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The Effect of COVID-19 Countermeasures on Korean Air Passenger Confidence

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Abstract: The COVID-19 pandemic has sharply reduced air travel demand since early 2020. This paper aims to identify factors influencing Korean passengers' air travel confidence after COVID-19 based on three countermeasure classifications: social distancing, health, and vaccination. Data were collected online from 307 Korean air passengers from December 2021 to January 2022. Structural equation modeling (SEM) was used to examine countermeasure influence on air passenger confidence. Health measures (face mask, temperature screening, and hand sanitizing) scored the highest on importance and air travel safety sensitivity. Social distancing measures (physical distancing, contactless boarding process, and sneeze guards) scored the lowest but were still perceived to be important. Only vaccine measures (vaccine pass check-in, vaccination rates, and personal vaccination status) were identified as having a significantly positive influence on Korean air travel confidence. The study's results do not support past studies showing social distancing and health measures partially or fully influencing air travel confidence. This finding has significant implications for understanding how Korean passengers' perceptions and perceived sense of safety are different or have changed two years into the crisis, as well as for achieving sustainability of the aviation and travel industries after COVID-19.

Keywords: COVID-19; pandemic; countermeasures; air passenger confidence; vaccination; vaccine pass; sustainability

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1. Introduction

The global aviation market before COVID-19 has grown steadily thanks to the rapid growth of low-cost carriers (LCCs) and aggressive route expansion [1,2]. The total number of air passengers more than doubled from 2 billion in 2004 to 4.7 billion in 2019 [3]. However, after COVID-19, the number of global air passengers fell sharply to 1.8 billion in 2021 [2]. As vaccination rates increased globally and countries considering changing their policies to "coexist with COVID", air passengers are expected to recover to 3.4 billion by 2022, up about 90% from 2020 [4]. This recovery is expected to be led by domestic flight demands, though the market is still suffering from international passenger demands [5–8].

COVID-19 has been spreading globally via immigration inspections at airports, seaports, riverports, and land ports [9]. As such, airports and airlines are implementing various countermeasures to prevent the spread of COVID-19. According to interim guidance from the World Health Organization (WHO) [10] published in the early stages of the pandemic, countermeasures are classified into four categories: (i) personal, (ii) physical and social distancing, (iii) movement, and (iv) special protection. Personal measures include hand hygiene, sneezing and coughing etiquette, and use of masks. Physical and social distancing measures involve physical distancing, reduction or cancellation of gatherings, and avoiding crowded spaces. Movement measures are to limit local and national movements of persons. Special protection measures are to protect persons or groups with more serious illness, social vulnerabilities, and higher occupational risk [10]. Similarly, the Korea Disease Control and Prevention Agency (KDCA) [11] and the Institute of Clinical Epidemiology (ICE) in

the Philippines [12] recommended that wearing face masks, adequate ventilation, social distancing, and good personal hygiene need to be observed to prevent infection. They also proposed that regular cleaning and disinfection should be carried out at the same time.

Despite airports' and airlines' efforts to make air travel safe by implementing COVID-19 countermeasures, air passengers who travel for leisure, business, and/or visiting friends and relatives (VFR) are still concerned about air travel after COVID-19. Airline customers will fly again when they are satisfied with their air travel experience [13–15]. We would like to examine whether the countermeasures have a positive effect on Korean air passenger confidence in air travel and how their impacts might differ. Previously, Sotomayor-Castillo et al. [16] surveyed airline passengers' attitudes towards various COVID-19 countermeasures in terms of safe and healthy travel. Similarly, Kungwola et al. [15] ranked the perceived importance of airline safety measures to passenger confidence among Thai domestic low-cost airline passengers and found cabin density control measures the most significant. Vichiensan et al. [17] examined Thai rail passenger confidence during the pandemic using social distancing, health, and contact tracing application measures and found that health and tracing application measures have an influence on travel confidence. The lack of studies using vaccination as a variable to assess air passenger confidence leads us to identify the research gap that will be addressed here. We would like to expand this line of research by introducing vaccine measures since COVID-19 vaccines have been widely disseminated on a global scale since their first introduction in December 2020. This study attempts to investigate a possible difference in countermeasure impacts on Korean passenger confidence to air travel when vaccination is actively underway and the global vaccination rate with the second inoculation reached 50% as of January 2022. This study can contribute to the aviation and travel industries by giving insights on effective measures to regain air travel confidence and keep the industry sustainable post COVID-19.

