

Research Article

In a Stressful Social Environment, Can Using Sports Apps Relieve the Physical and Mental Stress of the Elderly? From the Perspective of Industry 4.0

Po-Fang Huang,¹ Chih-Yen Chen,² Hsiao-Hsien Lin,³ I-Chi Wang,⁴ and Chin-Hsien Hsu ³

¹Physical Office of Fu Jen Catholic University, New Taipei, Taiwan

²General Education Center, National Taitung Junior College, Taitung, Taiwan

³School of Physical Education, Jiaying University, Meizhou City, Guangdong Province, China

⁴Department of Industrial Education and Technology, National Changhua University of Education, Changhua, Taiwan

Correspondence should be addressed to Chin-Hsien Hsu; hsu6292000@yahoo.com.tw

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The purpose of this research was to understand the current physical and mental health of the elderly using sports apps under the COVID-19 pandemic. A total of 711 questionnaires were collected using purposive sampling and the snowball method and were analyzed by Statistical Product and Service Solutions 22.0 and Analysis of Moment Structures 20.0 software. The survey found that elderly people who exercise at intervals of one month are more physically and mentally stressed, but that different exercise frequencies also have different levels of physical and mental health problems; the lower the exercise intensity, the more obvious the negative emotions, the stronger or the less time they spend in exercise, and the greater the pressure of sports. In a high-risk social environment, even if the elderly use sports apps to exercise, they will still change the intensity and time of the exercise, but they will not change the frequency of exercise that has become a daily habit.

1. Introduction

The COVID-19 pandemic is no longer a single health problem but rather a national and human crisis, as well as a major public security incident [1–3]. There have been cases of infectious diseases in the past, such as SARS and MERS, yet SARS, MERS, and COVID-19 are all the same type of virus with regular intervals of occurrence, and all three viruses are capable of endangering human health and causing serious damage to industrial development. Since the discovery of COVID-19 cases on December 26, 2019, the epidemic has spread rapidly, infecting large numbers of people. According to the statistics on May 4, 2020, a total of 187 countries were facing the impact of the epidemic, and the number of confirmed cases reached almost 23.7 million with 814,000 deaths in 127 days [4]. Patients mainly present with alveolar damage, decreased oxygenation of the blood,

decreased organ function due to inadequate oxygen supply [5], and eventually respiratory failure leading to death, with a mortality rate of 5.95% [6]. The current research found that COVID-19 has a clear mode of transmission, a long survival period of the virus in the air, the inability to distinguish the carrier by the symptoms [6], damage to the immune system [7–9], and an uncertain mode of transmission. It has hampered global economic development [1–3] and put individuals and communities under tremendous pressure, anxiety, and trauma [10]. It is obvious that COVID-19 is no longer an isolated health problem but has become a major national and human crisis as well as a public safety and health incident [1, 3, 11, 12]. It has been eight months since the COVID-19 pandemic began, and there is still no sign of a solution. During this period of time, the pressure of the epidemic has impacted human beings all over the world and caused the shock of physical and psychological stress. It has

been found that people who have been exposed to COVID-19 or have made a prior visit to an infected country and had to undergo self-quarantine and testing with inadequate supplies and information often suffer from fear, depression, boredom [13], and stress, leading to an increase in suicide and homicidal suicide rates [14, 15] and seriously affecting individuals' physical and mental health [15]. The lack of familiarity with technical software or the infrequent use of Internet technology for information exchange can cause the elderly to suffer higher mortality rates than other age groups under the pressure of this COVID-19 pandemic [16]. In addition to the immediate impact, postdisaster trauma can arise from these problems [17]. The human individual is the main object of community and society cohesion as well as the key to industrial and economic circulation. The experience of the impact of the global viral influenza (COVID-19) epidemic has shown that humans cannot respond quickly to rapid virus transitions [6, 9, 17, 18] and that it is not possible to predict whether novel viruses with unique genes will emerge again, so we can only formulate policies to prevent and improve the situation [19].

COVID-19 is a global epidemic, and the current epidemic prevention policy is to prevent people who are not yet affected by the virus or who are in areas that are already contaminated by the virus from being infected. When people are infected with the virus, their physical and mental health will be affected [14, 16, 17], causing a series of economic, social, and environmental impacts on individuals, societies, and nations [1–3]. Therefore, it is crucial to maintain good health, improve human behavior, increase mobility, enhance immunity [20], reduce stress, prevent health and psychological diseases [20], overcome anxiety and reduce depression [21], minimize the risk of disease [22], improve individuals' psychological status, promote social interaction and sensitivity [21], improve physical and mental health, and act correctly to avoid the impact on the overall economy and development of individuals, society, and country.

Through the accumulation of human wisdom, human beings have used machines and tools to resolve difficulties and satisfy the needs of life and work. In continuation of the Industrial Revolution at the end of the 18th century, mankind created steam power, electric appliances, computers, and other technological advancements. Now in the 21st century, with the emergence of the Internet, alternative energy, novel materials, and biotechnology, human civilization is making a great leap forward again with the application of automation technology, cloud computing, and artificial intelligence to operate machinery for human happiness and stability of life. This is called Industry 4.0.

Industry 4.0 refers to the effective management and analysis of users. It drives production, services, and even business models through the integration of the Internet. It includes the provision of the Internet of things, big data and analytics, additive manufacturing, automation, system integration, cyber security, augmented reality, simulations, and other industries [23]. These areas are all encompassed by the definition of Industry 4.0 and are gradually being extended [24].

Population aging is a global trend, and the number of elderly citizens in most countries is increasing every year. Although technology has brought about advances in human life and medical care that have extended life expectancies, it has also increased the pressure of work and life, and it has gradually deprived people of the opportunity to exercise. The physical functions of the elderly may be reduced due to changes in the environment and internal physiological factors [25], showing that the physical and mental health of the elderly is fragile. In particular, under the environmental pressure of global infectious disease epidemics, the physical and psychological health of the elderly are under greater threat [16].

