THE IMPACT OF INTELLIGENT SPORTS FACILITIES ON EXERCISERS' SATISFACTION WITH GYMS

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ABSTRACT

As public awareness of health continues to rise and living standards improve, fitness has become a crucial component of modern individuals' pursuit of a healthy lifestyle. This trend has driven the rapid development of the fitness industry, leading to the continuous upgrading and enhancement of various sports venues and fitness facilities. In this context, smart sports facilities, as a product of the integration of technology and fitness, have gradually entered the public eye and garnered widespread attention. This paper delves into the impact of personalized training programs, exercise data recording, and workout feedback within smart sports facilities on the satisfaction of fitness enthusiasts. Personalized training programs cater to the diverse needs and goals of exercisers by providing tailored workout plans and dynamically adjusting them to align with training progress, thereby significantly boosting the participants' enthusiasm and motivation. Exercise data recording quantifies workout effectiveness, visually displaying fitness outcomes, which encourages self-reflection and adjustment by the exercisers, ultimately enhancing their trust in and reliance on the sports venues. Workout feedback, delivered through real-time interactions, motivates exercisers to persist in their efforts while offering personalized guidance to enrich the fitness experience. Together, these three elements form an efficient, interactive, and personalized fitness experience loop that substantially elevates exercisers' satisfaction and sense of well-being. High satisfaction not only strengthens user retention but also contributes to the brand building and market expansion of sports venues, thereby fostering innovation and growth within the entire fitness industry. Consequently, sports venues should continue to increase their investment in and innovation of smart sports facilities to provide higher quality services and experiences.

Keywords: Sports Facilities; Exerciser Satisfaction

INTRODUCTION

In the technological wave of the 21st century, the integration and innovation of cutting-edge technologies such as information technology, artificial intelligence, and the Internet of Things are reshaping various industries at an unprecedented pace, and the sports industry is no exception. As public awareness of health increases and the quality of life improves, physical exercise has become an indispensable part of modern life (Tsai, 204). Sports venues, as essential spaces for physical exercise, have a direct impact on exercisers' satisfaction and loyalty through their service quality, facility configuration, and user experience, which, in turn, affects the sustainable development of the entire sports industry.

Smart sports facilities, as crucial carriers in the intelligent transformation of the sports industry, are gradually becoming key factors in enhancing the competitiveness of sports venues. These facilities not only integrate the latest technological elements, such as IoT sensors, big data analytics, and AI algorithms, but also deeply incorporate specialized knowledge from fields like sports science and ergonomics, providing exercisers with more personalized, efficient, and safe workout experiences (Li, 2021). From monitoring physiological indicators such as heart rate and step count through smart wearable devices to developing training plans tailored to individual physical conditions via smart fitness equipment, and optimizing resource allocation through intelligent venue management systems, smart sports facilities are fundamentally transforming how exercisers engage with fitness activities on multiple levels (Xiao, 2020). However, despite the significant potential of smart sports facilities to improve service quality and enhance user experience, the mechanisms by which they influence exercisers' satisfaction have not yet been fully explored. Exerciser satisfaction is a complex, multidimensional concept that encompasses not only the performance and comfort of hardware facilities but also the convenience of software services, the effectiveness of professional guidance, and the pleasantness of the environment (Tiggemann, 2000). Therefore, a thorough investigation of how smart sports facilities specifically affect exercisers' satisfaction is crucial for guiding the intelligent transformation of sports venues, optimizing resource allocation, and improving service quality.

Firstly, smart sports facilities can significantly enhance exercisers' workout experiences. Through real-time monitoring, data analysis, and personalized recommendations, these facilities accurately capture exercisers' physical states and needs, offering tailored training programs that make workouts more scientific, efficient, and enjoyable. This personalized experience not only improves workout outcomes but also enhances exercisers' engagement and sense of achievement, thereby increasing their satisfaction. Secondly, smart sports facilities can boost the interactivity and fun of workouts (Luo, 2021). In traditional fitness settings, exercisers often find themselves in relatively isolated situations with limited interaction and communication. Smart sports facilities, by incorporating advanced technologies such as virtual reality (VR) and augmented reality (AR), provide exercisers with rich interactive scenarios and entertaining elements, allowing them to enjoy more fun and challenges during their workouts. This increased interactivity and enjoyment not only attract more people to participate in physical exercise but also enhance their satisfaction and loyalty (Elnour, 2022).