The following section (Section 2) provides a literature review defining and examining the three countermeasure clarifications as well as the concept of passenger confidence. Section 3 describes data and methodology, and Section 4 reports the results of this research. Section 5 discusses the findings, and lastly Section 6 brings the paper to a conclusion with future expectations.

2. Literature Review

2.1. COVID-19 Countermeasures

From the Spanish flu pandemic, common measures used to contain the virus included wearing face masks, spraying disinfectant phenyl, handwashing, ventilation, and sanitizing [18]. Kampf et al. [19] found that countermeasures such as handwashing, hand sanitizing, face masks, gloves, disinfection of surfaces, and physical distancing were effective in preventing virus transmission to different extents. Gautret et al. [20] reported the use of preventive measures against Middle East Respiratory Syndrome (MERS), such as wearing face masks, hand hygiene, and physical distancing. Previous studies demonstrated that humankind has employed similar analogous measures to prevent infectious diseases, and this also applies to the current COVID-19 situation.

In this study, social distancing measures include physical distancing, contactless boarding process, and sneeze guards. Physical distancing is defined as maintaining approximately a one-meter distance between persons. This is believed to help prevent the spread of infectious respiratory diseases and to be one of the most effective measures to reduce the spread of viruses transmitted through air bubbles [21]. Physical distancing has been used as the most basic defense line to slow the spread of the COVID-19 virus [22]; however, it is unclear to what extent it is effective in various conditions [23]. James [24] observed the COVID-19 outbreak and strongly advocated for the need for social distancing measures and proper hygiene measures. Arora et al. [25] underlined the importance of the contactless boarding process, because the traditional boarding process enhanced the risk of disease transmission not only for passengers but also for airport staff who would be in contact with thousands of people on shift. As such, Changi Airport in Singapore adopted

non-face-to-face systems such as touchless self-service check-in machines, touchless elevator buttons, touchless biometric passport check lanes, and autonomous cleaning robots [26]. One commonly used measure to reduce the spread of COVID-19 is the set-up of a sneeze guard in the form of a glass or plastic barrier. Sneeze guards or glass barriers have been found to effectively curtail 1 µm aerosol propagation among students by an average of 92% [27]. In addition, WHO [10], Center for Disease Control and Prevention (CDC) [28], and ICE [12] presented that one of the most-used measures in transportation, indoors, or workspaces is a sneeze guard or a cough guard. Research on the use of sneeze guards in aircrafts has shown it to be a crucial measure, as effective as the passenger number limitation, as it prevents the direct propagation of salivary particles [29].

The importance of health measures such as face masks, hand sanitization, and temperature screening are not only brought up in the media but also shown in previous studies, both of which can have an impact on passenger confidence. For the media, BBC's 2009 TV drama, "Spanish Flu: The Forgotten Fallen", showed several measures to prevent the spread of Spanish Flu, of which face covering was recommended as a key measure [30].

The frequency of wearing face masks varies from country to country, but Asian countries have typically shown higher rates. This could be attributed to the experience from Severe Acute Respiratory Syndrome (SARS) that swept through Asia in 2003 [31]. Face masks have been proven to be effective in preventing the spread of all respiratory diseases, including COVID-19 [32]. Regarding hand sanitization, Bergs et al. [33] conducted medical research on four disinfectants and concluded that they have the potential to inactivate the coronavirus and prevent transmission. Surprisingly, Stave et al. [34] and Mitra et al. [35] found that temperature screening had negligible effects on detecting or finding COVID-19 infectees.

