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ORIGINAL RESEARCH

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Role of COVID-19 risk perception in predicting the intention to participate in exercise and health behaviors among Korean men

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Abstract

The coronavirus disease 2019 (COVID-19) pandemic has prompted the implementation of social distancing policies worldwide, limiting participation in exercise and substantially impacting health behaviors. In accordance with the theory of planned behavior (TPB), the present study aimed to develop a model for predicting the intent to participate in exercise and engage in health behaviors among Korean men using the perception of COVID-19 risk as an exogenous variable. We analyzed data obtained from 374 Korean men who had completed a 32-item, online questionnaire. Structural equation modeling was performed to evaluate the effect of attitudes, subjective norms, and perceived behavioral control (PBC) on the intention to participate in exercise and health behaviors using COVID-19 risk perception as an antecedent variable. COVID-19 risk perception exerted significant negative effects on the attitude toward exercise participation ($\beta = -0.857$, $p < 0.001$), subjective norms associated with exercise participation ($\beta = -0.862$, $p < 0.001$), and PBC related to exercise ($\beta = -0.738$, $p < 0.001$). In addition, both attitude ($\beta = 0.213$, $p < 0.001$) and subjective norms ($\beta = 0.168$, $p = 0.001$) exerted significant effects on the intention to participate in exercise. PBC also exerted significant effects on the intention to participate in exercise ($\beta = 0.580$, $p < 0.001$) and health behaviors ($\beta = 0.461$, $p < 0.001$). Lastly, the intention to participate in exercise exerted a significant effect on health behaviors ($\beta = 0.400$, $p < 0.001$). The data indicated that, among TPB variables, PBC exerted the greatest influence on the intention to participate in exercise and had a significant effect on engagement in health behaviors. The current findings support TPB as an important theoretical model for predicting the intention to participate in exercise and patterns of health behavior among Korean men during the COVID-19 pandemic. Our study also highlights the importance of addressing PBC when designing interventions to promote exercise participation and health behaviors among Korean men.

Keywords

COVID-19; Exercise; Health behavior; Men; Self-efficacy; Theory of planned behavior

1. Introduction

Coronavirus disease 2019 (COVID-19), which first emerged in the Wuhan region of China in December 2019, continues to threaten the global population's health [1]. Numerous countries have implemented social distancing policies to combat the spread of COVID-19 [2]. For instance, Korea limited the number of attendees and placed further restrictions on outside activities and indoor gatherings, emphasizing the need to shift to a social culture that is not reliant on face-to-face interactions [3]. As social distancing continues, research demonstrates the synergistic effects of the COVID-19 pandemic and depression in a phenomenon termed "COVID-19 Blues" [4], which has been shown to exert a negative impact on physical, social, and psychological functioning [5]. Additionally, in a "survey on the health status of the people" due to COVID-19 by the Korea Health Promotion and Development Institute [6], 40.7% of respondents reported experiencing COVID-19 Blues, citing weight gain due to a lack of exercise among the causes.

Government, sports, and exercise organizations provided guidelines to improve people's physical activity during the COVID-19 pandemic [7]. Freeman and Eykelbosh [8] suggested that people continue engaging in leisure activities. Several studies [9, 10] found that people did continue engaging in leisure activities despite the social distancing regulations by following safety guidelines for physical exercise. Therefore, despite the physical and social restrictions caused by COVID-19, Chtourou *et al.* [11] and Sallis *et al.* [12] suggest continuous participation in physical activities for people's physical and mental health. Despite the fear of COVID-19 infection in

Korea, some people continue to exercise as usual or rigorous their daily routines. Due to social distancing, Koreans spend significant time indoors and wear masks while engaging in physical activities [13]. Changes in eating habits influenced by Western eating habits, and decreased physical activities due to increased sedentary eating habits, have increased the obesity rates, particularly among Koreans [14]. A study on the prevalence of ambassador syndrome in South Korea was conducted using data from the Korea National Health and Nutrition Examination Survey 2008–2017 [15]. Prevalence among females showed a stable trend being 20.5% in 2008 and 18.7% in 2017, while male prevalence increased from 24.5% in 2008 to 28.1% in 2017 [15]. Per the 2019 National Health Statistics, the prevalence of hypertension and diabetes among men was 31.1% and 14.0%, respectively, and both were maintained for about ten years. Contrastingly, the prevalence of obesity, hypertension, and diabetes among women was 27.4%, 23.1%, and 9.5%, respectively, showing little change for about ten years [14].

