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ORIGINAL RESEARCH

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What are the phases of change in exercise behaviors (EB), and factors affecting exercise behaviors (EB) of male workers in a workplace setting?

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Abstract

The purpose of this study was to evaluate the phases of change of exercise among male workers and to analyze the factors affecting their EB using Information-Motivation-Behavioral skill-Revealed Related Variables (IMBR) model. The study included 163 male workers from a major Hyundai Transys company, Seosan city. Data were analyzed using Pearson's correlation coefficients, and hierarchical regression *etc*. Regarding the phases of change in exercise, 135 individuals (82.8%) were classified into phase 3 (preparation phase), phase 4 (action phase), and phase 5 (maintenance phase). In the first step, factors such as health status ($\beta = 0.26$, $p < 0.001$), smoking ($\beta = 0.16$, $p = 0.005$), number of exercises per week ($\beta = 0.35$, $p < 0.001$), times of each exercise ($\beta = 0.17$, $p = 0.005$), and phases of change in exercise ($\beta = 0.17$, $p = 0.014$) were identified as significant factors affecting EB. In the second step, health status ($\beta = 0.19$, $p = 0.001$), smoking ($\beta = -0.13$, $p = 0.019$), number of exercises per week ($\beta = 0.31$, $p < 0.001$), phases of change in exercise ($\beta = 0.13$, $p = 0.034$), and sport commitment ($\beta = 0.16$, $p = 0.019$) were identified as significant factors. In the third step, health status ($\beta = 0.27$, $p < 0.001$), number of exercises per week ($\beta = 0.14$, $p = 0.005$), and exercise self-efficacy ($\beta = 0.39$, $p < 0.001$) were identified as significant factors, explaining 68.3% of the variance in EB. To promote EB, it's important to assess the phases of change in exercise and consider factors such as health status, smoking, the number of exercises per week and the duration of each exercise. Interventions that enhance sport commitment and exercise self-efficacy should be considered. It's recommended to apply IMBR model in exercise studies for workers.

Keywords

Men; Working people; Exercise self-efficacy; Sport commitment; Exercise; IMBR model

1. Introduction

The objective of workplace health promotion activities is to improve the health-related quality of life and corporate productivity by preventing and reducing occupational diseases, work-related diseases, and lifestyle diseases through the promotion of healthy lifestyles among workers [1]. Exercise plays a crucial role in these health promotion activities as it improves overall well-being and reduces various risk factors associated with disease occurrence and mortality [2]. There has been a growing interest in exercise as a means of promoting health, and the 5th National Health Plan 2030 actively promotes physical activities, including exercise, as an integral part of a healthy lifestyle with a focus on disease prevention. Despite the acknowledgment of the benefits of these awareness campaigns and initiatives, many individuals struggle to engage in exercise regularly and incorporate it into their everyday lives [3].

In this study, particular attention was given to middle-aged men among workplace workers. The National Health and Nutrition Survey (NHNES), conducted from 1998 to 2018 over a period of 20 years, revealed a significant increase in cases of diabetes and hypercholesterolemia among Korean men aged 40 to 49, as well as a rise in hypertension among those aged 50 to 59 [4]. The low level of aerobic physical activity has been identified as a contributing factor [5], emphasizing the need to develop measures that promote exemplary health, such as exercise or physical activity. Middle-aged male workers in a workplace setting can be categorized into two groups: clerical workers and production workers. In the case of clerical workers, they often experience high levels of stress due to heavy workloads and long working hours. Factors such as lack of exercise opportunities at work, irregular eating habits, frequent drinking, competition with colleagues, and conflicts with supervisors further contribute to their stress levels. As the number of years spent in the workforce increases, these workers face increased health risks, as indicated by elevated

triglyceride levels, blood sugar levels, and waist circumference. The lack of physical activity emerges as a significant concern among this group [6], while their overall interest in health appears to be relatively low [7]. On the other hand, middle-aged male workers in production jobs frequently encounter stress and depression resulting from societal role expectations. They spend extended periods at their work sites and often operate in unfavorable environments, which can limit their access to appropriate medical assistance and healthcare professionals when health problems arise. Such cases are observed with some frequently [8]. The study findings indicate a low rate of engagement in health promotion behaviors among middle-aged male workers in the workplace [9]. Analyzing the phases of change in physical activity among these workers revealed that less than half of them (40.0%) were in non-practice phases, including pre-planning, planning and preparation stages. Some male workers do not engage in regular exercise, emphasizing the urgent need for initiatives aimed at interesting exercises participation rates [10]. Therefore, it can be started that physical activity and exercise are crucial factors in maintaining and promoting health, irrespective of gender and age.

In order to make exercise behavior a daily habit for middle-aged male workplace workers and increase their engagement in exercise, it is necessary to systematically analyze their exercise behavior status and the factors that influence their exercise participation. When considering research on the theoretical foundations of health behaviors, such as exercise, it is recommended that Kim *et al*. [11] utilize the IMBR model for exercise intervention.

On the other hand, Kim *et al.* [11] developed the IMBR model, which builds upon Fisher *et al.*'s [12] Information-Motivation-Behavioral skill (IMB) model. This IMBR model provides the framework for understanding health promotion behaviors specifically related to exercise. In Kim *et al.*'s [11] study, the IMBR model was applied, and factors such as EI, EM, ESE, SC, PBeE, PBaE and ESS were analyzed in relation to middle-aged men's EB. According to the IMBR model, when individuals have sufficient information about a behavior, achieve motivation for that behavior, and enhance their behavior performance and skills, they are more likely to adopt and maintain the behavior, leading to improvements in their overall health status [12].