Vaccine measures have been perceived as an important measure to prevent COVID-19 since they were introduced. Since a 91-year-old woman was first vaccinated in the UK on 8 December 2020, the COVID-19 vaccination rate has been consistently increasing worldwide. According to Our World in Data [36], as of February 2022, 61.9% of the world population has received at least one dose of a COVID-19 vaccine. In total, 10.42 billion doses have been administered globally, and 30.92 million are now administered each day. However, the vaccination rate varies greatly depending on the country's economic level. North American and European countries, South Korea, Japan, China, and Australia show high vaccination rates, while most countries in Africa and some Southeast Asian countries still have low vaccination rates. According to the International Air Transport Association (IATA)'s Annual Review [4], the exposed risk of vaccinated travelers is significantly lower than that of non-vaccinated travelers. It argued that governments should exempt vaccinated travelers from quarantine and comply with risk-based approaches appropriate to each country, as guided by WHO. Still, there are arguments that vaccination should not be a prerequisite for overseas travel because there are still many countries which face difficulties in securing an adequate supply of vaccines, and the world should provide non-discriminatory channels for travelers in such countries [4]. Since the appearance of smallpox vaccine in 1796, vaccination has been a critical public health achievement of the past two centuries. Vaccination is a key component for people to travel overseas, and various travel vaccines are administered to block the spread of diseases in the destination countries [37]. Ward et al. [38] suggested that regardless of whether vaccines are coercive or not, high vaccine coverage is necessary to prevent the spread of COVID-19. Many states in the U.S., European countries, and private companies have developed a digital platform to prove COVID-19 vaccination status [39]. Mills and Rüttenaue [40] reported that mandatory COVID-19 vaccine certification increases vaccination rates but cautioned that the context of various factors, including the level of the vaccination rates, vaccine hesitancy, eligible vaccine age, and the pandemic trajectory should be considered. Pavli and Maltezou [37] emphasized that the global use of COVID-19 vaccine certification would influence the attitudes and actions of travelers over the coming years.

2.2. Passenger Confidence

It is not the first time that infectious diseases have adversely affected air passenger confidence. SARS in 2002 and MERS in 2013 already warned us about the risks of contagious diseases [41]. Expanding the existing SARS and MERS literature, a few studies investigated passenger confidence and COVID-19 with multiple transport modes and countries.

During the first six months into the outbreak, Sotomayor-Castillo et al. [16] surveyed passengers' attitudes towards airline COVID-19 health and safety measures. Most respondents agreed that a complimentary kit with hand sanitizer, wipes, and face masks should be provided for air travelers, and more information about airline preventive measures should be shared. Mandatory face mask policy, on-board physical distancing, aircraft cabin cleanliness, and pre-boarding testing and screening were suggested to help respondents feel safe in the context of air travel.

Budd et al. [1] studied how the countermeasures in airports and on airlines were perceived differently for Norwegian passengers. They showed that passive measures (wearing face masks, physical distancing, and cleaning of surfaces) had the greatest influence on air passenger confidence, and technological measures (touchless surface and processes, a track-and-trace system, and virtual queuing procedures) were less effective. Active measures (temperature screening, mandatory virus testing, and mandatory submission of a health declaration) had an influence on passenger confidence somewhere in between the other two measures.

Kungwola et al. [15] ranked the countermeasure importance to air travel confidence based on the survey of Thai domestic low-cost airline passengers. Cabin density control measures came out as the most important, passenger hygiene measures (including hand sanitizer, masks, and no food consumption), pre-boarding screening, contactless boarding, and aircraft cleanliness followed. There was also a study on passenger confidence to travel by rail with COVID-19 countermeasures, a different transport mode from aviation. Vichiensan et al. [17] examined countermeasures of urban rail travel and passenger confidence in Bangkok, Thailand. The results also indicated that health measures such as wearing face masks and hand sanitizers had the most influence on rail passenger confidence. On the other hand, social distancing measures such as one-meter distance and sitting apart showed fewer positive influences due to long waiting time with longer queues that happened due to distancing. Social distancing measures, causing a decrease in the number of passengers, were argued to be unsustainable in the long term due to financial issues.

Song and Choi [42] found that COVID-19 situations, self-isolation requirements, destination circumstances, airport/airline preventive measures, and social perceptions all significantly impacted Korean air travelers' willingness to fly again based on the survey conducted in July 2020. They argued that air travel demand could increase before vaccines and/or cures if other conditions were met. They followed up with the same survey six months later to determine if the same five factors would still significantly impact Korean air traveler's flying decisions. However, they found a significant increase in COVID-19 situation factors' influences on air travel decisions. There was no significant change in the impact of airport/airline preventive measures [43].