Moreover, smart sports facilities improve the service quality and efficiency of sports venues. The application of intelligent access control systems, smart lockers, and smart surveillance enables venues to monitor and manage the flow of people, the use of equipment, and potential safety hazards in real time (Zhou, 2022). This intelligent management approach simplifies the entry process, enhances the convenience of accessing stored items, and promptly identifies and addresses safety issues, ensuring the safety and health of exercisers. Additionally, smart sports facilities can use big data analytics to deeply explore and analyze exercisers' behavior preferences and consumption habits, providing valuable data support for the operation and management of sports venues. These measures significantly enhance the service quality and efficiency of sports venues, thereby improving exercisers' satisfaction (Gao, 2019).

Furthermore, smart sports facilities promote the intelligent development of the sports industry. With the widespread application and popularization of these facilities, the sports industry is gradually building a new industrial ecosystem driven by data, centered on users, and characterized by intelligent services. In this ecosystem, sports venues will evolve from mere physical exercise spaces into comprehensive service platforms that integrate fitness, entertainment,

and social interaction. This transformation will not only drive innovation in the sports industry but also provide the public with higher-quality, more convenient, and efficient fitness services.

In summary, the impact of smart sports facilities on exercisers' satisfaction in sports venues is multifaceted and profound. They not only enhance the workout experience, increase interactivity and fun, and improve service quality and efficiency but also promote the intelligent development of the sports industry. Therefore, in-depth research into the mechanisms by which smart sports facilities affect exercisers' satisfaction is essential for driving the intelligent transformation of sports venues, improving service quality, and meeting the growing and diverse fitness needs of the public. This paper aims to systematically reveal these mechanisms through literature review, field research, and data analysis, providing scientific theoretical foundations and practical guidance for the intelligent development of sports venues.

REVIEW OF RELATED LITERATURE

Since Cardozo's pioneering work in 1965, which introduced the concept of customer satisfaction into the field of marketing management, this theoretical framework has rapidly transcended commercial boundaries, permeating the realm of public services, particularly in the field of public sports services, where it has demonstrated unprecedented vitality and influence. Scholars like Rha (2012) have emphasized the importance of a customer-oriented approach in government management, viewing the public as "customers." This shift has profoundly reshaped the logic and paradigm of public service delivery, driving a fundamental transformation from "government-centered" to "citizen-demand-oriented" approaches.

In the context of sports services, satisfaction serves as a core measure of service effectiveness, not only reflecting feedback on direct service elements such as sports facilities, event organization, and coaching quality but also encompassing a comprehensive assessment of social values such as fairness, accessibility, and inclusiveness throughout the service process (Mosimanegape, 2020). By regularly collecting and analyzing data on exercisers' satisfaction with sports services, managers can gain direct insights into which services are well-received and where improvements are needed, enabling targeted actions to continuously enhance service quality and efficiency. Simultaneously, the consideration of demand complements satisfaction evaluation, emphasizing the importance of understanding and responding to the public's desires for new sports services, innovative service models, and higher-level sports needs (Engdaw, 2020). A combined analysis of satisfaction and demand can reveal structural issues within the public sports service system, identify imbalances in resource allocation, and uncover potential areas for service innovation.

Through a differential analysis of satisfaction and demand for public sports services in Beijing, Liang (2016) found that while public demand for sports services is high, actual satisfaction levels are relatively low. In further research, Wei Lin et al. (2016) conducted a comprehensive evaluation of public sports service quality in large sports venues in Shanghai during public access hours using a public satisfaction index model. This study not only identified existing problems and shortcomings in the service provision of sports venues but also provided strong support for subsequent service improvements and enhancements. Concurrently, Chen and Qiu (2020) pointed out that the current evaluation system for venue operation reforms needs further refinement, advocating for the establishment of an evaluation index system guided by a sense of fulfillment to accurately reflect the extent to which public sports needs are met.