Examining previous studies on EB among men and workers, EI, EM, PBaE and ESE emerged as the key influencing factors in the EB of middle-aged men [11]. When considering the factors that impact exercise behaviors in male production workers and clerical workers, ESE, health status, exercise limitations, and ESS were found to affect the exercise behaviors of clerical workers. Notably, social support and having exercise experience of more than 3 months were identified as influencial factors [13]. Futhermore, self-efficacy and health status were found to influence the health promotion behaviors of middle-aged male workers [14].

Having a high level of exercise knowledge has been found to increase exercise behavior [15, 16]. Similarly, motivation to engage in exercise and sport commitment have been shown to enhance exercise behavior [17]. Furthermore, perceiving the benefits of health promoting behaviors and receiving support for such behaviors positively impact health promoting behavior [13, 18]. Conversely, perceiving a lower level of disability related to exercise is associated with better exercise behavior [13]. Lastly, when individuals have higher exercise self-efficacy, they gain confidence and exhibit improved exercise behavior [19]. Many previous studies have provided partial insights into the factors related to exercise behaviors and health promotion behaviors. However, there is a dearth of studies that apply the IMB theory or IMBR model specifically to identify key exercise behaviors among health promotion behaviors targeting middle-aged men and workplace workers. The IMBR model was used in previous studies by Kim *et al*. [11], but it was applied differently in this study. The previous study focused on sports enthusiasts, while this study targeted male workers at workplaces. It was important to see how the IMBR model, as first attempted in the previous study, differed in this study.

Consequently, the authors aim to conduct a hierarchical analysis of the factors influencing exercise behaviors using the IMBR model, focusing on middle-aged male workplace workers. The results of this study will serve as foundational reference for the development of exercise behavior interventions.

2. IMBR model

This study was grounded in Fisher's IMB model. In reviewing the variables from previous studies that were associated with the most significant exercise behavior among health promotion behaviors, it was deemed appropriate to incorporate the variables from Pender's health promotion model. Consequently, an integrated IMBR model was constructed, drawing upon both theoretical frameworks.

Firstly, according to the IMB model, health-related information, motivation and behavioral skills are assumed to be determinants that influence health behavior. When individuals possess adequate knowledge, motivation and behavioral skills, they are more likely to start and sustain health promotion behaviors, leading to desirable health outcomes [12]. Information refers to the knowledge individuals possess about behavior change and directly impacts the performance of healthy behaviors [12]. In the context of middle-aged male workplace workers, information provides an understanding of exercise and knowledge about its effects [11]. The provision of information is an important factor in promoting health behavior [16]. Motivation is a key factor that influences the adoption of health-related behaviors. Personal motivation reflects an individual's attitude towards behavior change, while social motivation pertains to social norms related to behavior change [12]. Personally and socially, the higher the level of motivation, the greater the compliance with the behavior, facilitating engagement in healthy behaviors [20]. Behavioral skill refers to the perception of self-efficacy, that is the belief in one's ability to effectively carry out health promotion activities. Well-informed and motivated individuals are more likely to enhance their self-efficacy, enabling them to engage in health promotion activities effectively [12]. Exercise self-efficacy emerged as a significant factor in exercise behavior performance [19]. By increasing exercise self-efficacy, which rep-

resents confidence in overcoming tasks or barriers, individuals can maintain regular exercise [21].

Furthermore, Pender's health promotion model suggests that engaging in health promotion behaviors can lead to enhanced well-being, self-realization and self-fulfillment for individuals or groups. These outcomes are influenced by multidimensional factors, including individual characteristics, experiences, cognitive and emotional factors related to behavior, and behavioral outcomes [22]. Perceptions and emotions related to behavior hold significant motivational meaning and can serve as important intervention targets [23]. Within this framework, the IMBR model incorporates variables such as EI, EM (personal characteristics and experiences), SC, PBeE, PBaE, ESS, ESE (specific to exercise motivation and behavior), and EB (behavioral outcome variables). These variables have been identified as significant factors in previous studies on exercise [11, 23]. Additionally, the review of previous studies indicates a strong association between sport commitment and exercise behavior. Immersion in exercise allows individuals to experience enjoyment, a sense of accomplishment, and peak performance without disturbance, thereby serving as the root of motivation for participating and maintaining exercise [24, 25]. Therefore, sport commitment is also in the model.

Thus, the IMBR model comprises EI, EM, SC, PBeE, PBaE, ESS, ESE and EB. Fig. 1 presents the research framework of this study.

3. Materials and methods

3.1 Research design

This research is a cross-sectional descriptive correlation study aimed at analyzing factors influencing workplace workers' exercise behavior.

3.2 Participants

This study targeted adult male workers at workplaces in Korea in 2023, specifically male clerical workers or male production workers in Chungnam. The study specifically focused on middle-aged male clerical workers or production workers aged 41 to 59 who are employed at Hyundai Transys company, Seosan city, a large-scale company located in Seosan, Chungcheongnam-do, and receive a salary in return. The total number of employees in Hyundai Transys company, Seosan city is approximately 2500, with around 2000 of them being middle-aged men. For sample selection, a convenience sampling method was employed among the non-probability sampling methods.

The inclusion criteria were as follows:

(1) The study included middle-aged men between the ages of 41 and 59.

(2) The study focused on individuals working as clerical or production workers.

(3) Only those who provided full-time work were included.

(4) Participants had to fill out the questionnaire and be able to communicate.

The following groups were excluded from the study:

(1) Middle-aged male workplace workers suffering from acute illness.

(2) Full-time middle-aged male worker at the workplace who were registered as disabled individuals according to the Disabled People Welfare Act.

