COVID-19 and amid COVID-19 era were 'Airport facilities' (-0.163) and 'Arrival services' (-0.071). Overall, the perceived importance of the eight categories between the pre-COVID-19 and amid COVID-19 era were changed significantly. Therefore, Hypothesis 3 was supported.

When comparing different participant groups' perceptions of airport services' attributes between the pre-and amid COVID-19 eras, the 'Check-in' category was strongly correlated with the preference for airport services' attributes in all participants and occasional travellers, and the 'Airport facilities' category was the highest category among frequent travellers during the pre-COVID-19. Not

surprisingly, the top category amid COVID-19 era with the strongest preference for airport services' attributes was the 'Passport and personal ID control' category among all participants and frequent travellers. The 'Check-in' category was the highest category among occasional travellers. Finally, the most significant positive change in path coefficients between the pre- and amid COVID-19 eras was the 'Security' category (0.270 and 0.275) among all participants and occasional travellers, and the 'Passport and personal ID control' category (0.252) is the largest change among frequent travellers. Similarly, the largest negative change in the path coefficients between the pre- and amid COVID-19 eras was the 'Airport facilities' category (-0.163, -0.174 and -0.151) in three sampled groups.

Table 5. The final model's modulus estimates during pre- and amid COVID-19 era (all participants)

Categories	Pre-COVID-19					COVID-19 era				
	Modulus estimates	Standardized coefficients	S.E.	C.R.	<i>p</i> -value	Modulus estimates	Standardized coefficients	S.E.	C.R.	<i>p</i> -value
Access	1.00	0.665***			0.001***	1.00	0.614***			0.001***
Airport environment	1.55	0.736***	0.12	9.24	0.001***	1.62	0.782***	0.13	12.22	0.001***
Check-in	1.71	0.856***	0.12	9.55	0.001***	1.70	0.861***	0.14	12.39	0.001***
Passport and personal ID control	1.98	0.714***	0.14	9.79	0.001***	1.91	0.887***	0.15	12.97	0.001***
Security	1.43	0.390***	0.24	5.55	0.001***	1.25	0.660***	0.11	11.16	0.001***
Wayfinding	1.98	0.772***	0.14	9.80	0.001***	1.69	0.792***	0.14	12.54	0.001***
Airport facilities	1.71	0.828***	0.12	10.22	0.001***	1.51	0.665***	0.14	11.24	0.001***
Arrival services	1.51	0.730***	0.11	9.78	0.001***	1.40	0.659***	0.13	11.06	0.001***
Goodness-of-fit	Values	Threshold				Values	Threshold			
<i>P</i> -value	0.0001	<0.05	Accept			0.0001	<0.05	Accept		
χ^2/df	3.423	<3.0	Can accept			2.382	<3.0	Accept		
SRMR	0.092	<0.1	Accept			0.094	<0.1	Accept		
GFI	0.725	>0.9	Can accept			0.832	>0.9	Can accept		
AGFI	0.694	>0.9	Can accept			0.818	>0.9	Can accept		
CFI	0.887	>0.9	Can accept			0.931	>0.9	Accept		
RMSEA	0.070	0.05–0.08	Accept			0.052	0.05–0.08	Accept		
NFI	0.848	>0.9	Can accept			0.888	>0.9	Can accept		
RFI	0.838	>0.9	Can accept			0.884	>0.9	Can accept		
IFI	0.887	>0.9	Can accept			0.932	>0.9	Accept		

Note: $p < 0.001$ ***; $p < 0.05$ **; $p < 0.1$ *. S.E., standard error; C.R., critical ratio.

5. Discussion and managerial implications

5.1 Using CLT theory to understand airport service during the COVID-19 era

Since the unprecedented and catastrophic COVID-19 pandemic happened, airports worldwide have experienced a dramatic decline in air passenger traffic and flight movements, and the pandemic has also influenced air travel and the quality of airport services (Lamb et al., 2020). The CLT theory is an effective tool for explaining airport passengers' behavioural decisions before and during the COVID-19 era. Importantly, the findings of this study support the CLT theory (temporal distance, spatial distance, social distance, and hypothetical distance), which posits that the perceived importance of airport services' attributes (e.g., security, passport and personal ID control, and check-in), particularly the services related to COVID-19 have increased their importance from the airport passengers' perspectives (see Table 3 and Figure 2). Passengers' behavioural changes and their different requirements for services and products at airports follow a rational path, which is guided by the relationship between their psychological distance and the extent to which passengers' thinking (i.e., psychological stress because of health concerns or experiences at an airport) is abstract or concrete. As the COVID-19 pandemic has severely impacted economies worldwide and drastically changed people's lifestyles, it is almost certain that these crisis-related experiences could influence passengers' behaviours and travel patterns (Dulam et al., 2021). Additionally, the CLT theory can help airport managers to better understand the rationale behind passengers' behavioural changes since the COVID-19 pandemic, and thus airport managers could spend more effort and resources in easing airport passengers' safety concerns and offering higher quality airport services. From a broader point of view, the CLT theory provides a practical framework and tool for airport managers to comprehend changes in airport passengers' behaviours during future pandemics or crises.