The sports industry has seized the opportunity and introduced Industry 4.0 technology to develop sports apps that are suitable for the elderly (Table 1), hoping to promote a sports culture and enter the market of sports and health for the elderly using the concepts of exercise at any time and real-time self-monitoring [26]. For consumers, the main purpose of sports apps is to provide users with exercise expertise and technology to improve their health through real-time online technology and computing, together with the concept of customization. However, although exercise can improve physical health, the effectiveness of any improvement can only be seen after a period of participation and experience [27]. From the perspective of long-term users, the most practical and clear answers can be obtained through systematic data compilation, collection, and analysis [28].

Scholars believe that Internet technology can help human exercise [29], and literature on Internet technology intervention in elderly health has shown that health technology apps can assist medical professionals in remotely monitoring the health of the elderly [30] and enhancing the self-health management of the elderly patients at home [31]. However, since prevention is better than treatment [30], in recent years, scholars have gradually begun to focus on the physical and mental health of the elderly [32]. Unfortunately, the research on exercise apps and the elderly has so far been limited to exploring the effectiveness of the software in managing the health of the elderly [29, 30, 31] and the health maintenance and management of the elderly in the community [32]. There is a lack of literature on the physical and mental health of the elderly [33] or the physical and mental health of the elderly after using exercise apps [32, 33]. Therefore, it is suggested that the study of the impact of online exercise apps on the physical and mental health of elderly people can be improved by the introduction of Industry 4.0 technology.

2. Theoretical Framework

2.1. Industry 4.0 Sports Apps for the Elderly. At the beginning of the 21st century, the so-called Industry 4.0 is being realized in the use of the Internet, alternative energy, novel materials, and biotechnology to intervene in the human operation of machinery or equipment. The movement is further utilized on the foundation of artificial intelligence, through perception, human-computer communication, decision-making,

TABLE 1: Questionnaire on the impact of leisure sports behavior and physical and mental health.

Main classification	Content	Numbering
Background information	Gender, education level	1-2
Recreational sports behavior	Leisure exercise intensity, leisure exercise time, leisure exercise frequency	3-5
	C1 cannot cope with things around	
	C2 is easy to feel scared	
	C3 is not satisfied with his work performance	6-10
	C4 is not interested in things or activities	
	C5 cannot make full use of time	
	D1 feels headache or head pressure	
	D2 feels tired or exhausted, exhausted	
	D3 felt pain in a certain part of the body and thought I was sick	11-15
Physical and mental health impact	D4 feeling of back pain	
	D5 insomnia or poor sleep	
	E1 stomach pain, indigestion	
	E2 increases diet and smoking	16-18
	E3 feels stiff and tight	
	F1 becomes impatient and loses temper easily	
	F2 considers itself worthless	
	F3 feels that work and life are meaningless	19-22
	F4 wants to use self-harm to escape everything	

implementation and feedback, and procedures to achieve product design, manufacturing process, management, and service intellectualization of the CPPS model. [34], that is, the realization of Industry 4.0 [24]. Thus, for consumers, the main purpose of sports apps is to provide users with exercise expertise and technology to improve their health through real-time online technology and computing and the concept of customization. However, although exercise can improve physical health, the effectiveness of such improvement can only be seen after a period of participation and experience [27, 30]. From the perspective of long-term users, the most practical and clear answers can be obtained through systematic data compilation, collection, and analysis [28].

The cloud intelligence technology intervention industry is a technical concept of a borderless network. Adopting artificial intelligence to develop exercise prescription or exercise management systems that help people engage in various leisure sports is a trend [33] that meets the current lifestyle and health needs of general and senior citizens. Exercise app software is expected to bring users effective health management measures, so as to gain the trust of consumers to continue using and create business opportunities. The ultimate goal of each product or decision is to know the real outcome of the user, especially the person directly involved [27, 28]. However, although the development of exercise app software has been discussed by some scholars, researchers have found that the current status of research on exercise apps for the elderly is mainly to understand how to monitor and manage the health of the elderly [29, 30, 32] or analyze the users' feelings toward the products [35-37]. There are few studies on changes in the physical and mental health of the elderly after using exercise apps. Therefore, based on the above analysis results, the researchers believed that it would be beneficial to explore the physical and mental health of the elderly after using sports applications.

2.2. Theoretical Framework for the Effects of Recreational Sports Behavior on Physical and Mental Health. With sufficient scientific evidence, effective, rational, and correct decision-making can be achieved [37]. To investigate the relationship between recreational sports behavior and physical and mental health, it is necessary to start with recreational sports behavior. Recreational sports behavior can be explored in terms of recreational frequency, recreational time, and recreational intensity [38]. Good recreational sports behavior can maintain health, and regular exercise habits in daily life can achieve the effect of maintaining health [39]. Studies have shown that exercise can promote awareness of physical and mental health maintenance, improve diet and lifestyle habits [39], increase immunity [20], reduce the risk of viral infection [20], adjust psychological stress [20, 21], and avoid potentially infectious environments [37, 39]. Thus, there is both a direct and indirect influence of recreational sports behavior on physical and mental health.

However, it is also important to understand whether or not recreational sports behavior has an impact on physical and mental health. In order to understand the key factors of physical and mental health, it is necessary to start by understanding the connotation and definition of physical and mental health. The WHO states that physical and mental health refers to the state of good health in both the physical and psychological aspects of an individual [40]. Based on this, research scales related to physical and mental health have been developed to investigate the effects of exercise behavior and self-efficacy [41, 42]. The original scales had too many questions, but gradually the research survey areas have been further categorized, and the questions of the scale have been gradually improved and refined. The Kessler Psychological Distress Scale was introduced in 2014. It has only 10 questions and mainly focuses on the respondents' psychological stress problems over a one-month period [43]. The main content of the survey asks about feelings of tiredness,

tension, inability to calm down, despair, irritability, restlessness, frustration, sense of accomplishment, sadness, and worthlessness [44]. Without compromising the privacy of the participants, the survey provides valid information about the mental health status of the participants under the concept of self-assessment in order to raise the awareness of people's depression and anxiety and to construct preventive measures [43].