This study used a previous study on hierarchical multiple regression as a reference [11]. The sample size was calculated based on entering 10 predictors in multiple regression, with an effect size of 0.15, a significance level of 0.05, and a power of 0.90. The calculated size of sample was 147. Considering a dropout rate of 10%, the final size of sample was determined to be 163. Questionnaires were distributed to 163 individuals to collect data, and no data was missing. Therefore, all 163 participants were included and analyzed, resulting in a response rate of 100%. In the study, more than 1800 middle-aged male workers at Hyundai Transys company, Seosan city were excluded from the sample.

3.3 Procedures

After receiving approval from the institutional review board of the university, the authors visited H Company, a large-scale company located in Seosan city. They met with an executive responsible for employee management, explained the aim and method of this study, and obtained permission to conduct the survey on 19 January 2023. On 26 January 2023, the authors conducted a training session for the executives to provide them with an understanding of the study's purpose and the methodology for collecting the questionnaire data, seeking assisstance from Hyundai Transys company, Seosan city. Subsequently, the executives, along with the authors, collected data from the participants. They distributed paper questionnaires to eligible employees, ensuring that they read the study description, which provided an explanation of the study's purpose and the preparation of the questionnaire. The participants were also encouraged to contact the research director if they had any questions. The data collection period lasted for 30 days, from 27 January to 27 February 2023.

During this time, the executives and researchers explained the aim and methodology of this study to eligible workers in each department. After obtaining voluntary consent, 163 participants signed a consent form and proceeded to complete the questionnaire, contributing to the data collection process. Later, feedback on the study results further increased the value of participation in the research.

3.4 Measures

This research tool used in the study is a questionnaire that comprises variables. It includes 13 questions related to demographic characteristics and exercise-related characteristics, 14 questions on EI, 13 questions on EM, 12 questions on SC, 18 questions on PBeE, 10 questions on PBaE, 7 questions on ESS, 13 questions on ESE, and 7 questions on EB.

3.4.1 Exercise information (EI)

EI section of the questionnaire was developed based on the research conducted by Kim *et al*. [26] and the content used in Song's [27] study. The EI tool from Kim *et al*. [11], which has been validated, was utilized in this study. The EI section was made of a total of 14 questions, including 8 questions related to understanding of exercise and 6 questions assessing knowledge

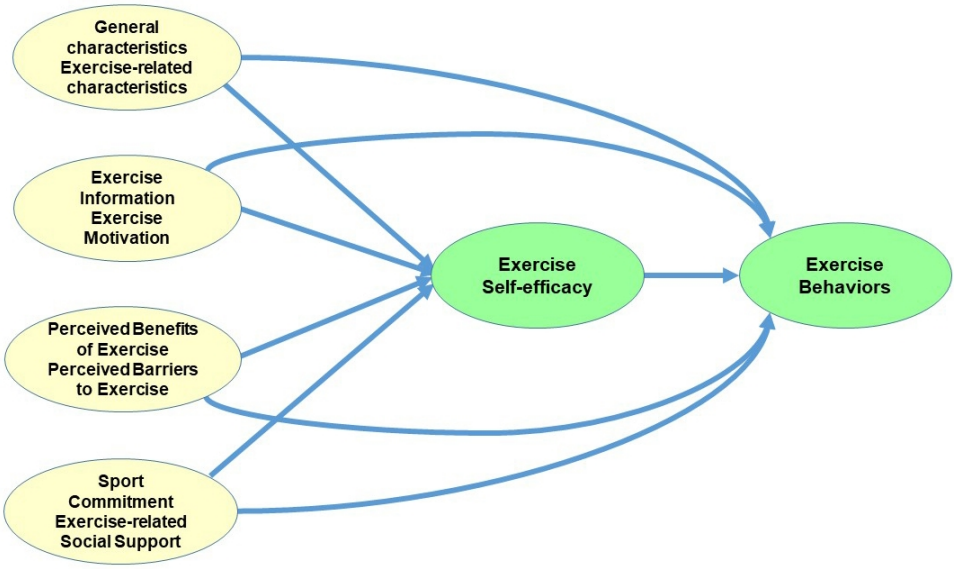

FIGURE 1. Conceptual Framework Based on IMBR Model.

about the effects of exercise. Each question is answered using the options "Yes", "No" or "do not know". A correct answer is scored as 1 point, while an incorrect answer or "do not know" answer is scored as 0 points. The average score for this section ranges from 0 to 1 point, and higher score indicates a better understanding of EI.

3.4.2 Exercise motivation (EM)

EM section was assessed using modified version of the tool developed by Jin [16], which was originally based on the tool used by Karvinen *et al*. [28]. The EM section consists of 12 questions, including 7 questions related to personal motivation and 6 questions related to social motivation. The items are rated on a 7-point Likert scale, with 1 point representing a negative statement and 7 points representing a positive statement. A higher score means a higher level of EM. In Jin's research [16], the reliability of personal motivation, measured using Cronbach's α, was found to be 0.90, and the reliability of social motivation was also 0.90. In this study, the Cronbach's α for personal motivation was 0.90, for social motivation was 0.87, and the overall Cronbach's α of the EM section was 0.91.

3.4.3 Sport commitment (SC)

SC section was assessed using an instrument developed by Jeong [29]. It consists of 12 questions, including 8 questions related to cognitive commitment and 4 questions related to behavioral commitment. The responses are rated on a 5-point Likert scale, ranging from "hardly ever" (1 point) to "very much so" (5 points). A higher score indicates a higher level of sport commitment. In Jeong's study [29], the reliability of the instrument, measured using Cronbach's α was found to be 0.94. In the present study, the Cronbach's α was 0.89.

3.4.4 Perceived benefits of exercise (PBeE)

PBeE section was assessed using an instrument developed by Lee [30]. It consists of 18 questions, and responses are rated on a 5-point Likert scale. "hardly ever" represents 1 point and "very much so" represents 5 points. A higher score indicates a higher level of PBeE. In the original development of the tool, the reliability (Cronbach's α) was found to be 0.93. The reliability was also found to be 0.93 in this study.