Regular physical activity, such as exercise, can help prevent various diseases [16–20]. In addition, exercise participation can reduce the impact of negative emotions (such as anxiety and depression) caused by social distancing [21]. Many authors have expressed concerns regarding the overall decrease in physical activity among adults due to social distancing and movement restrictions implemented during the pandemic [22]. There is an urgent need to develop exercise programs based on a structured and systematic theoretical framework to adopt during the pandemic to ensure favorable outcomes [23]. However, the optimal theoretical framework required for these programs needs to be determined [24].

This study aimed to develop a model for predicting the intention to participate in exercise and health behavior among Korean men per the theory of planned behavior (TPB) framework, using COVID-19 risk perception as an exogenous variable. Specifically, we aimed to identify factors significantly affecting these two behavioral variables and their relationships with COVID-19 risk perception and the general structure of health behaviors among Korean men.

2. Literature review

2.1 COVID-19 risk perception and participation in exercise for health

COVID-19 risk perception is consistently strongly correlated with multiple empirical and sociocultural factors across countries [25]. As deaths from COVID-19 rises worldwide, it is becoming increasingly important to understand the public's risk perceptions [26]. Simply put, risk refers to the potential to lose value. However, it is a complex construct based on relative and subjective judgments rather than objective standards. Risk is usually judged using an individual's immediate intuition, known as risk perception. Risk perception is an individual's subjective judgment regarding the nature or intensity of risk, which influences the individual's specific activities and behaviors [27, 28].

One of the most important strategies to prevent the spread of severe acute infections is to reduce close personal contact [22]. However, the overall decline in physical activity, such as exercise, due to social distancing and movement restrictions implemented globally during the COVID-19 pandemic is negatively impacting people's physical, psychological, and social health [2]. The Korea Health Promotion Institute surveyed people's health during the COVID-19 pandemic, and 40.7% of the respondents experienced depression due to COVID-19, citing weight gain due to lack of exercise as one of the causes [29]. As COVID-19 spreads, many countries are restricting the use of facilities like indoor and outdoor sports and gyms [30]. Halabchi *et al.* [31] suggested that high-intensity exercise in public gyms and complex spaces may pose more risks than benefits. While people exercise for better health, they are still at risk of contracting COVID-19 [32]. However, it is strongly recommended to continue activities despite the social distancing norms to maintain physical and mental health [33, 34] and to protect us from sources of COVID-19 infection [13].

2.2 Theory of planned behavior

One of the frameworks most frequently applied in predicting health-related human behavior is the theory of planned behavior (TPB) [35]. The TPB assumes that the closest determinant of a behavior is the intention to perform the behavior [36], which is greatly influenced by attitudes, subjective norms, and perceived behavioral control (PBC) [37]. The first factor (attitude) represents the individual's evaluation of certain behaviors as favorable or unfavorable. However, as attitudes once formed, persist for a long time and do not change easily, attitudes are a meaningful predictor of behavioral intentions [38]. The second factor (subjective norms) refers to the tendency of others to expect a specific behavior from the individual and the social pressure to engage or disengage in behaviors. Social pressures can form critical social-based judgments [39]. Subjective norms are regarded as variables that improve the explanatory power of TPB research models and contribute to more accurately predicting the actor's actions [40]. The last factor (PBC) represents the individual's perception of their ability to overcome internal and external constraints on specific behaviors and perform the intended behaviors [37]. PBC (controlling beliefs) is the ability to overcome an individual's internal and external constraints on particular behaviors and perform the intended behaviors. Resources or opportunities related to this must be supported [37].