Health is not only about psychological and physiological aspects but is also a manifestation of the physical state and immunity [40]. According to the literature, Cheng and Williams designed the CHQ-12 questionnaire in 1986 [45, 46] to explore the aspects of physical health, mental health, and environmental adaptability [47]. Later on, scholars revised the survey according to the current situation and developed different question scales consisting of 20, 16, and 13 items [47], and they started to explore the COVID-19 issue [12, 47–51]. Therefore, the scale has gradually developed into a research tool for exploring physical and mental health issues in the context of the COVID-19 epidemic.

According to statistics, in terms of the current status of COVID-19-related research, the areas of research include virus transmission and community infection [4, 32], the impact of economic and social development [1, 2, 16], biology and sports medicine [5, 6, 9, 49, 52], epidemic prevention and decision-making [8, 11, 19, 40], public health [10, 12, 15, 41], psychology [17, 18, 41, 48], and the impact on people's physical and mental health during an epidemic [10, 12, 14, 40]. However, few studies have used the perspective of leisure exercise to explore individual physical and mental health maintenance measures [8] and future research development trends [53]. Although physical and mental health scales have gradually been developed in response to the COVID-19 epidemic, few researchers have explored the impact of recreational exercise on physical and mental health in the context of COVID-19 [54, 55]. Therefore, this study suggested that the development of research on the impact of recreational sports on physical and mental health could help the government or the public to develop personal preventive measures and public health education in the face of global epidemic diseases in the future.

Given the situation, the framework and questions of the physical and mental health scales were developed based on the above literature [1, 2, 4, 10, 12, 21, 23, 29, 32, 37, 39, 47, 49–59] and adapted from relevant studies [54, 55] regarding the current COVID-19 situation. The structural equation model was used to validate the scale and investigate the regulation of recreational sports behavior on the physical and mental health of the elderly under the COVID-19 epidemic, in order to improve the research on COVID-19 and provide a reference for relevant targets, industries, organizations, and researchers.

2.3. Review of Relevant Studies and Hypotheses. Recreational sports behavior can be understood from the viewpoints of leisure frequency, leisure time, leisure intensity, etc. [38]. Good recreational exercise habits can maintain physical and mental health [40]. Recreational

sports behavior affects personal quality of life mainly through individuals' psychological and physiological health status [60]. People with adequate exercise intensity can prevent high-risk health hazards [61]. Adopting artificial intelligence to develop exercise prescription or exercise management systems to help people engage in various leisure sports is a trend [33] that meets the current lifestyle and health needs of general and senior citizens. There is a correlation between exercise intensity and physical and mental health, especially for higher levels of involvement, which can result in less emotional distress and suicidal behavior [62]. Although the intensity of exercise may affect health, consistent exercise behavior can help maintain sustainable physical and mental health [61]. Therefore, the first question of this study was whether different exercise intensities have an effect on the physical and mental health of the elderly when using sports apps.

The duration of recreational exercise affects the effectiveness of the exercise, and the existence of regular exercise habits can have a positive effect on maintaining health [39]. Studies have shown that exercise can improve quality of life and psychological health [63], and the duration of exercise is positively correlated with physical and mental health status [64, 65]. Therefore, the second question of this study was whether the difference in the time spent on exercise has an effect on the physical and mental health of the elderly when using sports apps.

Regular exercise planning is essential to achieve good physical and mental health, and good recreational exercise frequency will affect physical and mental health [65]. However, research has shown that appropriate exercise frequency has a slight effect on physical and mental health [66, 67], and it has been shown that exercise frequency has a significant effect on physical and mental health [67]. It could be inferred that the frequency of engaging in leisure sports is related to physical and mental health; therefore, the third question of this research was whether differences in the frequency of exercising using an exercise app have an effect on the physical and mental health of the elderly.

COVID-19 is a major public safety event [1–3] and a global problem that is difficult to solve [11, 12]. The most fundamental solution to prevent the spread of COVID-19 is to make sure that people have the means to fight against the virus, in addition to making good public health decisions [20]. In order to resist the virus, it is important to have good physical and mental health [20], and good physical and mental health can start with the maintenance of recreational exercise [40]. Studies have shown that people with regular exercise habits have better health maintenance effects [39] and that adequate time, frequency, and intensity of exercise can help people maintain their physical and mental health [60, 61] and have a good quality of life. However, according to research findings [2, 4, 21, 24, 29, 32, 37, 39, 40, 42, 43, 45, 47, 49, 51, 53, 57, 59, 68], few studies have investigated the impact of recreational exercise and physical and mental health in the context of COVID-19 [54, 55]. Therefore, researchers believe that understanding the influence of leisure exercise on the physical and mental health of the elderly in the COVID-19 infectious environment can

make a significant contribution by providing decision-making advice to the government and the public in the event of major infectious disease outbreaks in the future.

3. Methods and Instruments

3.1. Study Framework and Hypotheses. After reading the literature [20, 21, 23, 30, 32, 38, 57, 59, 69], the researcher first went to major sports parks in the north to conduct fieldwork. The researcher first observed the types of sports in which the elderly engaged and then summarized the current types of sports for the elderly based on the survey results. Next, the questionnaire tools were compiled based on the literature [10, 15, 40, 41, 55], the Delphi method was used to test the content validity, and Analysis of Moment Structures 20.0 and Statistical Product and Service Solutions 22.0 for Windows 22.0 statistical software package were used to perform CFA analysis to test the reliability. After the questionnaire tool was used, it was distributed. Statistical verification was used to analyze 711 formal questionnaires, and the results were compared with the content of the interviews. Finally, multiple verification methods were used to discuss.