3.4.5 Perceived barriers to exercise (PBaE)

PBaE section was assessed using a modified version of the tool developed by Lee [30], as modified by Oh [18]. It consists 10 responses are rated on a 5-point Likert scale. "hardly ever" represents 1 point and "very much so" represents 5 points. A higher score means a higher level of PBaE. In Oh [18]'s research, the reliability of the instrument, measured using Cronbach's α, was found to be 0.81. The reliability for the PBaE section was 0.85 in this paper.

3.4.6 Exercise-related social support (ESS)

ESS section was examined using a modified version of the instrument developed by Choi [31], which was based on the instruments developed by Sallis *et al*. [32] and Park [33]. It consists of 7 questions, including items related to emotional support (2 questions), informative support (2 questions), material support (2 questions), and appraisal support (1 question). Responses are rated on a 5-point Likert scale. "not at all" represents 1 point and "very much so" represents 5 points. A higher score indicates a higher level of ESS. In the process of developing the tool, the reliability, measured using Cronbach's α, was found to be 0.89. The Cronbach's α for the ESS section was 0.90 in this study.

3.4.7 Exercise self-efficacy (ESE)

ESE section was examined using a modified version of the tool developed by Choi [31], which was based on the instruments by Dzewaltowski [34] and Sallis *et al*. [32]. It consists of 13 questions, including items related to self-efficacy in different exercise methods or types (3 questions), self-efficacy in making time for exercise (5 questions), and self-efficacy in performing exercise despite barriers (5 questions). Participants rated their level of confidence in successfully performing exercise on a scale of 0 to 10. A higher score means a higher level

of ESE. In the process of developing the tool, the reliability, measured using Cronbach's α, was found to be 0.95. The Cronbach's α for the ESE section was 0.89 in this paper.

3.4.8 Exercise behaviors (EB)

EB section was assessed using an instrument developed by Lee [30], which was based on the health promoting lifestyle instrument by Walker *et al*. [35] and the instrument by Park [36]. It consists of a total of 7 items. Participants rated their frequency of engagement in exercise behaviors on a 4-point Likert scale, ranging from "hardly ever" to "always do". Higher the score, the higher the level of EB. In the process of developing the instrument, the reliability, measured using Cronbach's α, was found to be 0.83. The Cronbach's α for the EB section was 0.91 in the study.

3.5 Data analysis

The SPSS® Statistics 27.0 software made by IBM Corporation, Armonk, NY, USA, was used for data analysis of demographic characteristics and exercise-related variables through descriptive statistics. The *t*-test was used to compare the levels of EB based on demographic characteristics and exercise-related variables among male workplace workers. Pearson's correlation coefficients were used to examine the relationships between EI, EM, SC, PBeB, PBaB, ESS, ESE and EB. The factors affecting EB were analyzed using hierarchical regression analysis.

3.6 Ethical consideration

The consent form provided participants with information on anonymity and confidentiality. The subjects were told that they could withdraw from the study at any time and that there was no disadvantage. The personal information collected was managed under the Privacy Act. The researchers emphasized their commitment to maintaining the confidentiality of all obtained information. Prior consent was obtained from all participating individuals. The collected data were securely stored in a locked furniture accessible only to researchers for a period of 3 years. Computerized data was anonymized for statistical analysis. It was communicated that data would be disposed of using a grinder in three years.

4. Results

4.1 General characteristics (demographic and exercise-related characteristics) of participants

The general characteristics of male workers were presented in Table 1. Regarding the demographic characteristics, there were 163 male workplace workers, with an average range of 41–59 years and the mean age of 48.40 $\pm$ 5.73 years. Among them, 102 person (62.6%) were aged 41–49 years. In terms of occupation, 100 people (61.3%) were production workers, and 83 people (50.9%) considered their health to be good. Additionally, 155 people (95.1%) reported their economic level as middle to upper. Marital status indicated that 152 people (93.3%) were married or in other marital statuses, and 112 people (68.7%) had a university education or higher. Furthermore, 101 people (62.0%) reported not smoking, and 136 people (83.4%) stated that they consumed alcohol. In terms of health conditions, 96 people (59.3%) had two or fewer diseases. Among specific diseases, 28 people (29.2%) had hypertension, 12 people (12.5%) had diabetes mellitus, 8 people (8.3%) had musculoskeletal disorders, and 3 people (3.1%) had other diseases, such as respiratory disease. Additionally, 5 people (5.2%) had prostate disease, and 40 people (41.7%) had skin disease.

Regarding exercise-related variables, the average number of exercises per week was 2.86 $\pm$ 1.47 times, and 100 people (61.3%) responded that they exercised more than 3 times per week. The average exercise time per exercise was 55.61 $\pm$ 44.84 minutes, and 88 people (54.0%) reporting an exercise time exceeding 60 minutes. In the analysis of phases of change in exercise, 136 people (82.8%) were in phases 3, 4 and 5, which corresponding to the preparation, action, and maintenance phases respectively.

4.2 Comparison of differences in the EB by the general characteristics of participants

Table 1 presents the results of the differences in EB based on the general characteristics (demographic and exercise-related characteristics) of participants are shown. Regarding demographic characteristics, participants who reported good health status had a higher level of EB compared to those who reported poor health status ($t = -6.51, p < 0.001$). Nonsmokers showed a higher level of EB compared to smokers ($t = 4.01, p < 0.001$). In terms of exercise-related characteristics, participants who engaged in exercise 3 times or more per week had a higher level of EB than those who exercised 2 times or less ($t = -9.15, p < 0.001$). Participants who exercised for more than 60 minutes per session had a higher level of EB than those who exercised for less than 60 minutes of participants who exercised for less than 60 minutes ($t = -5.27, p < 0.001$).