Furthermore, as suggested by Hennessy *et al.* [41], the TPB can accommodate additional predictive variables, and several studies related to exercise and health behaviors have identified and integrated a wide range of predictors within the TPB framework [42–44]. Kim *et al.* [13] also investigated the relationship between participation in leisure activities and wearing a mask by applying TPB to 545 Koreans during the COVID-19 pandemic. Jang *et al.* [45] applied TPB to 243 Koreans to identify the motives and intentions of physical activity during the COVID-19 pandemic. In addition, several studies [38, 46] have been conducted to verify the COVID-19 risk perception as an extended variable of the TPB. TPB is a powerful model for predicting physical activities, like exercise. Therefore, it is necessary to apply TPB to verify the COVID-

19 risk perception, exercise participation intention, and health behavior for safe exercise participation. In addressing these issues, we aimed to evaluate the following hypotheses:

Hypothesis 1 (H1). COVID-19 risk perception will have a negative effect on attitudes regarding exercise.

Hypothesis 2 (H2). COVID-19 risk perception will have a negative effect on subjective norms regarding exercise.

Hypothesis 3 (H3). COVID-19 risk perception will have a negative effect on PBC regarding exercise.

Hypothesis 4 (H4). Attitudes regarding exercise will affect the intention to participate in exercises.

Hypothesis 5 (H5). Subjective norms regarding exercise will affect the intention to participate in exercises.

Hypothesis 6 (H6). PBC regarding exercise will affect the intention to participate in exercises.

Hypothesis 7 (H7). PBC regarding exercise will affect health behavior.

Hypothesis 8 (H8). The intention to participate in exercise will affect health behavior.

3. Materials and methods

3.1 Data collection

The survey was conducted from 19 January to 11 February 2022, and 402 questionnaires were collected. The Republic of Korea was implementing social distancing policies around this time. An unspecified majority of adult Korean men (18–64 years old) were selected as the study population. As face-to-face surveys were difficult to conduct due to COVID-19, data were collected using online questionnaires. An online survey was posted through the Naver online community (*i.e.*, Naver cafe), where researchers anonymously used a non-probability convenience sampling method. As the survey used the Naver office platform, it was automatically coded after the survey was completed. The relevant content was presented before the beginning the survey, and an age-check function was used to prohibit ineligible participants (those under the age of 18 and over 65) from proceeding to the next stage upon confirmation of consent. The study's purpose and the survey's contents were explained to the participants, who had to give their consent before proceeding with the survey. After excluding those with incomplete responses, the data from 374 questionnaires (93%) were included in the final analysis.

3.2 Measures

The questionnaire contained 32 items, including four related to demographic characteristics. COVID-19 risk perception was assessed using four questions, based on those utilized by Dolnicar [47], Larsen and Brun [48], and Lepp and Gibson [49], *e.g.*, "Participating in exercise is not safe due to COVID-19". Attitudes were assessed using four questions adapted from Ajzen [37], *e.g.*, "I think it is good to participate in exercise". Subjective norms were also assessed using four questions, such as "People who are important to me will think it is good for me to participate in exercise". The questionnaire also included eight items related to PBC, such as "I can participate in exercise whenever I want". The intention to participate in exercise was evaluated using four items based on those used by Park *et al*. [50], such as "I will participate in exercise regardless of possible surroundings". Finally, health behaviors were assessed using four items based on those reported in Park *et al*. [50], rated on a 5-point Likert scale ranging from "not at all" to "strongly agree". *e.g.*, "I am continuously participating in health-related behavior".

3.3 Statistical analysis

This study processed data using IBM PASW 18.0 and AMOS 23.0 (IBM Corp., Armonk, NY, USA). Frequency analysis was used to examine the demographic characteristics of the study participants and the normality of the data. Confirmatory factor analysis (CFA) and reliability analysis were performed to confirm the validity and reliability of the measurements. Pearson's correlation analysis was performed to identify their relationships with the set variables. In addition, structural equation modeling (SEM) was performed to test the paths between the set variables. We used four model fit indices to assess the goodness of fit (root mean square error of approximation (RMSEA), chi square, comparative fit index (CFI), and Tucker-Lewis index (TLI)). Statistical significance was set at $\alpha = 0.05$.