As illustrated in the study framework, the hypotheses of the study are as follows, as shown in Figure 1:

H1: when exercising with sports apps, different exercise intensities have a significant impact on improving the physical and mental health of the elderly

H2: when exercising with sports apps, different exercise times have a significant impact on improving the physical and mental health of the elderly

H3: when exercising with sports apps, different exercise frequencies have a significant impact on improving the physical and mental health of the elderly

3.2. Research Objects. The study population was the residents of northern Taiwan. Because of the COVID-19 epidemic, sample information can only be collected through the Internet platform. Therefore, a questionnaire survey was used to select subjects by intentional sampling for the study of a specific population group and to obtain a larger number of samples by snowball sampling. After 39 invalid questionnaires were removed from the total 750 questionnaires, 711 valid questionnaires were collected with a recovery rate of 94.8%. The valid questionnaires were coded and analyzed by SPSS 22.0 statistical software for documentation and descriptive analysis of demographic variables. Finally, the research will use AMOS 20.0 software to analyze the number of samples and analyze the results by means of test statistics.

3.3. Research Tools. The purpose of this study was to investigate the effects of recreational sports behavior on physical and mental health during the COVID-19 epidemic. Using a questionnaire survey, we deduced similar results of the positive effects of recreational sports behavior on physical and mental health compared to the research findings [20, 21, 23, 38–44], which will manifest in the

current uncertainty of the epidemic. The content of the questionnaire consisted of three parts, namely, background variables, recreational sport behaviors, and physical and mental health effects. The background variables [8, 11–15] contained three questions in total. With reference to previous studies [60, 61, 63, 64, 66, 67], a total of three questions were compiled for the modes of recreational sports behaviors. Seventeen questions were compiled to investigate the physical and mental health impact [10, 12, 15, 40, 41, 55] and a total of 23 questions were included in the questionnaire, as shown in Figure 2.

In consideration of the five-point scale, a score of one to five points was designed, in which one represents total disagreement and five represents total agreement. The interviewees were invited to provide feedback on the research questions. The demographic variables included gender (male, female) and education level (elementary school, secondary school, high school, college/university, institute (inclusive) and above). The recreational sport behavior was characterized in terms of its duration, frequency, and intensity. Leisure exercise time was categorized as none, within 30 minutes, one hour, one to three hours, and more than three hours. The frequency of leisure exercise was categorized as none, at least one time per day, at least one time per week, and more than one time per month or more. The intensity of leisure exercise was categorized as mild intensity (including no intensity), low intensity, medium intensity, medium-high intensity, and very high intensity. Physical and mental health effects included psychological feelings, mental state, physical state, negative thoughts, and other four components, as shown in Table 1.

Under the pressure of the epidemic transmission environment and other constraints, 50 questionnaires were distributed from May 1 to 5, 2020, to test the data. After deleting the invalid questionnaires, the data were coded, documented using SPSS 22.0, and then analyzed using AMOS 20.0 to determine the feasibility of the questionnaire.

3.4. Offending Estimate. The error variance values in this study ranged from 0.01 to 0.03, and the standardized coefficients ranged from 0.67 to 0.95 but did not exceed 0.95. This result is consistent with the standard of the offending estimate test that is to determine whether there is a negative error variance and whether the standardized regression coefficient exceeds or is too close to 1 [70]. Therefore, it means that the results of these data do not violate the estimation and can be tested for the overall model fitness, as shown in Table 2.

4. Measurement Mode Analysis

4.1. Verification of Convergent Validity. In this study, the convergent reliability of the mode was measured using the standardized path coefficient, average variance extracted, and composite reliability. In general, the composite reliability should be greater than 0.60, and the mean number of variances sampled should be greater than 0.50 [60]. After confirmatory factor analysis and obtaining standardized

Study Framework

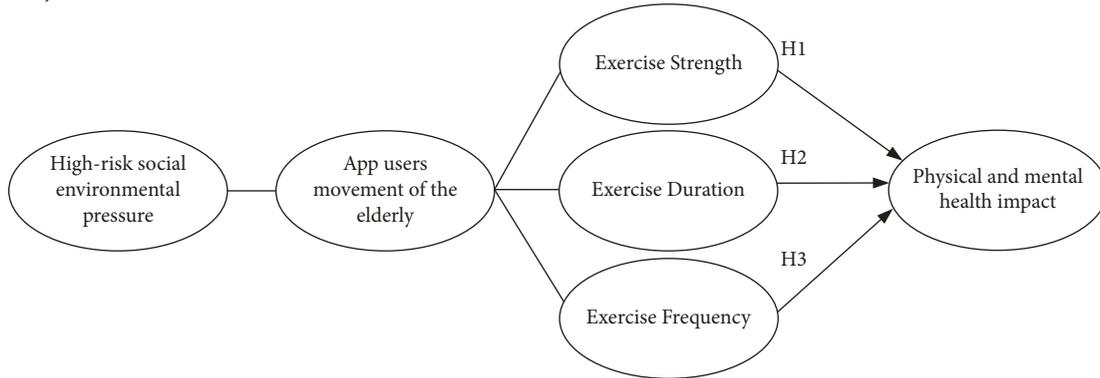


FIGURE 1: Study framework.