5.2 Relating COVID-19 to airport services

This study revealed that airport services related to COVID-19 (e.g., security, passport and personal ID control, wayfinding) were perceived as more important by airport passengers during the COVID-19 era, compared with the pre-COVID-19 era (see Figure 2). For example, infectious disease and epidemic control information markings and signage were perceived as far more important during the COVID-19 era than before. These findings can be explained by the fact that clear information and communication can create a sense of safety, assurance, and confidence, and it is important for airports to develop a sustainable service process (Allen et al., 2020; Chonsalasin et al., 2020). Airport passengers also perceived the enforcement of wearing face masks and taking body temperature at airport terminals were critical attributes of airport services during the COVID-19 pandemic. Moreover, the enforcement of social distancing at security and immigration checkpoints was perceived as another important attribute by airport passengers. Aside from the mandatory safety examinations and document inspections at check-in areas, airport passengers are keen to see their airports operating the security systems in an efficient and timely manner. This finding is in agreement with Chonsalasin et al. (2020), which suggested that access, security, check-in, airport facilities, wayfinding, airport environment, and arrival services were significant for assessing airport service quality. However, airport passengers have perceived some safety measures (e.g., social distancing and hygiene procedures) as less important after passing through the check-in and passport and personal ID control areas, or when walking around the terminals after the checkpoints. It may be that airport passengers find that the airport's security system can engender feelings of safety and confidence, and hence they expect a comfortable and relaxing environment while waiting for their flights in the departure lounges (Lu, 2014).

Additionally, this study showed that the perceived importance of other attributes of airport services (e.g., access, airport facilities, and arrival services) has declined to a different degree during the COVID-19 era (see Figure 2). For example, it is unsurprising that airport passengers perceived ground transportation to and from the airport, the availability of baggage carts and trolleys, and food and beverage facilities to be less critical during the COVID-19 era. These findings are likely to be related to the reduced demand for air travel during the COVID-19 era, and airport passengers' changing travel habits and preferences may also contribute to their views of access and baggage cart availability as less important than before. Moreover, it is apparent that an airport's commercial facilities (e.g., shopping and entertainment) have suffered huge losses or have been closed during the pandemic as a result of the significant decline in airport passenger numbers, and their performance has not fully recovered and returned to their former flourishing business (Hotle & Mumbower, 2021; Zhang et al., 2021). Accordingly, airport passengers have considered the number and quality of shopping and entertainment facilities to be more important when they resumed air travel during and after the pandemic.

To gain more insight into airport passengers' changing perceptions of airport services' attributes, two sub-sample group travellers (i.e., occasional and frequent travellers) were classified among all participants in this study. Despite the behavioural differences between occasional and frequent travellers (Fodness & Murray, 2007; Pabedinskaitė & Akstinaitė, 2014), it is surprise to see that the findings of these two types of travellers' changing perceptions of airport services' attributes before and amid COVID-19 eras are fairly consistent. This consistency may partly be explained by their travel patterns being significantly influenced by the COVID-19 pandemic (Abdullah et al., 2020; Shamshiripour et al., 2020). However, only the 'Airport environment' category has been perceived as more important among occasional and frequent travellers. A possible explanation might be that airport passengers still looked for ways to make their airport experiences more comfortable and enjoyable after longer waiting times for departure, as the rigid health and safety protocols implemented for controlling the spread of COVID-19 virus during air travel.

5.3 Practical implications

This study provides practical implications and a better understanding for airport managers of how airport passengers perceive the importance of airport services' attributes. Practically, for understanding of the increasing importance of some airport services' attributes (e.g., infectious disease and epidemic control information markings and signage) (see Table 3), it is fundamental for airport managers to ensure that updated infectious disease and epidemic control information marking and signage are placed within the airport environment, and to publish this information on the airport's website for arriving and departing passengers to view. Considering the criticality of airports in disease control, a variety of actions by airport managers need to be made for controlling and mitigating the spread of the COVID-19 virus or future pandemics across cities or countries (Salesi et al., 2022).