4. Results

4.1 Demographic characteristics of participants

All participants were male, with ages mostly between 20 and 29 years (n = 149). Regarding weekly exercise levels, 106 participants reported exercising more than five times per week, representing the most common frequency. The most frequently reported duration of exercise for each session ranged from 60 to 90 minutes (n = 127). The demographic characteristics of the participants are presented in Table 1.

4.2 Validity and reliability of measurement tools

Table 2 below shows the results of CFA and reliability analysis to confirm the validity and reliability of the measurement. The CFA results indicated a good fit between the measurement model and the data ($x^2 = 1097.356$, df = 335, $p < 0.001$, CFI = 0.922, TLI = 0.912 and RMSEA = 0.078) [51]. In addition, the CFA and reliability analysis indicates that the measured items are reliable and valid.

4.3 Correlation analysis and normality of data

In the correlation analysis, the values of the correlation coefficients ranged from −0.357 to 0.775, which is below the reference value of 0.85. This indicates that the criterion for verifying the independence of the measurement had been satisfied [51]. As the structural equation model assumes multivariate normality, the analysis proceeds under the assumption that the observed variables follow a normal distribution. Therefore, in this study, as the parameter estimation method was used as the maximum likelihood (ML) method assuming multivariate normality, normality was tested through the normality test.

TABLE 1. The demographic characteristics of the study population.

Collection category		n	%
Gender	Men	374	100.0
Age	20's	149	39.8
	30's	83	22.2
	40's	66	17.7
	Over 50–under 65	76	20.3
Exercise frequency (weekly)	Once a week	84	22.6
	Twice a week	54	14.4
	Three times a week	66	17.6
	Four times a week	64	17.1
	Five or more times a week	106	28.3
Duration of each exercise session	Less than 30 minutes	23	6.1
	At least 30 minutes but less than 60 minutes	76	20.3
	At least 60 minutes but less than 90 minutes	127	34.0
	At least 90 minutes but less than 2 hours	92	24.7
	2 hours or more	56	15.0

TABLE 2. Validity and reliability of measurement tools.

Measurement Items	Loading (λ)	Standard error	Cronbach's α
COVID-19 risk perception 1	0.760	-	0.749
COVID-19 risk perception 2	0.427	0.082	
COVID-19 risk perception 3	0.811	0.087	
COVID-19 risk perception 4	0.590	0.087	
Attitude 5	0.834	-	0.959
Attitude 6	0.969	0.046	
Attitude 7	0.969	0.046	
Attitude 8	0.926	0.044	
Subjective norms 9	0.907	-	0.952
Subjective norms 10	0.852	0.040	
Subjective norms 11	0.952	0.029	
Subjective norms 12	0.942	0.030	
Perceived behavioral control 13	0.590	-	0.908
Perceived behavioral control 14	0.788	0.105	
Perceived behavioral control 15	0.559	0.087	
Perceived behavioral control 16	0.720	0.106	
Perceived behavioral control 17	0.786	0.099	
Perceived behavioral control 18	0.814	0.177	
Perceived behavioral control 19	0.840	0.177	
Perceived behavioral control 20	0.819	0.112	
Intention to participate in exercise 21	0.637	-	0.903
Intention to participate in exercise 22	0.921	0.076	
Intention to participate in exercise 23	0.945	0.080	
Intention to participate in exercise 24	0.930	0.081	
Health behavior 25	0.799	-	0.874
Health behavior 26	0.916	0.053	
Health behavior 27	0.826	0.058	
Health behavior 28	0.670	0.066	

Note. $x^2 = 1097.356$ ($p < 0.001$), $df = 335$, *comparative fit index = 0.922, Tucker-Lewis index = 0.912, root mean square error of approximation = 0.078.*

TABLE 3. Results of the pearson's correlation and normality analyses.