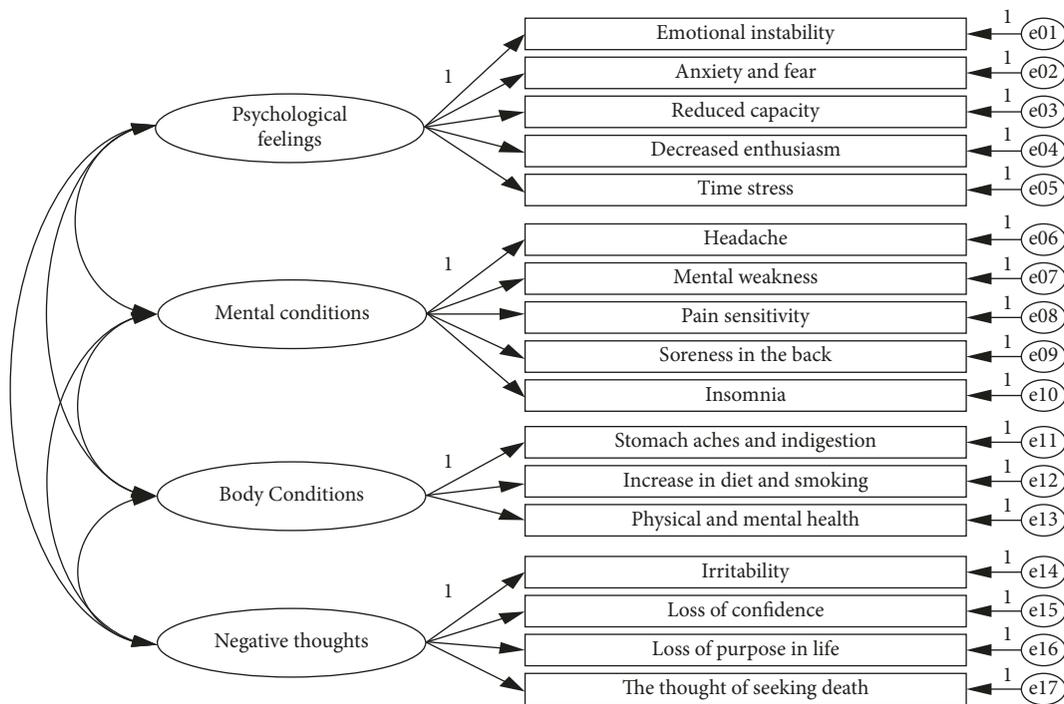


FIGURE 2: Confirmatory factor analysis framework of the physical and mental health scale.

parameter estimates, as shown in Table 3, the psychological perceptions ranged from 1.00 to 1.12; mental status ranged from 1.00 to 1.08; physical status ranged from 0.87 to 1.00; and negative thoughts ranged from 0.87 to 1.00. The composite reliability values of the four potential parameters psychological feelings, mental state, physical state, and negative thoughts were 0.80, 0.95, 0.86, and 0.86, respectively, all greater than 0.60. The mean variance extracted values were 0.66, 0.90, 0.76, and 0.75, respectively, all greater than 0.50. These results indicated that the mode had good inner quality and convergent validity.

4.2. Discrimination of Validity Verification. The structural mode analysis in this study was performed using a χ^2 check and the following indices: χ^2 to degrees of freedom ratio,

GFI, AGFI, RMSEA, CFI, and PCFI [60]. After the mode correction of the physical and mental health impact scale, the GFI was 0.98, AGFI was 0.95, RMSEA was 0.15, CFI was 0.99, and PCFI was 0.50. All the fit indices met the mode fitness criteria, which indicated that the results of this study were an acceptable mode, as shown in Table 4.

After completion of the questionnaire, 711 responses were collected between May 20 and June 20, 2020, using the intentional sampling method to select the target participants. SPSS 22.0 statistical software was used for the descriptive analysis of the demographic variables. Then, semistructured interviews were conducted with three scholars who had backgrounds in recreational sports, medical care, and health protection, as well as two elderly sports enthusiasts, to obtain their opinions on the analysis results. This paper was subsequently constructed in the order

TABLE 2: Estimation checklist for the violation of leisure sports behavior on the physical and mental health scale.

Questions	Standardized regression coefficient	Error variance
Emotional instability<--- Psychological feelings	0.76	0.03
Anxiety and fear<--- Psychological feelings	0.67	0.03
Reduced capacity<--- Psychological feelings	0.84	0.02
Decreased enthusiasm<--- Psychological feelings	0.79	0.03
Time stress<--- Psychological feelings	0.78	0.03
Headache<--- Mental conditions	0.72	0.03
Mental weakness<--- Mental conditions	0.78	0.02
Pain sensitivity<--- Mental conditions	0.85	0.02
Soreness in the back<--- Mental conditions	0.94	0.01
Insomnia<--- Mental conditions	0.95	0.01
Stomach aches and indigestion<--- Body conditions	0.95	0.01
Increase in diet and smoking<--- Body conditions	0.78	0.03
Feeling stiff and tight<--- Body Conditions	0.69	0.03
Irritability<--- Negative thoughts	0.85	0.02
Loss of confidence<--- Negative thoughts	0.94	0.01
Loss of purpose in life<--- Negative thoughts	0.90	0.01
The thought of seeking death<--- Negative thoughts	0.79	0.02

TABLE 3: Convergent reliability and mean variance extracted values of the impact of recreational sports behavior on physical and mental health scale.

Questions	Standardized loading	Nonstandardized loading	SE	CR (t-value)	P	SMC	CR	AVE
Decreased enthusiasm<--- Psychological feelings	1.00	0.81				0.65	0.80	0.66
Time stress<--- Psychological feelings	1.12	0.82	0.08	14.51	***	0.67		
Soreness in the back<--- Mental conditions	1.00	0.92				0.85	0.95	0.90
Insomnia<--- Mental conditions	1.08	0.98	0.02	51.42	***	0.95		
Stomach aches and indigestion<--- Body conditions	1.00	0.95				0.91		
Increase in diet and smoking<--- Body conditions	0.87	0.79	0.03	30.21	***	0.62	0.86	0.76
Loss of confidence<--- Negative thoughts	1.00	0.94				0.88		
The thought of seeking death<--- Negative thoughts	0.88	0.79	0.03	27.85	***	0.63	0.86	0.75

*P < 0.05; **P < 0.01; ***P < 0.001.

TABLE 4: Fitness analysis of the impact of recreational sports behavior on the physical and mental health scale study mode.

Fit indices	Acceptance criteria	Mode (before correction)	Mode (after correction)	Fitness determination
χ^2 (Chi-square)	Smaller the better	1901.28	52.10	
χ^2 /degree of freedom	<3	16.83	3.72	Fit
GFI	>0.90	0.73	0.98	Fit
AGFI	>0.90	0.64	0.95	Fit
RMSEA	<0.08	0.15	0.06	Fit
CFI	>0.90	0.85	0.99	Fit
PCFI	>0.50	0.71	0.50	Fit

of induction, organization, and analysis [61]. Finally, a multidimensional approach was adopted to combine information from different research subjects, research theories, and methods by examining multiple pieces of data from multiple perspectives and comparing the results of different studies [63], in order to obtain accurate knowledge and meaning.