Regarding the phases of change in exercise, participants in phases 3, 4 and 5 (preparation, action, and maintenance phases) exhibited higher levels of exercise behavior compared to participants in phases 1 and 2 (pre-planning and planning phases) ($t = -7.09, p < 0.001$).

Additionally, there were no statistically significant differences in EB based on age, job type, economic level, marital status, education, drinking habits and the number of diseases.

4.3 Phases of change of exercise of participants

Table 2 presents the phases of change in participants' exercise behaviors, consisting of five stages. Stage 1: Pre-planning stage comprised 5 individuals (3.1%), Stage 2: Planning stage comprised 23 individuals (14.1%), Stage 3: Preparation stage comprised 35 individuals (21.5%), Stage 4: Action stage comprised 45 individuals (27.6%), Stage 5: Maintenance Stage comprised 55 individuals (33.7%). Phases 1 and 2 corresponded to the stage of not exercising, while phases 3, 4 and 5 indicated the stage where participants recognized their exercise activities.

TABLE 1. Differences in the EB by the demographic characteristics and exercise-related characteristics (N = 163).

Variables	Classification	n	%	Mean	SD	*t*	*p*-Value
Age (yr)							
	41–49	102	62.6	2.36	0.73	−1.86	0.065
	50–59	61	37.4	2.58	0.70		
Type of job							
	Clerical worker	63	38.7	2.41	0.73	−0.46	0.649
	Production worker	100	61.3	2.46	0.72		
Health status							
	Bad	80	49.1	2.11	0.57	−6.51	<0.001
	Good	83	50.9	2.76	0.71		
Economic level							
	High-Middle	155	95.1	2.43	0.72	−0.52	0.602
	Low	8	4.9	2.57	0.85		
Marital state							
	Unmarried	11	6.7	2.61	0.85	0.80	0.423
	Married *ect.*	152	93.3	2.43	0.72		
Education							
	Graduated from high school or lower	51	31.3	2.52	0.70	0.95	0.341
	Graduated from college or higher	112	68.7	2.40	0.73		
Smoking							
	No	101	62.0	2.61	0.72	4.01	<0.001
	Yes	62	38.0	2.16	0.64		
Drinking							
	No	27	16.6	2.46	0.99	0.15	0.879
	Yes	136	83.4	2.44	0.66		
The number of diseases							
	2 or under	96	59.3	2.46	0.71	0.62	0.534
	3 or more	66	40.7	2.39	0.74		
number of exercises per week							
	Below 2	63	38.7	1.91	0.50	−9.15	<0.001
	3 or more	100	61.3	2.78	0.64		
Times of each exercise							
	Less than one hour	75	46.0	2.14	0.66	−5.27	<0.001
	More than one hour	88	54.0	2.70	0.68		
Phases of change of exercise behavior							
	Pre-planning and planning stage	28	17.2	1.67	0.49	−7.09	<0.001
	Preparation, Action, maintenance stage	136	82.8	2.60	0.66		

SD: standard deviation.

TABLE 2. Phases of change of exercise of participants (N = 163).

Step	Meaning	n	%
Stage 1: Pre-planning phase	The stage where they have no intention of starting a regular exercise	5	3.1
Stage 2: Planning phase	The stage where they are not exercising but are thinking about doing it in the future	23	14.1
Stage 3: Preparation phase	The stage where they plan to start exercising and are preparing little by little	35	21.5
Stage 4: Action phase	The stage where they have been aware of exercise for less than 1–6 months but are not doing it regularly	45	27.6
Stage 5: Maintenance phase	The stage where they exercise regularly for more than 6 months	55	33.7

4.4 Level of exercise information (EI), exercise motivation (EM), sport commitment (SC) perceived benefits of exercise (PBeE), perceived barriers to exercise (PBaE), exercise-related social support (ESS), exercise self-efficacy (ESE), and exercise behavior (EB) of participants

Table 3 presents the EB of the participants and the mean and actual range of related variables. The participants had a mean EI of 0.89 ± 0.12 out of a total score of 1 point, while the mean EM was 6.02 ± 0.81 out of a total score of 7 points. The level of SC was reported as 3.49 ± 0.63 out of a total score of 5 points. Participants' PBeE had a mean of 3.13 ± 0.39 out of a total score of 4 points, and PBaE had a mean of 2.08 ± 0.49 out of a total score of 4 points. The ESS received a mean score of 3.24 ± 0.70 out of a total score of 5 points. Participants reported a mean of ESE of 6.26 ± 1.73 out of a total score of 10 points. The level of EB was reported as 2.44 ± 0.72 out of a total score of 4 points.

TABLE 3. Level of research variables (N = 163).

Variables	Mean	SD	Range
Information for exercise	0.89	0.12	0.43–1.00
Motivation for exercise	6.02	0.81	2.46–7.00
Sport commitment	3.49	0.63	1.00–5.00
Perceived benefits of exercise	3.13	0.39	2.06–4.00
Perceived barriers to exercise	2.08	0.49	1.00–4.00
Exercise-related social support	3.24	0.70	1.43–5.00
Exercise self-efficacy	6.26	1.73	1.00–10.00
Exercise behavior	2.44	0.72	1.00–4.00

SD: standard deviation.

4.5 Relationships of exercise information (EI), exercise motivation (EM), sport commitment (SC) perceived benefits of exercise (PBeE), perceived barriers to exercise (PBaE), exercise-related social support (ESS), exercise self-efficacy (ESE), and exercise behavior (EB)

Table 4 presents the results of correlations between EB and the variables of male workers. EB showed positive correlations with EI (r = 0.26, $p = 0.001$), EM (r = 0.43, $p < 0.001$), SC (r = 0.53, $p < 0.001$), PBeE (r = 0.50, $p < 0.001$), ESS (r = 0.32, $p < 0.001$), and ESE (r = 0.71, $p < 0.001$), indicating statistically significant associations. On the other hand EB showed negative correlation with PBaE (r = −0.28, $p < 0.001$). In other words, higher levels of EI, EM, SC, PBaE, ESS and ESE, along with lower levels of PBeE were associated with higher levels of EB in male workers.