	COVID-19 risk perception	Attitudes	Subjective norms	Perceived behavioral control	Intention to participate in exercise	Health behaviors
COVID-19 risk perception	1.000					
Attitudes	−0.357***	1.000				
Subjective norms	−0.388***	0.775***	1.000			
Perceived behavioral control	−0.427***	0.602***	0.598***	1.000		
Intention to participate in exercise	−0.427***	0.698***	0.685***	0.770***	1.000	
Health behaviors	−0.467***	0.530***	0.526***	0.701***	0.735***	1.000
Mean	2.807	4.334	4.077	4.198	4.156	3.819
Standard deviation	1.575	0.948	0.998	0.793	0.923	1.106
Skewness	0.018	−1.572	−0.856	−1.161	−1.194	−0.757
Kurtosis	−0.737	2.126	−0.027	1.584	1.070	−0.242

****p < 0.001.*

The normality assessment yielded skewness values ranging from 0.018 to −1.572 and kurtosis values ranging from −0.027 to 2.126, indicating that the data conformed to a normal distribution [52]. The results of Pearson's correlation and normality analyses are shown in Table 3.

4.4 Structural equation modeling (SEM)

In this study, since the parameter estimation method was used as the ML method assuming multivariate normality, normality was tested through the normality test. The ML method was used for parameter estimation in the SEM analysis, which yielded the following results: $x^2 = 1097.356$ ($p < 0.001$), degrees of freedom (df) = 342, CFI = 0.898, TLI = 0.888, and RMSEA = 0.088. Thus, the measurement models accurately represented the data [53–55]. In addition, all hypotheses were supported based on the results of this analysis (Table 4).

COVID-19 risk perception exerted significant negative effects on the attitude of TPB ($\beta = -0.857$, $p < 0.001$; Hypothesis 1), subjective norms associated with TPB ($\beta = -0.862$, $p < 0.001$; Hypothesis 2), and PBC related to exercise ($\beta = -0.738$, $p < 0.001$; Hypothesis 3). In addition, both attitude ($\beta = 0.213$, $p < 0.001$; Hypothesis 4) and subjective norms ($\beta = 0.168$, $p = 0.001$; Hypothesis 5) exerted significant effects on the intention to participate in exercise. PBC also exerted significant effects on the intention to participate in exercise ($\beta = 0.580$, $p < 0.001$; Hypothesis 6) and health behaviors ($\beta = 0.461$, $p < 0.001$; Hypothesis 7). Lastly, the intention to participate in exercise significantly affected on health behaviors ($\beta = 0.400$, $p < 0.001$). Thus, Hypothesis 8 was accepted. Fig. 1 shows the path coefficients of the SEM.

5. Discussion and limitations

Using data obtained from 374 Korean men, we performed SEM to evaluate the effects of attitudes, subjective norms, and PBC on the intention to participate in exercise and health behaviors using COVID-19 risk perception as an antecedent variable. The research results are summarized as follows. COVID-19 risk perception exerted a significant negative effect on the attitude of TPB (H1), subjective norms associated with TPB (H2), and PBC related to exercise (H3). In addition, both attitude (H4) and subjective norms (H5) significantly affected on the intention to participate in the exercise. PBC also significantly affected on the intention to participate in exercise (H6) and health behaviors (H7). Lastly, the intention to participate in exercise significantly affected on health behaviors, and thus, H8 was accepted. Our findings highlight the complex relationships among these variables and their influence on exercise and health-related patterns in this population.

Risk perception refers to the subjective expectations regarding a loss of value due to uncertainty and has been shown to influence behavior and performance [56]. This loss of value can lead to negative consequences such as a delay in or failure to initiate actions [57], with natural disasters and certain diseases representing potential risks [58]. COVID-19 risk perception is high worldwide, and related studies have revealed that risk perception of such diseases constrains individual behaviors and attitudes [59–61].

In the current study, COVID-19 risk perception had a significant negative effect on attitudes toward exercise among Korean men. Increased risk perception shows aversion to sports activities, and risk perception is a major variable that affects the continuation of sports activities [62]. Per Ashraf *et al.*'s study [63], during the COVID-19 pandemic, disease awareness and risk perception levels increased, negatively affecting stress levels. In addition, as quarantine measures such as social distancing and COVID-19-related restrictions on daily life increased, personal stress levels have also increased. Most people tend to judge risk subjectively [64]. Hence, our results suggest that higher subjective perceptions surrounding the risk of COVID-19 negatively impacted attitudes toward exercise among Korean men. However, a study by Jimeno-Almazán *et*

TABLE 4. Structural equation modeling.