Some scholars have turned their research focus to specific groups and service content. For instance, Tan (2020) through a satisfaction factor analysis, studied the demand satisfaction of fitness enthusiasts with sports social instructors, offering insights for the fine-tuning of fitness

market services. These studies have not only enriched the research on public sports services but also provided more precise decision-making references for policymakers. Facing the challenges of an aging society, many scholars have also begun to focus on the sports service needs of the elderly. Xu (2021) et al., through the construction of a satisfaction evaluation index system for public sports service demand among the elderly, explored optimization paths for making public sports services more age-friendly. This research not only reflects humanitarian care and social responsibility but also injects new vitality into the sustainable development of the public sports service system.

To better evaluate and measure the satisfaction of sports participants, Theodorakis (2014) by comparing the effectiveness of different service evaluation models in Greek sports and fitness centers, found that satisfaction models have clear advantages when assessing sports services. Polyakova (2020) focusing on frequent gym users, researched the perceived quality of fitness services in public sports centers in the UK, finding a strong linear relationship between the importance attached to service quality factors by regular users and their perceived performance. The research by these scholars not only provided new perspectives and methods for evaluating sports services and promoted the continuous improvement and development of evaluation systems but also revealed the specific needs of regular users, offering robust support for the refined management of fitness services.

In the specific context of researching the impact of sports facilities on exercisers' satisfaction in sports venues, Zhang (2020), in their study of fitness groups in urban areas of Taiyuan, used a refined application of the Kano model to reveal that venue facilities and sports activity services, as the cornerstone of public sports services, play a crucial role in enhancing exercisers' satisfaction. They further detailed this finding by indicating that high-quality sports facilities, such as spacious and well-lit basketball courts, well-equipped gyms, and diverse activity areas, significantly enhance exercisers' experience and satisfaction, encouraging their continued participation in sports activities. Additionally, the convenience, maintenance condition, and safety features of facilities are critical factors influencing satisfaction, forming key dimensions in exercisers' overall evaluation of sports venues. On this basis, Zhu (2024) emphasized the dual benefits of optimizing public sports facilities: On the one hand, improving the quality and diversity of facilities directly enhances the appeal of sports services, meeting the needs of different age groups and interest groups, thereby raising the overall service level; on the other hand, such optimization can indirectly drive economic benefits, such as attracting more citizens to engage in physical exercise, which could, in turn, stimulate the development of surrounding businesses, restaurants, and other service industries, creating new growth points in sports consumption.

Drawing on observations from the use of sports facilities in the UK, Zhang Wei and Kang Le's research also prompts us to consider how to optimize facility allocation to better serve various demographic groups. In the UK, while adults and middle-income groups are the primary beneficiaries, this also highlights the need for future facility planning to pay greater attention to youth participation. This can be achieved by designing more sports programs and facilities suitable for young people and offering targeted guidance and incentives, thereby broadening the user base of sports facilities and promoting balanced development in national fitness. Additionally, the research by Zhu (2010) and Qiu (2011) provides a multidimensional perspective on enhancing participation in sports activities. Zhu (2010) emphasized that, beyond hardware conditions, improving students' understanding and awareness of sports knowledge and clarifying the benefits of physical activity are also vital pathways to increasing student participation in sports. Qiu (2011) further confirmed the foundational role of sports facility allocation in stimulating exercise behavior, suggesting that in facility construction, it is essential not only to focus on quantity and

scale but also to emphasize scientific layout, functional completeness, and human-centered design to maximize the satisfaction of exercisers' diverse needs and enhance their satisfaction and loyalty.

Research Hypothesis

Personalized Training Programs refer to targeted training plans designed for exercisers based on individual differences (such as age, gender, weight, fitness level, health status, exercise preferences, etc.) through intelligent algorithm analysis (Sui, 2018). These programs not only include specific types of exercises, intensity, and duration but may also offer dietary suggestions, recovery strategies, and other comprehensive support. Personalized training programs precisely match the needs and goals of exercisers, making the workout process more efficient, enjoyable, and challenging, which is expected to significantly enhance exercisers' satisfaction (Huang, 2024). Specifically, customized training plans can reduce ineffective exercise and improve workout outcomes; at the same time, training content designed according to personal preferences can increase the enjoyment and motivation of the workout process, enhancing the pleasure experienced during exercise. Additionally, the convenience provided by smart sports facilities (such as automatic data recording, real-time feedback, etc.) also helps to improve overall satisfaction. Therefore, the research hypothesis is proposed:

H1: Personalized training programs provided by smart sports facilities have a significant positive impact on exercisers' satisfaction.