5. Research Results

5.1. *Sample Descriptive Statistics.* A total of 711 respondents were interviewed in the study. Most of them were female (451 or 63.4%), while 260 or 36.6% were male. In terms of education, the majority had a college education (536 or 75.4%), while primary education accounted for the least (1.7%). Finally, most of them are engaged in Chinese Kung Fu (for example: Tai Chi) and fitness exercises (34%), and a small number of elderly people choose to engage in social

TABLE 5: Respondents' demographics.

Variable	Classification	Quantity	(%)
Gender	Male	260	36.6
	Female	451	63.4
Education level	Elementary school	12	1.7
	Secondary school	33	4.6
	High school	112	15.8
	College/university	536	75.4
	Institute (inclusive) and above	18	2.5
Kind	No	110	15.4%
	Ball	163	22.9%
	Dance class	49	7%
	Fitness class	106	14.8%
	Leisure	42	5.9%
	Qigong or literary	241	34%

dance (for example: aerobic dance) exercises (7%). The results are shown in Table 5.

5.1.1. Analysis of the Regulatory Power of the Influence of Different Leisure Exercise Intensities on Physical and Mental Health. According to the literature, adequate leisure exercise intensity can improve the quality of life of individuals [61, 71], which can be seen in terms of both psychological and physiological health aspects [61]. Based on this result, the researcher proposed hypothesis 1 (exercise intensity has an impact on improving physical and mental health). As shown in Table 6, leisure exercise intensity was classified into five categories: nonexercise, low intensity, low intensity, medium intensity, high intensity, and very high intensity. Statistical tests were used to analyze the effects of enthusiasm. It was found that enthusiasm was most affected by those with very high intensity (1.79), medium-high intensity (2.92), and no exercise (3.14). Those who exercised at light intensity (2.67), low intensity (3.40), medium intensity (2.85), and very high intensity (1.79) felt the most pressured by time. The results were not entirely consistent with the assumptions.

The effects of different exercise intensities on psychological perception, mental status, physical status, and negative thoughts were further investigated. It was found that low-intensity exercise had the greatest effect on the psychological aspects of physical and mental health ($M = 3.30$), while those who did not exercise had the greatest effect on negative thoughts ($M = 2.19$), mental condition ($M = 2.41$), and physical condition ($M = 3.95$), as shown in Figure 3.

According to the results, this result was different from that expected research hypothesis 1. When exercising with sports apps, different exercise intensities have a significant effect on improving the physical and mental health of the elderly.

5.1.2. Analysis of the Regulatory Power of the Influence of Leisure Sports Time on Physical and Mental Health. Adequate exercise time planning can improve physical and mental health [39, 69], and duration is a key factor [61]. Based on this result, the researcher proposed hypothesis 2 (exercise time has an impact on improving physical and mental health). As shown in Table 7, leisure exercise time was divided into five

categories: none, less than 30 minutes, one hour, one to three hours, and more than three hours. Therefore, after statistical analysis, it was found that individuals who planned one hour of exercise (3.06) felt the greatest influence on enthusiasm; those who planned less than 30 minutes (2.88), one to three hours (2.71), and more than three hours (3.47) felt the most pressured by time, while those who did not exercise lost their confidence (2.19) and had suicidal thoughts (2.19).

The psychological perception, mental condition, physical condition, and negative thoughts of the participants were further investigated according to the different exercise times. It was found that those who planned exercise for more than three hours showed the greatest influence on psychological feeling ($M = 3.445$), mental condition ($M = 2.985$), and physical condition ($M = 2.955$), while those who did not exercise showed the most significant influence on negative thoughts ($M = 2.19$), as shown in Figure 4.

According to the results, this result was different from that expected by research hypothesis 2. When exercising with sports apps, different exercise time has a significant effect on improving the physical and mental health of the elderly.

5.1.3. Analysis of the Regulatory Power of the Influence of Leisure Exercise Frequency on Physical and Mental Health. Regular exercise habits can achieve the effect of maintaining health [39, 69], and the length of time is the key. Based on this result, the researchers proposed hypothesis 3 (exercise frequency has an impact on improving physical and mental health). As shown in Table 8, the frequency of leisure exercise was divided into five categories: none, at least once a day, at least once a week, at least once a month, and more than once a month. After statistical analysis, it was found that the enthusiasm of those who exercised once a week (2.85) and those who did not exercise (1.25) were the most influenced by the frequency of exercise, while those who exercised once a day (2.94) and once a month (3.86) felt the most pressured by time.

Next, psychological perception, mental condition, physical condition, and negative thoughts were examined according to exercise frequency. It was found that those who planned exercise once a month showed the most significant

TABLE 6: Analysis of the physical and mental health perceptions of elderly people with different exercise intensity behaviors.

Facet	Issue	No exercise	Light intensity	Low intensity	Medium intensity	Medium to high intensity	Very high intensity
Psychological feelings	Decreased enthusiasm	3.14☆	2.56	3.20	2.74	2.92☆	1.79☆
	Time stress	3.05	2.67☆	3.40☆	2.85☆	2.58	1.79☆
Mental conditions	Soreness in the back	2.48	2.17	2.30	2.04	1.67	1.53
	Insomnia	2.33	2.17	2.30	2.04	1.67	1.55
Body conditions	Stomach aches and indigestion	2.33	2.33	2.10	1.93	1.75	1.53
	Increase in diet and smoking	2.29	2.06	2.10	1.85	1.58	1.46
Negative thoughts	Loss of confidence	2.19★	2.11	1.90	1.81	1.42★	1.46
	The thought of seeking death	2.19★	1.94★	1.70★	1.78★	1.42★	1.40★

☆ = high perception ; ★ = minimal perception.