Hypothesized relationship				Standard coefficient (ß)	Critical ratio	*p*	Results
Hypothesis 1	COVID-19 risk perception	→	Attitudes	−0.857	−11.212	<0.001	Supported
Hypothesis 2	COVID-19 risk perception	→	Norms	−0.862	−11.684	<0.001	Supported
Hypothesis 3	COVID-19 risk perception	→	Perceived behavioral control	−0.738	−8.554	<0.001	Supported
Hypothesis 4	Attitude	→	Intention to participate in exercise	0.213	4.143	<0.001	Supported
Hypothesis 5	Subjective norms	→	Intention to participate in exercise	0.168	3.286	<0.001	Supported
Hypothesis 6	Perceived behavioral control	→	Intention to participate in exercise	0.580	8.150	<0.001	Supported
Hypothesis 7	Perceived behavioral control	→	Health behaviors	0.461	5.721	<0.001	Supported
Hypothesis 8	Intention to participate in exercise	→	Health behaviors	0.400	5.243	<0.001	Supported

Note. $x^2 = 1097.356$ ($p < 0.001$), $df = 342$, *comparative fit index = 0.922, Tucker-Lewis index = 0.912, root mean square error of approximation = 0.078.*

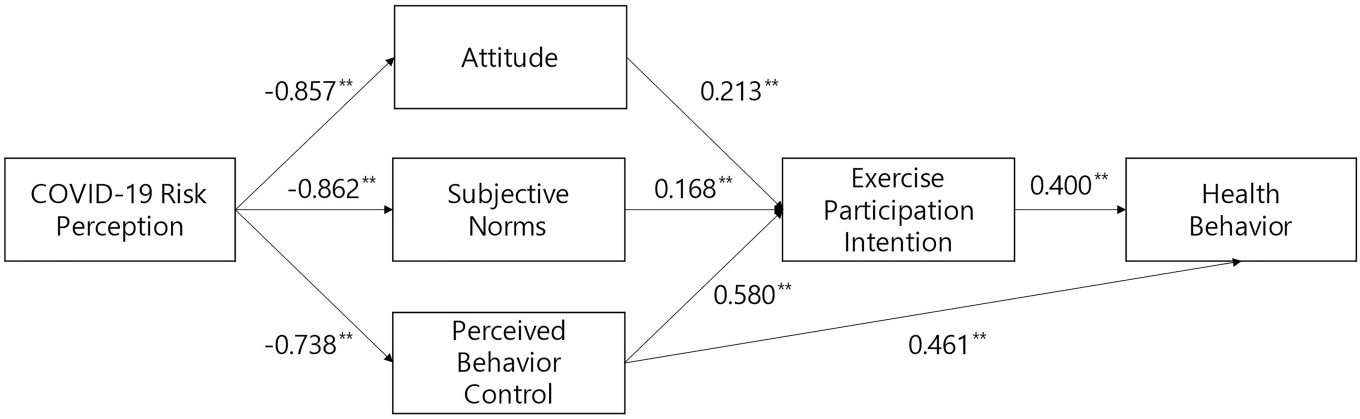

FIGURE 1. Structural model.

al. [65] provided sufficient evidence that adequately tailored and supervised exercise training is an effective therapy for post-coronavirus syndrome when tailored to the variability of symptoms. Therefore, the government or health and exercise departments should actively promote a positive attitude toward exercise, focusing on the long-term benefits of regular exercise in general and regarding specific symptoms of COVID-19.

Our analysis also revealed that COVID-19 risk perception exerted a significant negative effect on subjective norms regarding exercise among Korean men. Individuals perceive the risk of COVID-19 within the context of their social environment, meaning that responses and behaviors will vary across individuals. Studies have reported that factors associated with social anxiety, such as inaccurate information about infectious diseases and confusion regarding treatment methods, also exert negative effects on individual behavior [66]. As the impact of these factors increases, individuals attain a certain risk-awareness related to COVID-19 in their social environments, resulting in an overall negative impact on subjective norms. Our findings highlight the need to develop social programs, such as the "Social Media Certification Event for Practice and Spread of Health Rules in Life" held by the Korea Ministry of Health and Welfare and the Korea Health Promotion and Development Institute, that can reduce the frequency and in-

tensity of negative emotions and promote positive emotions by adjusting social and environmental perceptions regarding COVID-19 risk [67].