Exercise Data refers to various quantitative information about exercisers' behaviors collected through smart sports facilities (Xiong, 2024). This data is objective, accurate, and real-time, providing a comprehensive reflection of the exerciser's physical state and performance. The exercise data provided by smart sports facilities allows exercisers to clearly understand their progress, effectiveness, and potential issues (Ha, 2024). This quantitative feedback helps enhance exercisers' self-awareness and self-management capabilities, thereby improving their satisfaction. On the one hand, by comparing data over time, exercisers can intuitively see their progress and achievements, boosting their confidence and motivation; on the other hand, data feedback can help exercisers promptly identify and correct incorrect exercise methods or bad habits, preventing injuries and improving exercise safety and effectiveness. Therefore, the research hypothesis is proposed:

H2: Exercise data provided by smart sports facilities have a significant positive impact on exercisers' satisfaction.

Exercise Performance Feedback refers to the comprehensive evaluation and suggestions provided by smart sports facilities regarding an exerciser's performance, progress, and goal achievement based on the analysis of exercise data (Hou, 2023). This feedback is targeted, timely, and constructive, offering valuable reference information for exercisers. The exercise performance feedback provided by smart sports facilities can directly reflect the results of the exerciser's efforts and progress, thereby enhancing their sense of achievement and confidence (Zhou, 2022). When exercisers see that their efforts are recognized and can clearly observe the progress they have made, they are often more satisfied with their exercise experience. Moreover, exercise performance feedback can help exercisers adjust their training plans in a timely manner, avoiding ineffective workouts and improving workout efficiency, further enhancing their satisfaction. Therefore, the research hypothesis is proposed:

H3: Exercise performance feedback provided by smart sports facilities has a significant positive impact on exercisers' satisfaction.

METHODOLOGY

When exploring complex phenomena in the social sciences and humanities, researchers often distinguish between two primary research approaches: quantitative research and qualitative research. Quantitative research, also known as measurement or quantitative analysis, focuses on the precise measurement and analysis of numerical characteristics using mathematical tools and statistical methods. This approach not only forms one of the foundational paradigms of social science research but also serves as an indispensable technique for advancing scientific progress. It emphasizes the collection, processing, and analysis of data to uncover relationships, trends, and causal connections among variables, providing a quantified basis for decision-making.

In contrast, qualitative research is a method for deeply exploring the essential attributes of phenomena. It relies on logical reasoning, philosophical reflection, historical investigation, and regulatory analysis, among other perspectives, to qualitatively and deeply analyze the research object. Qualitative research is particularly important in fields like communication studies and other humanities, as it helps researchers understand the meanings, motivations, and cultural contexts behind phenomena. This approach is an extension and application of traditional humanistic research methods in the modern academic domain.

In practice, both research methods share the common analytical strategy of comparison and contrast. They use horizontal comparisons of different indicators or longitudinal tracking of the same indicator over different time points to reveal the multidimensional characteristics of phenomena, such as scale, quality level, efficiency differences, resource consumption, and development speed. This provides robust information support for evaluation and decision-making. It is important to note that while quantitative research is known for its rigor and scientific nature, it requires researchers to have a solid foundation in mathematics and statistics. On the other hand, qualitative research demonstrates flexibility when data is insufficient or mathematical ability is limited, but its conclusions may be broader and lack precise quantification.

Therefore, in actual research, there is a growing trend to combine qualitative and quantitative methods to leverage their complementary strengths, aiming for a more comprehensive and in-depth understanding. Given that this paper aims to explore the internal connections between smart sports facilities and exercisers' satisfaction with sports venues, considering the complex relationships involving psychological, cultural, and behavioral aspects, we have chosen the quantitative research method as the primary analytical tool. Through precise data collection and analysis, this approach seeks to uncover the quantitative relationships between these variables, contributing new insights to both theory and practice in the relevant field.