Moreover, Suess et al. [44] conducted a study of vaccination and travel confidence. They showed that the benefits of COVID-19 vaccine and commitment to immunization led to a belief that people should be vaccinated prior to travel. They also found that there were significant differences in awareness of the benefits from vaccines and a willingness to vaccinate between the groups of high and low frequency travelers. The difference also existed between those who tested positive for COVID-19 and those who did not; those who tested positive had more awareness of vaccination benefits and were more willing to be vaccinated. Chakraborty et al. [45] also argued that modern technologies such as internet of things (IoT) and artificial intelligence (AI) implemented by airlines and airports to provide sustainable practice can help air travelers enhance confidence and satisfaction post COVID-19. Studies examining a change of transport modes due to COVID-19 were also carried out. Parker et al. [46] studied the immediate impact of the COVID-19 pandemic

on U.S. public transport occupants and their travel patterns. The results showed that the travel patterns of public transportation passengers changed more significantly compared to those of non-occupants. While most of public transportation passengers used less public transport due to concerns regarding the risk of transport infection, still a few public transport passengers were comfortable taking public transport as usual. They also found that public transit users were more likely to change their transportation modes, and low-income transit passengers had less room to change to other modes of transport. Harrington and Hadjiconstantinou [47] investigated commuters' changes in transport behaviors due to COVID-19 in the U.K. Most car commuters would not change their transport, but half of public transport commuters might switch their modes to walking or cycling.

The previous literature investigated a change in passenger confidence after the COVID-19 outbreak according to transportation, country, and travel pattern. We attempt to add a contribution to this by researching the effectiveness of countermeasures on air traveler confidence in Korea at the time of recovery with a high vaccination rate. Our study is closest to Kungwala et al. [15] and Vichiensan et al. [17]. However, compared to Kungwala et al. [15], we use more sophisticated analytical tools suggested by Vichiensan et al. [17], with a sample representing general air travelers (not limited to domestic low-cost air passengers). Our study is also different from that of Vichiensan et al. [17], who studied train traveler confidence and did not include vaccine measures in their study. We set up three hypotheses to extend the literature:

Hypothesis 1. *Social distancing measures have an influence on Korean air passenger confidence.*

Hypothesis 2. *Health measures have an influence on Korean air passenger confidence.*

Hypothesis 3. *Vaccine measures have an influence on Korean air passenger confidence.*

Hypotheses 1 and 2 were set up to confirm countermeasure effectiveness on Korean air passenger confidence. It has been previously shown in different circumstances that Hypothesis 1 was partially supported, while Hypothesis 2 was fully supported [1,17]. In addition, we established Hypothesis 3 to determine the effectiveness of vaccine measures on Korean air passenger confidence to fill a gap in the literature.

3. Methodology

3.1. Data Collection

To collect data for this study, an online survey was conducted on 307 Korean air passengers via Google Forms from 29 December 2021 to 9 January 2022. The survey period coincided with the announcement of a stricter revised social distancing policy in December 2021. The number of confirmed cases had been increasing sharply due to a new Omicron variant, and the vaccination rate reached 82% in Korea during the survey period.

The survey consisted of three parts: demographic characteristics, air travel experience, and perception of COVID-19 countermeasures. The questionnaire of the perception of countermeasures included 18 statements and was further divided into two main topic areas: general perception and perceived sense of safety of countermeasures.

3.1.1. Sample Demographics

Of the sample, 52.8% were male and 47.2% female. The 30s (32.9%) and 40s (50.5%) age groups, who have a high frequency of air travel, accounted for the majority of the respondents. The sample proportion of married respondents (68.7%) was higher than unmarried (31.3%), and more than 85% of the respondents had a bachelor's degree or higher. The monthly incomes of the majority of respondents (45.9%) ranged from 2 million KRW (approximately USD 1600) to 4 million KRW (approximately USD 3200). Finally, the number of respondents with less than two family members was 85 (27.7%), reflecting

an increase of single-person and childless families in Korea. Table 1 shows the detailed distribution of demographic characteristics.

Table 1. Respondent demographics.

Demographic Category		Sample	Frequency
Gender	Male	162	52.8%
	Female	145	47.2%
Age	20–30	30	9.8%
	31–40	101	32.9%
	41–50	155	50.5%
	51–60	14	4.5%
	>60	7	2.3%
Marital status	Married	221	68.7%
	Single	96	31.3%
Education	High school	8	2.6%
	College	36	11.7%
	Bachelor's degree	217	70.7%
	Master's degree	45	14.7%
	Others	1	0.3%
Occupation	Company employee	228	74.3%
	Government officer	8	2.6%
	Business owner	29	9.4%
	Student	4	1.3%
	Housewife	24	7.8%
	Others	14	4.6%
Monthly income	<KRW2,000,000	28	9.1%
	2,000,000–2,999,999	54	17.6%
	3,000,000–3,999,999	87	28.3%
	4,000,000–4,999,999	40	13.0%
	5,000,000–5,999,999	40	13.0%
	≥KRW6,000,000	58	18.9%
Family size	1	35	11.4%
	2	50	16.3%
	3	94	30.6%
	4	109	35.5%
	≥5	19	6.2%