Among the Korean men included in our study, COVID-19 risk perception exerted a significant negative effect on PBC related to exercise. While risk perception refers to the subjective judgment of the nature or intensity of risk, which in itself can induce changes in behavior [27, 28], PBC refers to the level of control an individual they have over a specific behavior [37, 68]. Our results suggest that factors such as personal quarantine and avoidance of social contact and gatherings have had a negative impact on exercise-related PBC among Korean men during the COVID-19 pandemic. As of 12 July 2022, 37,100 people had been infected with COVID-19 in Korea [69], representing a drastic increase from the 12,513 confirmed cases for the previous day. Given this rapid spike, the Korean government is preparing a response system for the re-emergence of COVID-19. As such, if the number of confirmed COVID-19 cases increases, the perception of COVID-19 risk will likely increase, which is expected to significantly reduce PBC related to exercise participation. A loss of control due to actual restrictions may have reduced the sense of agency among participants. This indicates the need for a program that emphasizes factors that people can control despite strict restrictions.

Unsurprisingly, our SEM analysis demonstrated a significant effect of attitudes toward exercise on the intention to participate in exercise among Korean men. According to several studies [37, 70–73] conducted using the TPB framework, attitudes and PBC are major variables with a high degree of influence on intentions [30]. In addition, positive attitudes toward exercise and physical activity and control over behavior in the context of COVID-19 remain strong predictors of intention [45]. It is argued that the reason people who do not usually exercise participate in exercise is because they are motivated by the positive results that they can get from exercise [74]. Since exercise participation is an individual's purposeful physical activity and is highly likely to be determined by an individual's internal factors, they decide to participate in exercise when they believe and expect positive results from exercise. Using "home training using YouTube" and "exercise with family in an open space" can contribute to raising a positive feeling such as a change in attitude toward exercise participation [22]. The current findings support the need for health behavior designed to shift attitudes toward exercise during the COVID-19 pandemic in order to strengthen the intention to participate in exercise. In addition, since internal motivation is regarded to be the most important factor in intention to participate in sports, it is necessary to consider internal factors such as fun and satisfaction more than the external environment caused by COVID-19.

In the current study, subjective norms also significantly affected Korean men's intention to participate in exercise. While attitudes are factors specific to each person, subjective norms refer to external social factors [70]. Subjective norms represent social beliefs regarding behaviors and perceptions of social pressures that promote or discourage these behaviors [75, 76]. Hence, an individual's behavior is influenced by whether the reference group harbors a positive or negative attitude toward a specific behavior [77]. Previous studies have reported that subjective norms exhibit relatively low explanatory power in relation to intentions when compared with attitudes or PBC [78, 79]. Similarly, our analysis indicated that subjective norms exerted the least influence on intentions among the TPB variables, suggesting that the attitudes of others play a minor role in determining the intention to participate in exercise among Korean men. Therefore, exercise participation and health behavior programs should focus more on individual factors than social perceptions. In addition, interventions targeting agents may be more effective than pressurizing individuals using social ideals.

PBC significantly affected the intention to participate in exercise among the present study participants and was identified as the factor exerting the greatest influence on attitudes. Per several studies [80–82], PBC is a stronger determinant of intentions than attitudes. Within the TPB, PBC is included in the theory of reasoned action [77], and attitudes and subjective norms influence the execution of intentions or behaviors. Therefore, Ajzen [37] argued that PBC, also known as self-efficacy, plays a decisive role in shaping intentions and behaviors. Moreover, Kaushal *et al*. [83] suggest the importance of access to exercise equipment and PBCs in limited settings by setting exercise and physical activity at home as target behaviors during COVID-19. Therefore, to strengthen the intention to participate in exercise within the context of the COVID-19 pandemic, programs designed to promote social awareness and enhance individual PBC may be the most critical interventions.