Futhermore, All variables including EI, EM, SC, PBeE, ESS and ESE showed positive correlations with each other at a statistically significant level, while PBaE showed negative correlations with all the variables. However, the relationship between ESS and PBaE, and between PBaE and SC were not statistically significant.

4.6 Factors affecting Exercise Behaviors (EB) of participants

The analysis on the factors affecting EB of participants are presented in Table 5. To test the effectiveness of IE, ME, PBeE, PBaE, ESS and ESE on EB, we first verified the underlying hypothesis of multiple regression analysis. The results of verifying the hypothesis showed that the Durbin-Watson test yielded a value of 1.48, which is close to 2, indicating independence and no autocorrelation between model error terms. Additionally, the normal p-p chart showed that the residuals were in a straight line, suggesting normal distribution. There were no issues with multicollinearity, as the tolerance limits scoped from 0.44 to 0.83, and the Variance Inflation Factor (VIF) values scoped from 1.21 to 2.28, which were all below 10.

In the first stage of the hierarchical regression analysis, controlling for exogenous variables, we included health status, smoking, number of exercises per week, times of each exercise, and phases of change of exercise, which showed significant differences in EB. These variables were treated as dummy variables. The analysis revealed that health status ($\beta = 0.26$, $p < 0.001$), smoking ($\beta = -0.16$, $p = 0.005$), number of exercises per week ($\beta = 0.35$, $p < 0.001$), times of each exercise ($\beta = 0.17$, $p = 0.005$), and phases of change of exercise ($\beta = 0.17$, $p = 0.014$) had significant effects on EB, explaining 52.0% of the variance ($F = 34.06$, $p < 0.001$).

In the second stage, the main variables related to changes in EB, such as IE, ME, SC, PBeE, PBaE and ESS, were included. An additional explanatory power of 9.7% was observed. The analysis revealed that health status ($\beta = 0.19$, $p = 0.001$), smoking ($\beta = -0.13$, $p = 0.019$), number of exercises per week ($\beta = 0.31$, $p < 0.001$), phases of change of exercise ($\beta = 0.13$, $p = 0.034$), and SC ($\beta = 0.16$, $p = 0.019$) were significant

TABLE 4. Relationships of information for exercise, motivation for exercise, sport commitment, perceived benefits of exercise, perceived barriers to exercise, exercise-related social support, exercise self-efficacy and exercise behavior.

Variables	Information for exercise r (*p*)	Motivation for exercise r (*p*)	Sport commitment r (*p*)	Perceived benefits of exercise r (*p*)	Perceived barriers to exercise r (*p*)	Exercise-related social support r (*p*)	Exercise self-efficacy r (*p*)	Exercise behavior r (*p*)
Information for exercise	1.00							
Motivation for exercise	0.32 (<0.001)	1.00						
Sport commitment	0.30 (<0.001)	0.50 (<0.001)	1.00					
Perceived benefits of exercise	0.42 (<0.001)	0.54 (<0.001)	0.51 (<0.001)	1.00				
Perceived barriers to exercise	−0.04 (0.632)	−0.21 (0.008)	0.00 (0.995)	−0.25 (0.001)	1.00			
Exercise-related social support	0.30 (<0.001)	0.44 (<0.001)	0.39 (<0.001)	0.47 (<0.001)	−0.05 (0.494)	1.00		
Exercise self-efficacy	0.24 (0.002)	0.51 (<0.001)	0.56 (<0.001)	0.55 (<0.001)	−0.32 (<0.001)	0.39 (<0.001)	1.00	
Exercise behavior	0.26 (0.001)	0.43 (<0.001)	0.53 (<0.001)	0.50 (<0.001)	−0.28 (<0.001)	0.32 (<0.001)	0.71 (<0.001)	1.00

predictors of EB, explaining 61.7% of the variance ($F = 22.14$, $p < 0.001$).

In the third stage analysis, ESS, an important variable for exercise behavioral skills, was included. An additional explanatory power of 6.6% was observed. The analysis revealed that health status ($\beta = -0.14$, $p = 0.005$) and number of exercises per week ($\beta = 0.27$, $p < 0.001$) were significant predictors, and ESS ($\beta = 0.39$, $p < 0.001$) was a significant predictive variable for EB, explaining 68.3% of the variance ($F = 26.87$, $p < 0.001$).

5. Discussion

The phases of change in EB of men production workers and office workers was investigated, and the factors affecting exercise behaviors were analyzed based on the IMBR model in this study. The level of EB of the participants was 2.44 points out of 4 points. Consistent with the research by Yang *et al.*'s research [13], the exercise behavior of production workers was 2.1 out of 4 points, and office workers were 1.8 points. This similarity in results suggests that both groups of male workers have relatively low exercise activities. While production workers, who engage in more physical movement due to the nature of their work, exhibit slightly higher activity levels compared to office workers, neither group demonstrates high exercise engagement. Consequently, measures should be devised to improve the exercise practice rate of middle-aged male workers in the workplace. Kim *et al.*'s [11] study, found that men in the middle age who are members of the athletic club scored higher with 3.04 points. Regular exercise and physical training activities of men in the middle age reduce the incidence of metabolic syndrome and effectively improve physical and mental health [37]. Conversely, low EB can cause physical deterioration and disease [13], resulting in economic losses in the workplace, such as reduced work capacity and productivity [38]. Given these implications, strategies are needed to guide workers toward regularly engaging in exercise.