3.1.2. Sample Air Travel Experience

What stands out in the sample air travel experience reported in Table 2 is the high proportion of respondents who had not traveled by air since COVID-19. Most respondents who had never traveled after COVID-19 were those who traveled for leisure purpose before COVID-19. The survey showed that one out of two travelers had not traveled by air for almost two years after the pandemic. In addition, LCCs were preferred by 45.3% of the respondents. The questionnaires of air travel purpose, destination, and preferred airline are based on usual travel patterns before COVID-19.

Table 2. Sample air travel experience.

Air Travel Experience		Number of Samples	Frequency
Frequency of air travel before COVID-19	1–2 times per year	101	34.9%
	3–4 times per year	107	32.9%
	5–8 times per year	57	18.5%
	≥9 times per year	42	13.7%
Frequency of air travel after COVID-19	Never	162	52.8%
	1–2 times in total	106	34.5%
	3–4 times in total	22	7.2%
	≥5 times in total	17	5.5%
Air travel purpose	Leisure	223	72.6%
	Business	63	20.5%
	VFR	17	5.6%
	Education	3	1.0%
	Others	1	0.3%
Destination	Domestic	72	23.5%
	International	235	76.5%
Preferred airline	Domestic FSC	116	37.8%
	Domestic LCC	101	32.9%
	Foreign FSC	52	16.9%
	Foreign LCC	38	12.4%

3.1.3. Perception of Countermeasures for Air Travel

The questionnaire in Table 3 with 18 statements was used to examine perceptions of COVID-19 countermeasures when passengers were at airports and boarding airplanes, with the Likert scale from one to five. The first nine statements evaluated how important respondents find each measure to be when they are traveling by air. Results showed health measures (face mask, temperature screening, and hand sanitization) scored the highest, above or close to 4.5. Social distancing measures scored the lowest, but they still found important scoring above 3 (neutral). The last nine statements evaluated passenger confidence, i.e., perceived sense of safety, on COVID-19 countermeasures. Amongst all measures examined, face mask scored the highest (4.73), and the contactless boarding process from social distancing measures scored the lowest (3.38). Overall, importance scores were generally lower than sense of safety to passenger confidence scores, but the order of scores was about the same.

3.2. Methodology

With the measures adapted from Vichiensan et al. [17], Suess et al. [44], and Parker et al. [46], a confirmatory factor analysis (CFA) was conducted (please refer to [13,42,43,46] for measure validation and explanation). Structural equation modeling (SEM) was applied to test hypotheses using IBM SPSS AMOS 25. Multiple group SEMs were conducted and subsequently compared using the goodness of fit indices, path significance, and effect size testing. In the final stage of analysis, we used pairwise parameter comparisons to determine whether any of the structural parameters were significantly different. Measures of Comparative Fit Index (*CFI*), Tucker Lewis Index (*TLI*), root mean square error of approximation (*RMSEA*), and standardized root mean square residual (*SRMR*) were used to estimate the fit of this study [48].

Table 3. Descriptive statistics.