Similarly, our analysis also revealed PBC significantly affects health behaviors among Korean men. Perugini and Bagozzi [84] demonstrated that PBC exerts a significant, direct effect on behavior. In addition, Ajzen [68] highlighted PBC as an important determinant of specific behaviors. That is, PBC is an important determinant in that this sense of control does not require an individual to process the intention to participate before engaging in the behavior. Following this notion, our study identified PBC as a significant and direct predictor of the intention to participate in exercise and health behaviors.

The Korea National Fitness 100 program issues certificates (Korea National Fitness Award) based on age and fitness levels. Although the Korean government currently calculates health insurance rates according to income levels, efforts should be made to highlight exercise participation to improve health and reduce overall insurance costs. Using such certificates and awards as incentives may help to strengthen PBC related to exercise.

Lastly, our analysis indicated that the intention to participate in exercise significantly affected health behaviors among Korean men. Fishbein and Ajzen [77] explained that there is a strong, direct correlation between intention and the performance of actual behavior. The intention is regarded as an index of behavioral performance, representing the probability that beliefs and attitudes will be translated into behavior in the future [85]. Based on this framework, our results highlight the importance of intentions related to participation in exercises as an antecedent variable for individual health behaviors. However, in many cases, those who were determined to regularly

engage in desirable health behaviors fail to translate their intentions into specific behaviors [86]. Thus, strategies that can mediate this relationship and increase the explanatory power between intentions and behavior are required to promote the adoption of healthy behaviors among Korean men. Hence, setting SMART goals (specific, measurable, achievable, relevant, and timely) can improve the transition from deliberation to action.

Our study had several limitations. First, although we included data for 374 Korean men, the results may not be generalizable to all Korean men. Second, this study conducted a survey using an online community. Online surveys are limited in securing more specific information because the response rate may be low due to time constraints and attention span if the general characteristics of the participant are asked excessively. Third, this study's results are difficult to apply to people over 65 years due to factors such as, health status that may affect intentions. Further, as numerous variables can directly affect the intention to participate in exercise and health behaviors, we should be cautious when interpreting the results. Moreover, as we did not include women, further well-designed studies are necessary to identify whether there are any gender-based differences in these relationships.

6. Conclusions

The current results indicate that high perceived COVID-19 risk is associated with a great negative impact on attitudes toward exercise participation, subjective norms, and PBC. Our study supports the TPB framework as a theoretical model for predicting the intention to participate in exercise and engage in health behaviors among Korean men during the COVID-19 pandemic. Our findings suggest that COVID-19 risk negatively affects TPB variables related to exercise participation, while TPB variables (attitudes, subjective norms, and PBC) positively influence the intention to exercise. Among these variables, PBC exerted the greatest influence on the intention to participate in exercise and engage in health behaviors. Thus, our results highlight the importance of addressing PBC when designing interventions to promote exercise participation and healthy behavior patterns among Korean men.

AVAILABILITY OF DATA AND MATERIALS

The data presented in this study are available on reasonable request from the corresponding authors.

AUTHOR CONTRIBUTIONS

SUP, HA and WYS—designed the study and the methodology. SUP and WYS—provided the software. SUP and HA—contributed to the formal analysis. SUP, HA and WYS—contributed to the resource and data curation. SUP and HA—contributed to data curation. SUP—drafted the manuscript. HA and WYS—revised the manuscript. SUP and WYS—contributed to data visualization. SUP, HA, and WYS—supervised the study. SUP, HA and WYS—were responsible for project administration. All authors contributed to the editorial changes in the manuscript. All authors have read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study protocol was approved by the Ethics Committee of the Sungshin Women's University, Seoul, Republic of Korea (No. SSWUIRB-2022-001) and conformed to the standards set by the latest revision of the Declaration of Helsinki. Written informed consent was obtained from all study participants.

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CONFLICT OF INTEREST

The authors declare no conflict of interest. SUP and WYS are serving as the Editorial Board members and guest editors of this journal. We declare that SUP and WYS had no involvement in the peer review of this article and have no access to information regarding its peer review. Full responsibility for the editorial process for this article was delegated to BG.

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