Regarding the phases of change in exercise among the participants, 28 people (17.2%) were in the pre-planning and planning phases, indicating that they were not currently preparing for exercise. However, 135 individuals (82.8%) were in the preparation or action stages, indicating that they were either preparing for or actively engaging in exercise. These results are more favorable than those reported by Lee [39] among clerical workers and Lee [40] among middle-aged men in the workplace, as a larger proportion of participants in this study were preparing for or engaging in exercise. However, 17.2% of the subjects were in the pre-planning stage, indicating that they did not have immediate plans for exercise but expressed willingness or intention to exercise within the next six months. Behavioral changes can be challenging to induce in the pre-planning stage, as there is limited motivation to participate in exercise [40]. Therefore, it is desirable to promote attitude changes by steadily providing information about the benefits of exercise. Participants in the planning stage require guidance from an advisor who can assist them in implementing their exercise plans, as they have thoughts about behavior change but struggle to initiate them. Since the stability of the preparation stage is not guaranteed, increasing self-efficacy for exercise at this stage is recommended [39]. Therefore, it is necessary to employ different approaches for each stage of exercise in this study to facilitate behavioral changes.

TABLE 5. Factors affecting the exercise behavior of participants.

Variables	Model 1					Model 2					Model 3				
	B	SE	β	t	p	B	SE	β	t	p	B	SE	β	t	p
Constants	1.62	0.11		14.36	<0.001	0.09	0.44		0.19	0.850	0.30	0.41		0.72	0.474
Health status (good)	0.38	0.09	0.26	4.48	<0.001	0.27	0.08	0.19	3.35	0.001	−0.21	0.07	0.14	−2.82	0.005
Smoking (no)	−0.24	0.08	−0.16	−2.84	0.005	−0.19	0.08	−0.13	−2.37	0.019	−0.08	0.08	0.06	−1.09	0.278
Number of exercise per week (3 or more)	0.52	0.10	0.35	5.33	<0.001	0.46	0.09	0.31	5.02	<0.001	0.40	0.08	0.27	4.84	<0.001
Times of each exercise (60 or over)	0.24	0.09	0.17	2.84	0.005	0.01	0.08	0.07	1.24	0.217	0.12	0.08	0.09	1.62	0.108
Phases of change of exercise	0.32	0.13	0.17	2.47	0.014	0.25	0.12	0.13	2.14	0.034	0.19	0.11	0.10	1.74	0.084
Information for exercise						0.13	0.35	0.02	0.37	0.712	0.23	0.32	0.04	0.72	0.471
Motivation for exercise						0.05	0.06	0.06	0.91	0.363	0.01	0.05	0.02	0.26	0.799
Sport commitment						0.19	0.08	0.16	2.37	0.019	0.08	0.08	0.07	1.01	0.314
Perceived benefits of exercise						0.21	0.13	0.11	1.60	0.112	0.06	0.12	0.03	0.46	0.560
Perceived barriers to exercise						−0.13	0.08	−0.09	−1.61	0.109	−0.03	0.08	−0.02	−0.43	0.668
Exercise-related social support						0.08	0.06	0.08	1.31	0.191	0.04	0.06	0.04	0.71	0.478
Exercise self-efficacy											0.16	0.03	0.39	5.55	<0.001
R^2	0.520					0.617					0.683				
Adjusted R^2	0.505					0.589					0.657				
△ Adjusted R^2 (p)						0.097 (<0.001)					0.066 (<0.001)				
F (p)	34.06 (<0.001)					22.14 (<0.001)					26.87 (<0.001)				

SE: standard error; ref: reference; health status (bad = 0, good = 1), smoking (no = 0, yes = 1), Exercise behavior stage (do not exercise = 0, exercise = 1), number of exercise per week (less than 2 times = 0, more than 3 times = 1), exercise time (less than 60 minutes = 0, more than 60 minutes = 1).

Next, regarding the participants' demographic characteristics and exercise-related characteristics, differences in the level of EB were observed bases on health status, smoking, number of exercises per week, exercise time per exercise, and exercise change behavior stage. Perceived health status is a significant factor influencing health behavior. Individuals who perceive themselves to be in good health are more likely to engage in health-promoting behaviors, like exercise. Engaging in exercise can improve subjective health status, creating a cycle of positive reinforcement [40]. Therefore, it is important to promote exercise to foster a perception of good health. A study conducted on middle-aged men in an exercise club revealed differences in exercise behavior based on health status, smoking, the number of exercise sessions per week, and the duration of each exercise session [11]. The group with the best health status engaged in the highest levels of exercise and reported the highest satisfaction with their exercise routine. Conversely, the group with the poorest health status exercised the least and reported the lowest satisfaction. Smoking negatively impacts lung and respiratory function, reduces red blood cell transportation capacity, and weakens muscle strength. As a result, individuals who exercise are more likely to quit smoking due to their awareness of the detrimental effects of smoking [26]. Moreover, individuals who exercise tend to experience higher levels of satisfaction with their exercise, aligning with the notion that greater psychological and emotional satisfaction derived from exercise corresponds to a higher intention to continue exercising [24, 25, 37]. Regular exercise has also been shown to enhance awareness of health status and improve sleep quality, further emphasizing the importance of exercise promotion [41]. It is recommended to engage in exercise at least three times a week, with each session lasting a minimum of one hour [26]. Therefore, considering the aforementioned general characteristics of male workers, interventions promoting regular exercise are necessary to improve EB.