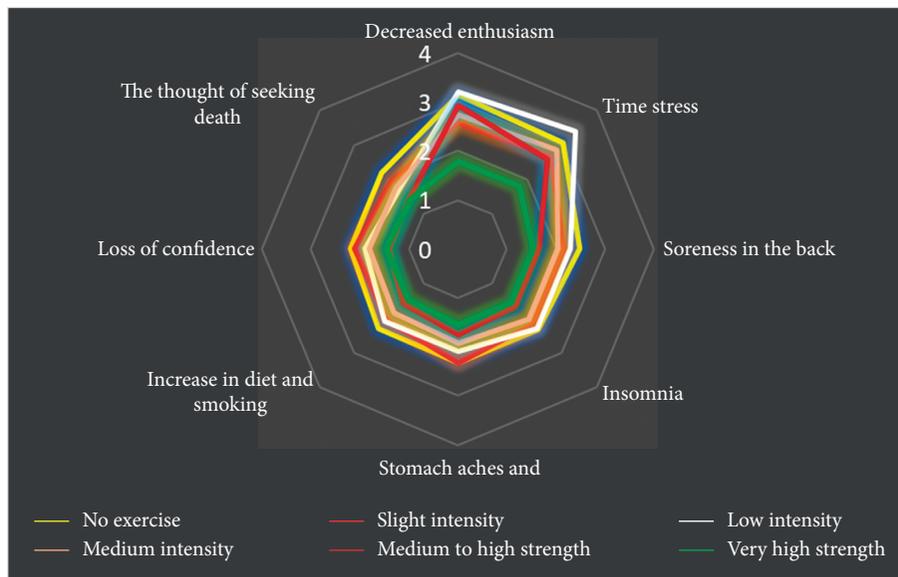


FIGURE 3: Analysis of the effects of different exercise intensities on psychological feelings, mental status, physical status, and negative thoughts.

TABLE 7: Analysis of physical and mental health perceptions of the elderly with different exercise behaviors.

Facet	Issue	No exercise	Within 30 minutes	1 hour	1–3 hours	More than 3 hours
Psychological feelings	Decreased enthusiasm	1.27	2.73	3.06☆	2.52	3.42
	Time stress	1.20	2.88☆	2.91	2.71☆	3.47☆
Mental conditions	Soreness in the back	1.13	2.08	2.13	1.92	2.95
	Insomnia	1.12	2.00	2.13	1.94	3.02
Body conditions	Stomach aches and indigestion	1.11★	2.00	2.13	1.87	3.00
	Increase in diet and smoking	1.11★	1.69★	1.91	1.75★	2.91
Negative thoughts	Loss of confidence	2.19☆	2.11	1.90	1.81	1.42★
	The thought of seeking death	2.19☆	1.94	1.70★	1.78	1.42★

☆ = high perception ; ★ = minimal perception.

effect on their psychological feeling ($M=3.725$), negative thoughts ($M=3.205$), and mental ($M=3.34$) and physical condition ($M=3.23$), as shown in Figure 5.

According to the results, this result was different from that expected by research hypothesis 3. When exercising

with sports apps, different exercise frequencies have a significant effect on improving the physical and mental health of the elderly.

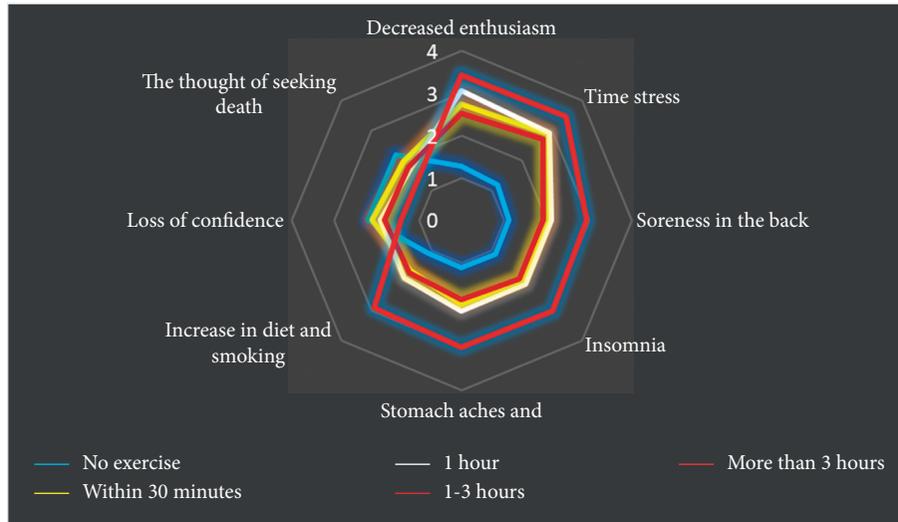


FIGURE 4: Analysis of the effects of different exercise durations on psychological feelings, mental state, physical state, and negative thoughts.

TABLE 8: Analysis of physical and mental health perceptions of elderly people with different exercise frequencies.

Facet	Issue	No exercise	Once a day	Once a week	Once a month
Psychological feelings	Decreased enthusiasm	1.25☆	2.81	2.85☆	3.59
	Time stress	1.21	2.94☆	2.68	3.86☆
Mental conditions	Soreness in the back	1.13	2.15	2.00	3.36
	Insomnia	1.12	2.23	1.96	3.32
Body conditions	Stomach aches and indigestion	1.12	2.15	1.96	3.32
	Increase in diet and smoking	1.13	2.01	1.75	3.14★
Negative thoughts	Loss of confidence	1.11★	2.03	1.68	3.18
	The thought of seeking death	1.11★	1.85★	1.57★	3.23

☆ = high perception ; ★ = minimal perception.