No.	Latent Constructs and Measurement Items	Statements	Mean	Adapted from
		Social distancing measures		
1	*Physical distancing (I)*	*It is important to keep physical distancing at the airport and on the plane.*	3.83	Vichiensan et al. (2021) [17]
2	*Contactless boarding process (I)*	*It is important to take contactless boarding process.*	3.38	
3	*Sneeze guard (I)*	*It is important to set up screen fences to block between persons at the airport.*	4.12	
		Health measures		
4	*Face mask (I)*	*It is important to wear facemask at the airport and on the plane.*	4.73	Vichiensan et al. (2021) [17]
5	*Temperature screening (I)*	*It is important to check the temperature of passengers during boarding process*	4.52	
6	*Hand sanitizing (I)*	*It is important to use hand sanitizer before and after air travel.*	4.46	
		Vaccine measures		
7	*Vaccine pass check-in (I)*	*It is important to check-in with vaccine pass at the airport.*	4.08	Suess et al. (2022) [44] Parker et al. (2021) [46]
8	*Vaccination rates (I)*	*It is important to achieve a certain level of vaccination rate.*	4.19	
9	*Personal vaccination status (I)*	*It is important for passengers (including me) to get vaccinated.*	4.26	
		Passenger confidence		
10	*Physical distancing (S)*	*I feel safe when passengers keep physical distancing at the airport and on the plane.*	3.92	Vichiensan et al. (2021) [17] Suess et al. (2022) [44] Parker et al. (2021) [46]
11	*Contactless boarding process (S)*	*I feel safe when passengers take contactless boarding process.*	3.61	
12	*Sneeze guard (S)*	*I feel safe when screen fences are set up to block between persons at the airport.*	3.97	
13	*Face mask (S)*	*I feel safe when every passenger wear face mask at the airport and on the plane.*	4.52	
14	*Temperature screening (S)*	*I feel safe when the passenger temperature is screened during boarding process.*	4.13	
15	*Hand sanitizing (S)*	*I feel safe when passengers use hand sanitizer before and after air travel.*	4.09	
16	*Vaccine pass check-in (S)*	*I feel safe when passengers check in with vaccine pass at the airport.*	3.94	
17	*Vaccination rates (S)*	*I feel safe when vaccination rate is over a certain level.*	4.01	
18	*Personal vaccination status (S)*	*I feel safe when passengers (including me) get vaccinated.*	4.09	

4. Results

4.1. CFA Results

Table 4 presents summary statistics after low value squared multiple correlation (SMC) variables were eliminated. The SMC values for the remaining were all above 0.40 except for face mask (0.34). The face mask factor was kept as it was the most preferred and significant measure on COVID-19 in this study as well as in other studies [1,13]. Cronbach's alpha

values were above 0.70 for health measures (0.706), vaccine measures (0.892), and passenger confidence (0.941), which is acceptable according to Anderson and Gerbing [49], Taber [50], and Adadan and Savasci [51] for internal consistency. The Cronbach's alpha value for social distancing measures was 0.660, which is acceptable according to Hulin et al. [52], indicating sufficient internal consistency. The sample indicated that the CFA model fit the data (*CFI* = 0.97, *TLI* = 0.95, *RMR* = 0.03, *RMSEA* = 0.08). Items loading onto constructs were significant ($p < 0.001$) with the standardized factor loadings ranging from 0.58 to 0.92, confirming convergent validity. Average variance extracted (*AVE*) was higher than 0.50 for all but one construct, health measure (0.46), partially supporting meaningful composite reliability (0.72) [53]. All these results are presented in Table 4.

Table 4. Validity of the latent constructs.

Latent Constructs and Measurement Items	Factor Loading	Cronbach's α	Construct Reliability	Average Variance Extracted (*AVE*)
Social distancing measures		0.660	0.673	0.510
Physical distancing (I)	0.632			
Sneeze guard (I)	0.788			
Health measures		0.706	0.716	0.460
Face mask (I)	0.581			
Temperature screening (I)	0.719			
Hand sanitizing (I)	0.724			
Vaccine measures		0.892	0.887	0.723
Vaccine pass check-in (I)	0.840			
Vaccination rates (I)	0.871			
One's own vaccination status (I)	0.840			
Passenger confidence		0.941	0.937	0.832
Vaccine pass check-in (S)	0.891			
Vaccination rates (S)	0.923			
One's own vaccination status (S)	0.922			

4.2. SEM Results

Applying the CFA results, our SEM model indicated an acceptable fit to the data, as shown in Figure 1. The structural model was developed to examine a significant relationship between COVID-19 countermeasures and passenger confidence on air travel. Maximum likelihood estimation (MLE) results are presented in Figure 1 and Table 5, where the standardized values of the factor loadings and path coefficients are shown. The structural model results demonstrated that only vaccine measures have significantly positive impacts on passenger confidence on air travel (H3: coefficient (β) = 0.94, standard error (*SE*) = 0.06, critical ratio (*CR*) = 17.13) with *CR* above 1.96. Social distancing and health measures did not show significant impacts on Korean air travel confidence (H1: $\beta = -0.03$, *SE* = 0.08, *CR* = −0.54 and H2: $\beta = -0.03$, *SE* = 0.11, *CR* = −0.48) Vaccine measures showed a 73% influence on Korean air passenger confidence and social distancing, and health measures insignificantly influenced passenger confidence, also negatively. The results imply that the credibility of initial COVID-19 preventive measures has decreased as time has passed, while passenger confidence due to the vaccine has increased as the vaccination rate has reached about 82%. The results do not support Hypotheses 1 and 2, in contrast to previous studies [1,13].