Next, EI, EM, SC, PBeE, ESS, ESE and EB of middle-aged male workplace workers exhibited positive correlations, whereas PBaE demonstrated negative correlations. These findings align with the research conducted by Kim *et al.* [11] on the factors influencing exercise behavior among middle-aged men

in sports clubs, providing support for the present study. Greater access to accurate exercise information, exercise motivation, knowledge of the benefits of exercise, and social support related to exercise were associated with improved exercise behavior. Conversely, a lower perception of barriers to exercise was linked to better exercise performance. Similarly, in the case of clerical workers, self-efficacy was found to be strongly associated with EB and the reduction of sedentary behavior, further corroborating the outcomes of this study [40].

When individuals acquire sufficient exercise information, it enhances their motivation [12], enabling them to engage in exercise while recognizing its benefits and focusing on the activity itself [11]. Health status is known to improve through behavior change and maintenance [11, 12]. Since health-related information directly influences exercise behavior, it is crucial to provide necessary education to workplace workers. It is advisable to develop the educational content based on literature review and preliminary survey on exercise-related information that participants are interested in [42, 43]. Personal motivation plays a crucial role in fostering exercise motivation. By countering misconceptions about exercise and cultivating positive beliefs. Futhermore, promoting social motivation, such as the enjoyment of group interaction, is essential [12, 16]. The more individuals immerse themselves in and enjoy exercise, the higher their satisfaction and the greater their likelihood of maintaining regular exercise habits [17, 37]. Therefore, encouraging individuals to find enjoyment and focus in their exercise routines is important. Additionally, higher perceptions of benefits and social support for workers' health promotion are associated with increased engagement in health promoting behaviors [23]. These findings underscore the need for support policies and systems, such as raising awareness and establishing support groups, to enhance perceived benefits and social support. Moreover, addressing barriers to exercise is crucial as they hinder participation. Measures should be taken to analyze, eliminate and mitigate these barriers [22].

The regression analysis revealed that health status, smoking, number of exercises per week, exercise duration, and the stage of change in exercise behavior were significant factors in the first stage, accounting for 52.0% of the variance. In the second stage, health status, smoking, frequency of daytime exercise, stage of change in exercise behavior, and self-efficacy (SC) emerged as influencing factors, explaining 61.7% of the variance. In the third stage, health status, the number of exercises per week, and exercise-specific enjoyment (ESE) were identified as significant factors, explaining 68.3% of the variance. Including variables such as EI, EM and exercise-related factors increased the explanatory power compared to considering only demographic characteristics and exercise-related characteristics. These findings align with a previous study that employed the IMBR model to analyze factors influencing EB in middle-aged men [11]. In the first stage, health status, smoking, number of exercises per week, and exercise duration were identified as main factors, consistent with the results of a study by Seo and Kim [23] that demonstrated a positive relationship between health condition and health-promoting behavior. This underscores the importance of promoting regular exercise, as it not only improves health but also facilitates health-promoting behavior. Specifically, considering the frequency and duration of exercise in combination is crucial, with aerobic exercise being recommended for at least 3–5 times a week and lasting 30–60 minutes per session [44]. Moreover, in the stage of change in exercise behavior, it is essential to progress beyond the planning phase and engage in regular exercise, as individuals who reach at least three of the five stages are more likely to exercise.

SC was added in the second stage, as it has been found to significantly impact EB. Previous research on middle-aged men demonstrated that SC increased through foot volleyball activities, leading to greater satisfaction and exercise behavior [17]. This supports the findings of the present study, highlighting the significance of SC in influencing EB. Sport commitment contributes to pleasure in daily life and serves as a factor for maintaining relationships and continuity. Encouraging positive sport commitment experiences can foster a stronger desire to participate in exercise.

In the third stage, self-efficacy of exercise was included. ESE emerged as a common influencing factor for both production workers and clerical workers, emphasizing the importance of enhancing motor skills [13]. Regular exercise enhances self-efficacy, and ESE plays a crucial role in exercise adherence [39, 40]. Therefore, to promote exercise behavior among middle-aged male office workers, it is crucial to consider their health status, smoking cessation, frequency of exercise, exercise duration, and stage of change in exercise behavior. Additionally, developing programs and strategies to enhance ESE and providing opportunities for immersive exercise experiences are necessary.

Meanwhile, this study did not find significant effects of major variables in the IMBR model such as EI, EM, PBeE, PBaE and ESS. Future research with an expanded sample size is warranted to further investigate these variables.

The limitation of this study is that although the required sample size was met, the generalizability of the research results should be approached with caution due to the small number of workplace workers included. It is recommended that future studies expand the sample size and employ probability sampling methods. Futhermore, the data collection period was limited to winter, and exercise behavior can be influenced by the environment factors such as season and temperature. Therefore, these factors should be considered in future studies.

6. Conclusions

The variables effecting the EB among middle-aged male workplace workers were identified as health status, smoking, frequency of exercise per week, exercise duration, and the stage of change in exercise behavior in the first stage. In the second stage, the influencing factors were health status, smoking, frequency of exercise per week, stage of change in EB and SC. The factors in the third stage determined to be health status, frequency of exercise per week and ESE. The IMBR model can be applied to develop EB strategies for middle-aged male workplace workers. This study provides valuable baseline data for the development and implementation of workplace exercise programs with active support from employers. Moreover, by incorporating exercise-related variables based on the

IMB model to promote exercise behavior among workplace workers, this study is expected to contribute to the activation of health promotion behaviors.

AVAILABILITY OF DATA AND MATERIALS

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

AUTHOR CONTRIBUTIONS

HKK and JHS—Conceptualization; methodology; formal analysis; writing-original draft preparation; writing-review and editing; HKK—supervision. All authors have read and agreed to the published version of the manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was conducted in accordance with the Declaration of Helsinki. The protocol was approved by the institutional review board of Kongju National University (IRB No. KNU_IRB_2023-1). Informed consent was obtained from participants in this study.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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