DATA COLLECTION

The research question addressed in this study focuses on the impact of smart sports facilities on exercisers' satisfaction with sports venues, specifically targeting individuals with prior experience in gym or sports venue exercise. The questionnaire is designed to ensure that questions are clear, concise, and free from ambiguity, allowing respondents to easily comprehend and accurately respond. By concentrating on individuals with gym experience, the survey aims to collect data that is both representative and relevant. Utilizing the Wenjuanxing platform, which is efficient for designing and distributing online questionnaires, enables broad participation through multiple channels, such as social media platforms like WeChat, Weibo, and Douyin, direct promotion on gym websites, and targeted email distribution. This approach not only enhances the response rate but also increases the diversity of the sample. Following data collection, a rigorous data cleaning and organization process will be conducted to eliminate any invalid or duplicate

responses, thereby ensuring that the subsequent analysis is based on accurate and reliable data, which in turn provides a solid foundation for the study's conclusions.

In the execution of the survey process, the core importance of ethical principles cannot be overstated. These principles encompass voluntariness, informed consent, data confidentiality, and anonymity. The design and implementation of this study strictly adhere to these ethical standards to ensure the legitimacy of the research process and the full protection of respondents' rights. Firstly, and most importantly, the questionnaire content is meticulously designed to ensure that all questions avoid potentially sensitive areas that could negatively impact the respondents' psychological well-being, thereby creating a safe and pressure-free participation environment. Secondly, regarding the guarantee of informed consent, the introduction of the questionnaire clearly and explicitly outlines the purpose, significance, and potential implications of the research, allowing each respondent to make an informed decision about their participation. We respect the autonomy of every participant, emphasizing that their involvement is entirely voluntary, without any coercion or inducement. Lastly, concerning confidentiality and anonymity, a series of strict measures are implemented. All collected information is processed anonymously to ensure that respondents' identities remain undisclosed. Furthermore, we commit that the collected data and the conclusions drawn from it will be used exclusively for academic research and educational purposes, with access strictly controlled to prevent unauthorized disclosure.

DATA ANALYSIS PROCEDURE

After collecting the survey responses, data processing will be conducted on the valid samples, followed by data analysis using statistical software. The analytical methods employed include descriptive statistics, correlation analysis, and regression analysis.

1) Descriptive Statistical Analysis

Descriptive statistics serve as the foundation of data analysis, offering an intuitive overview of the overall characteristics and distribution of the sample data by calculating statistical measures such as mean, standard deviation, frequency distribution, and percentage. In this study, an initial descriptive statistical analysis was performed to summarize fundamental information such as the total number of survey responses and the proportion of valid questionnaires. Subsequently, a detailed description of the respondents' demographic characteristics (e.g., gender, age, exercise frequency) was provided to understand the basic composition of the participants. Regarding smart sports facilities, the frequency of use and satisfaction ratings for various facilities were also calculated to reveal their prevalence and popularity among exercisers. Lastly, the description of satisfaction with sports venues was analyzed to assess the overall level of satisfaction among the respondents.

2) AMOS Path Analysis

To gain a deeper understanding of the specific impact of smart sports facilities on exercisers' satisfaction with sports venues, a multiple regression model was employed for further analysis. Satisfaction was considered the dependent variable, while the use of smart sports facilities (such as usage frequency and satisfaction ratings) and other potential factors affecting satisfaction (such as personal characteristics and exercise habits) were treated as independent variables. Path analysis was conducted using AMOS 23.0 to estimate the influence of each independent variable on the dependent variable and to test the significance of these effects. This step not only reveals the overall impact of smart sports facilities on satisfaction but also helps identify other key factors that may influence satisfaction.

RESULTS AND DISCUSSION

The incorporation of intelligent sports facilities within gym environments marks a substantial leap forward in the realm of fitness, offering the potential for improved user experiences by way of customized training regimens, meticulous tracking of exercise data, and instantaneous feedback mechanisms. These cutting-edge technologies are meticulously crafted to address the unique requirements of each individual, thereby maximizing the efficacy of workout routines and furnishing valuable, actionable information regarding one's exercise patterns. Nevertheless, despite the increasingly prevalent deployment of these smart technologies in fitness centers, there remains a scarcity of concrete, empirical data that definitively illustrates their true influence on the satisfaction levels of gym-goers with respect to the facilities they utilize.