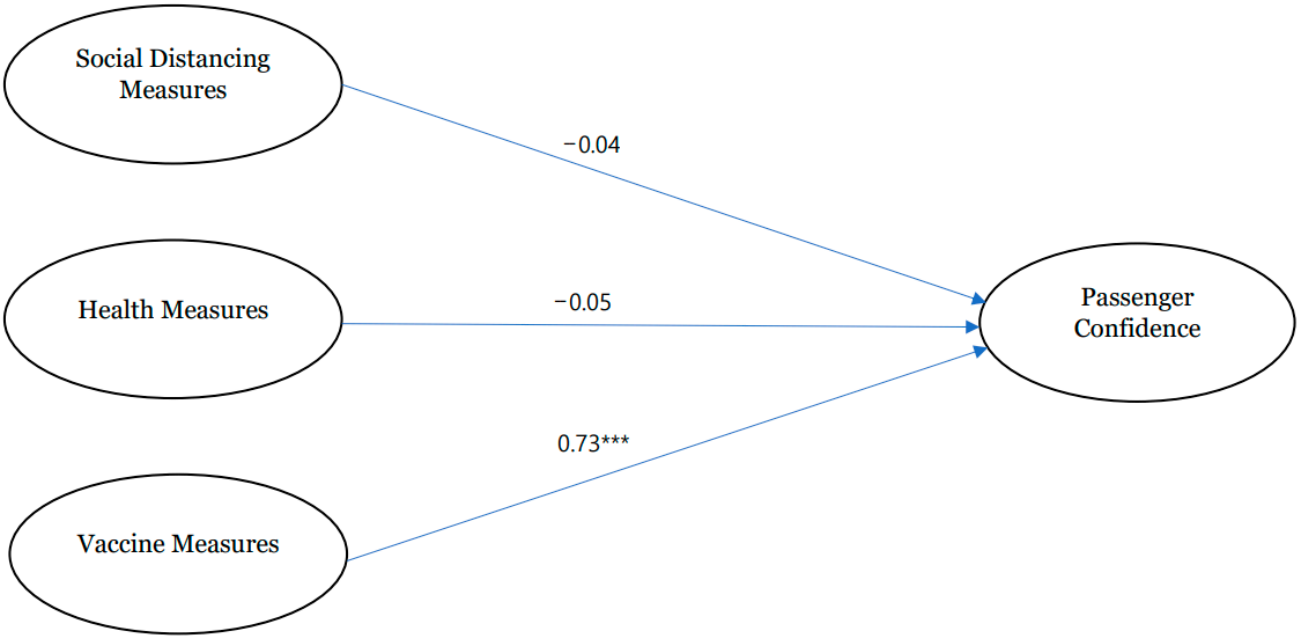

Figure 1. SEM results: CMIN/DF = 2.91, GFI = 0.94, CFI = 0.97, RMSEA = 0.08. *** $p < 0.001$.

Table 5. Hypothesis acceptance.

Hypotheses	Coefficient (β, Standardized)	*SE*	*CR*	Results
H1. Social distancing measures → Passenger confidence	−0.03	0.08	−0.54	Not Accepted
H2. Health measures → Passenger confidence	−0.03	0.11	−0.48	Not Accepted
H3. Vaccine measures → Passenger confidence	0.94 ***	0.06	17.13	Accepted

*** $p < 0.001$.

5. Discussion

Since the pandemic erupted, various countermeasures have been introduced and implemented at airports, gates of international travel, and on aircrafts, a long-distance transportation mode, to ensure safety for air travelers. Infection prevention and control measures for safe air travel discussed in Sotomayor-Castillo et al. [16] in the early days of the pandemic have all been adopted since. This research examined three categories of countermeasures to determine their effects on Korean air travelers' sense of safety: social distancing, health, and vaccine measures. Health measures (face mask, temperature screening, and hand sanitizing) were perceived as the most important COVID-19 countermeasures in air travel, scoring the highest. This can be explained by their longer service history in addition to high visibility. The results are also in line with Sotomayor-Castillo et al. [16], showing that more than 90% of the respondents felt at least slightly safe to fly when using hand sanitizers, wipes, and face masks. However, the results showed that health measures had no significant impact on Korean air traveler confidence when considered alongside vaccine measures. Social distancing measures (physical distancing, contactless boarding process, and sneeze guards) showed lower importance among Korean respondents but still perceived important scoring to be higher than neutral. This implies that social distancing measures are better suited to be used as a complementary means used in conjunction with other preventive measures. The results are in contrast with Kungwola et al.'s [15] finding that cabin density control measures are the most significant factor in air travel confidence