The changes in the perceptions of airport services' attributes among different passenger groups (i.e., occasional and frequent travellers) have been investigated, as illustrated by Figures 3 and 4. Importantly, this study built on the extant literature on airport service quality to illustrate the "big picture" of airport operations in the post-COVID-19 era. This may, in turn, serve as a foundation of further investigations in establishing airport service quality strategies, facilitating improvement programs and prioritising resource allocations, which aimed at enhancing the quality of airport services and improving passenger satisfaction (Li et al., 2022). In addition, enhancing air travel safety and reducing the perceived risk of infection by the COVID-19 virus during air travel could be more important than ever in a pandemic world. In particular, many passengers will still perceive that air

travel is not safe and that they will more easily catch the COVID-19 virus or some other virus (Sotomayor-Castillo et al., 2021). Therefore, airport managers need to implement procedures and strategies that take the potential effect of infection with the virus in the airport environment into account, and explain why these steps will be effective. These are vital requisites for rebuilding consumers' confidence in air travel and facilitating the recovery of the post-COVID air travel industry. More importantly, this study emphasises the practical usefulness of understanding the perceptions of airport services' attributes during a crisis, such as the COVID-19 pandemic, suggesting that different attributes of airport services or new needs of passengers during the COVID-19 era would be very insightful for airport operations in the post-COVID-19 era. On the other hand, airport managers need to continuously work on creating a more pleasant and enjoyable atmosphere in the airport environment to cater the needs of passengers, such as introducing new seating areas with comfortable couches and incorporating arts and music to create a more welcoming and relaxed environment.

6. Conclusions and future research

On the basis of CLT theory, this study used SEM to investigate passengers' perceptions of airport services' attributes before and during the COVID-19 era. Specifically, it aimed to reveal and identify the categories of airport services that changed airport passengers' perspectives and behaviours before and during the COVID-19 era. A sample of 503 participants was surveyed at Taichung International Airport in October 2021. The findings of this study showed that airport passengers have significant differences in the importance of or preference for airport services' attributes between the pre-COVID-19 and COVID-19 eras. Importantly, airport passengers were found to pay more attention to airport service categories related to COVID-19 (e.g., security, passport and personal ID control, wayfinding) during the COVID-19 era. Airport passengers perceived these COVID-19-related airport services' attributes, including infectious disease and epidemic control information markings and signage, the enforcement of social distancing at security and immigration checkpoints, the enforcement of wearing face masks, and taking body temperature at airport terminals, to be far more important during the COVID-19 era than before. These findings also suggested that different airport services' attributes are expected by airport passengers in different times, which highlights the critical role of creating a sense of safety, assurance, and confidence in air travel during the post-COVID-19 era.

Some findings of this study reinforced the propositions already documented in the literature (e.g., the changes in the requirements of airport services' attributes), whereas others shed new light and made a novel theoretical contribution to the literature (e.g., the emphasis on airport services' attributes related to COVID-19 in air travel). For airport managers, the insights gained from this study may help them to develop suitable airport services and products for passengers in different operating environments, and to renovate airport facilities, improve the quality of airport products and services, as well as suggesting practices and strategies for improving airport services and products to meet passengers' needs during the post-COVID-19 era. Considering the importance of airports in controlling a virus, airport managers need to continually devote their effort in controlling and mitigating the spread of the COVID-19 virus across borders, as well as future pandemics.

Two possible limitations of this study are observed. First, this study did not explore new airport service technologies (e.g., touchless and self-check-in kiosks) and how the acceptance of new technologies varies between age groups. This may, in turn, prompt future research to look at the effect of airport technologies on passengers' perceptions of airport service quality. Second, this study's findings could be not entirely representative of or generalised to the perspectives of airport passengers/travellers in other countries as this study analysed Taiwan's Taichung International Airport as the case. Moreover,

further research may also explore the types of airport services related to COVID-19 or a future pandemic required by different airports (e.g., small, medium, hub, domestic and international airports) and different passenger groups (i.e., business and leisure groups) and age groups. Comparing passengers' perceptions of important service attributes between domestic and international airports and in different passenger and age groups, which could provide practical guidance and insights for airport managers to help them develop and improve their service quality, cope better with passengers' needs in different airport environments and different passenger and age groups in the post-COVID-19 era, and respond better to any future pandemics.

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Highlights:

- Explore changes in preferences of airport service attributes pre- and amid COVID-19
- Airport services related to COVID-19 are far more important
- Airport environments are important among different types of travellers
- Practical implications for improving airport services and products are provided

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Author statement

Yi-Hsin Lin: Conceptualization, Methodology, Data collection, Formal analysis, Investigation, Resources, Writing - Original Draft, Review & Editing, Visualization, Funding acquisition

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