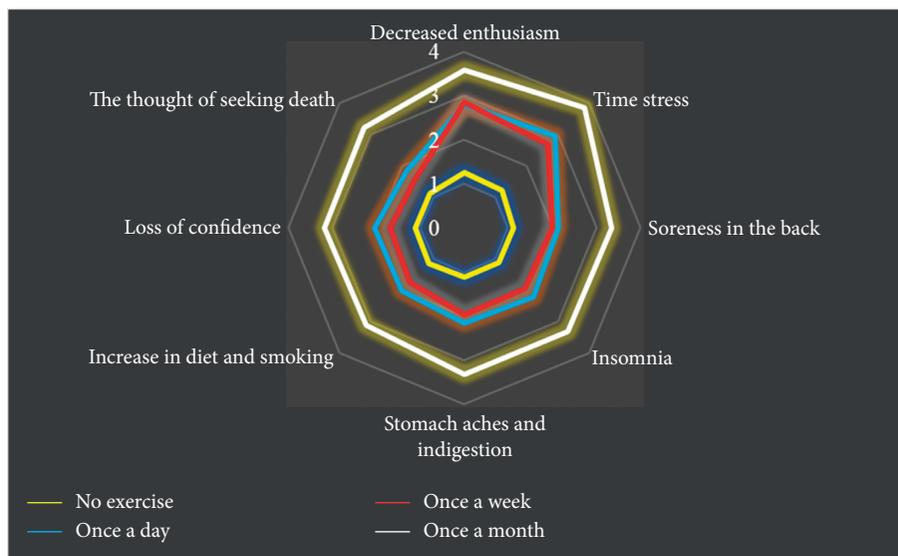


FIGURE 5: Analysis of the effects of different exercise frequencies on psychological feelings, mental status, physical status, and negative thoughts.

6. Results and Discussion

The aim of this study was to investigate the modulating effect of recreational sports behaviors on the physical and mental health of the elderly during the COVID-19 epidemic. Three hypotheses were established based on the literature [20, 39, 40, 60, 61, 64, 67], and a questionnaire survey was conducted to analyze the results of the study. Semistructured interviews were then conducted with three scholars who had backgrounds in recreational sports, medical care, and health protection, as well as two elderly sports enthusiasts, to obtain their opinions on the analysis results. This paper was subsequently constructed in the order of induction, organization, and analysis in a rigorous manner [72]. Finally, a multidimensional approach was adopted to combine information from different research subjects, research theories, and methods by examining multiple data from multiple perspectives and comparing the results of different studies [73, 74], in order to obtain accurate knowledge and meaning.

6.1. Leisure Exercise Intensity. Although researchers have suggested that exercise intensity has an impact on health [60, 61, 63], for the elderly, higher intensity represents a greater level of commitment and dedication to exercise. As such, their bodies may no longer easily handle the intensity, and their enthusiasm may be compromised due to insufficient time and restricted environments during the epidemic. Moreover, the participants who did not exercise at all or exercised at a low intensity were constantly limited in space and time and had no proper way to relieve stress, making them more sensitive than others in terms of their physical and mental health. As a result, the enthusiasm of people with very high intensity, moderate to high intensity, and no exercise was affected. People who exercised at light, low, moderate, and very high intensities were pressured by time. It was also found that low-intensity exercise had the greatest psychological impact, while those who did not exercise had serious negative thoughts, as well as mental and physical health problems. Therefore, this study concluded that when the environmental pressure is high, the intensity of exercise may not have an impact on the improvement of the physical and mental health of the elderly, which was not entirely consistent with hypothesis 1.

6.2. Leisure Exercise Time. Studies have confirmed that long-term exercise planning can improve health [39, 64, 65], and it is believed that adequate exercise duration can improve health; however, because of the deterioration of physical and psychological performance and the reduced mobility of the elderly, the need for adequate time to engage in exercise may be restricted due to the current environmental pressure. In addition, those who did not exercise usually had few ways to relieve stress, and those who exercised for a short period had to take time away from work or family life to exercise. Due to the COVID-19 epidemic, the exercise environment is confined and exercise times are limited, which deprive people of finding relief. The enthusiasm of those who planned for one hour of exercise was most affected; those who planned for

30 minutes, one to three hours, or more than three hours felt the greatest pressure by the time, and those who did not exercise were likely to lose confidence and have suicidal thoughts. Furthermore, it was found that the psychological feelings and the mental and physical conditions of those who planned to exercise for more than three hours had the greatest influence, while those who did not exercise had the most obvious negative thoughts. Therefore, the present study concluded that as the amount of environmental stress increases, the duration of exercise may not be fully effective in improving the physical and mental health of the elderly.

6.3. Leisure Exercise Duration. Although regular exercise frequency can improve health [39], the elderly participants who had regular exercise frequency already included exercise as part of their daily life; however, their lives were affected by external environmental constraints and the limited time for leisure exercise. All these factors disrupted the existing planning and led to the shortening or even cancellation of exercise planning for the elderly. The enthusiasm of those who exercised once a week and those who did not exercise was affected the most, and the time pressure of those who exercised once a day and once a month was the most noticeable. It was also found that the effect of exercising once a month was most evident on the aspects of psychological feelings, negative thoughts, and mental and physical conditions. Therefore, the present study concluded that as the environmental stress level increases, the frequency of physical activity among the elderly does not have a direct correlation with the improvement of physical and mental health.

7. Conclusions and Suggestions

The research and investigation of this study found that when the elderly are in a high-risk social environment, although they may use sports apps to exercise, the intensity and time involved in exercise will be affected, but they will not change the frequency of exercise if it has become a daily habit. The elderly who exercise at intervals of one month are more physically and mentally stressed, but different exercise frequencies also result in different levels of physical and mental health problems; the lower the exercise intensity, the more obvious the negative emotions, the stronger or the less time they spend exercising, and the greater the exercise pressure they must face.

The following suggestions were proposed based on the aforementioned results.

7.1. For the Elderly. The elderly should combine their existing living environment with online exercise education courses to change the current exercise pattern and satisfy the demand and quality of exercise. They should also try to make up for the shortage of exercise time by planning intermittent exercise.

7.2. For the Government. In high-tension environments, governments should integrate local administrative manpower or work with community organizations to care for the

physical and mental health of those who are unwilling or unable to exercise.

7.3. For Future Studies. Future studies should attempt to understand the different types of exercise for individuals with different workout schedules and continue to explore the effects of high-tension environments on physical and mental health. Researchers should also continue to explore the issue by focusing on different regions, countries, or genders.

Data Availability

Data are available on request to the authors. The data source is obtained from the questionnaire analysis of the authors' research.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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