among Thai domestic low-cost carrier travelers. In addition, there was no significant impact of social distancing measures on Korean air traveler confidence, unlike the results of previous studies [1,17]. Note that Vichiensan et al. [17] studied rail passengers who travelled domestically with fewer procedures to board. The difference in the results can be attributed to Korean air traveler characteristics, general air traveler characteristics, and/or a change in countermeasure effectiveness as the pandemic has continued for more than two years since previous studies were conducted when the outbreak had just started in 2020. Vaccine measures (vaccine pass check-in, vaccination rates, and personal vaccination status) were found to be the most effective, reliable, and preferred measures in securing Korean air traveler confidence. The results are in line with Pavli and Maltezou (2021), reporting that many countries were determined to issue or were already issuing vaccine passports for safe travel [54]. Sotomayor-Castillo et al. [16] also anticipated that the availability of effective vaccines could impact the implementations of the countermeasures. The results also suggest that vaccines are a game changer in Korean air traveler confidence and do not support Song and Choi's prediction [42].

More countries are opening borders and lifting traveling restrictions such as quarantine requirements, mandatory submission of vaccination certificates, and negative COVID test results. Based on the results of this study, increasing vaccination rates is suggested as the most effective countermeasure for recovering traveler confidence and international air travel. It needs to be noted that health and social distancing measures must not be alienated to prevent the spread of the current infectious disease. Health measures are still preferred in general perception and perceived sense of safety, much more so than vaccine measures. Social distancing measures can be utilized selectively according to circumstance. Use of all three measures will be critical to keeping the aviation and travel industry sustainable during the current pandemic and should another crisis of this nature emerge.

As the pandemic continues, in addition to the studies on COVID-19 countermeasures and passenger confidence discussed, further studies on COVID-19 countermeasures in airports have been conducted. Debachine et al. (2020) proposed simulations to estimate airport capacity under different assumed countermeasures [55]. Drljača et al. (2020) studied how COVID-19 social-distancing measures will impact airport passenger flow by the faster implementation of Industry 4.0, the fourth industrial revolution into the technological phase from artificial intelligence to advanced robotics [56]. However, no study to date has considered the role of vaccination on air passenger confidence. We attempted to fill a gap in the literature, and our research consequently showed that only vaccine measures significantly impacted Korean air traveler confidence.

6. Conclusions

This is the first study to our knowledge to identify vaccination as a part of a solution to control the damage by the pandemic in the aviation and travel industries. This study confirmed that vaccines are perceived as a significant and essential tool for safe travel in the aviation and travel industries.

Implications for airlines are to implement all infectious disease prevention and control measures, and health and social distancing measures at first, and to communicate with air passengers to reduce their travel concerns until effective vaccine measures become available. Vaccine measures will help recover air passenger confidence for air travel demand to return to normalcy. It is also recommended for airlines and airports to invest in modern technologies to enhance passenger trust and satisfaction.

Limitations of this study are as follows: Not all respondents experienced the countermeasures due to limited air travel after the COVID-19 outbreak, which could have affected our results. The sample overrepresents the 20s to 40s age group compared to the actual air travel demographics. Since younger travelers may be less sensitive to risk than the underrepresented 50s and older traveler demographics [16], the results could have been influenced. Lastly, our difference in results from previous studies could be attributed to

Korean air travelers' different characteristics. This study can be extended to cover more countries and nationalities for future research.

Research on how the perceived safety of countermeasures changes in the future will have to be conducted. Vaccine measures may lose their influence on air passenger confidence if vaccines are ineffective in preventing new variants or if other more effective measures appear. The air travel industry will be reorganized as a result of the pandemic, and those changes will likely affect passenger confidence. Both of these represent directions for further research.

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