The primary objective of this research is to address the existing disparity in knowledge regarding the impact of intelligent sports facilities on the satisfaction levels of individuals who regularly use gym facilities. To achieve this, the study meticulously evaluates a multitude of intelligent sports facility aspects and their influence on the overall satisfaction of gym-goers. This evaluation encompasses an in-depth examination of how personalized training plans are crafted and implemented, the efficiency with which exercise data is collected and utilized, and the manner in which workout feedback is provided to users. By doing so, the research aims to construct a comprehensive framework that elucidates the extent to which these specific factors contribute to enhancing the overall exercise experience.

To conduct this evaluation, the study relies on a detailed analysis of survey data meticulously gathered from a diverse group of gym users. These surveys are designed to capture a wide range of user experiences and opinions regarding the technological features integrated into intelligent sports facilities. By scrutinizing this data, the research seeks to identify and understand the intricate relationships between these technological features and the levels of satisfaction reported by exercisers. The ultimate goal is to offer valuable insights that can guide future improvements in both gym services and the adoption of technology within the fitness industry. These insights could potentially lead to the development of more effective strategies for leveraging intelligent sports facilities to maximize user satisfaction and promote a more engaging and effective exercise environment.

Descriptive Statistics

This particular survey managed to gather a total of 320 participants, with a significant majority being male, accounting for 65.63% of the respondents, while females constituted 34.38% of the total. This noticeable gender imbalance could potentially indicate a higher level of activity or a greater willingness among men to participate in surveys within specific fields or interest groups. When examining the age distribution of the participants, it was observed that the majority of the sample was composed of young adults falling within the age range of 18 to 25 years old. This particular age group represented a substantial 56.25% of the respondents. This finding suggests a robust interest and active engagement in health and fitness topics among the younger generation. Conversely, as the age of the participants increased, the number of individuals participating in the survey tended to decrease. Those over the age of 41 years old made up a mere 6.56% of the sample. This trend might be influenced by various factors such as life pressures, differing interests, and varying levels of access to information across different age groups.

When examining the exercise habits of individuals, the findings from the survey painted a picture of a varied landscape in terms of physical activity. A significant portion of the people

surveyed, which amounted to 57.81%, indicated that they engaged in exercise 0-1 times per week. This particular statistic is somewhat alarming because it implies that a substantial majority might not be participating in enough physical activity to sustain their health and well-being. On the flip side, a much smaller fraction of the participants, specifically 10.94%, reported exercising an impressive 6-7 times per week. This group demonstrated a commendable dedication to physical fitness, essentially committing to a near-daily exercise routine and setting a benchmark for what could be considered an exemplary healthy lifestyle. Interestingly, the general consensus suggests that exercising 2-3 times per week is a moderate yet advantageous frequency for maintaining good health. However, only 23.44% of the respondents adhered to this guideline, thereby emphasizing the necessity for the broader population to enhance their exercise routines and strive for healthier habits.

With the rapid advancement of technology, smart facilities in gyms are gradually becoming a key force in promoting personalized health management. In the areas of personalized training programs, exercise data tracking, and workout feedback, smart facilities have shown significant potential but also face challenges in adoption and acceptance. Personalized training programs, as a hallmark of the integration of technology and health, are gradually transforming the way people exercise. However, this survey uncovered a noteworthy phenomenon: despite the high regard for personalized training plans due to their precision and efficiency, only 40.94% of respondents indicated that their gym was utilizing such plans. This figure suggests that while there is considerable market interest, significant obstacles remain in the broader implementation of these programs, such as high costs, public awareness, and operational complexity.

Driven by the wave of digitalization, exercise data has become an important tool for evaluating workout effectiveness and optimizing training plans. In this survey, 50.31% of respondents reported paying attention to and using exercise data to track their workout progress in the gym. Feedback from workouts serves as a crucial link between exercise behavior and performance adjustments. In this survey, 65.94% of respondents indicated that they received workout feedback, a relatively high proportion, yet a notable segment (34.06%) reported that they did not receive or were not particularly concerned with feedback. For this group, the lack of feedback might prevent them from understanding their workout status in a timely manner, thereby affecting their motivation and effectiveness in exercising.

Regarding overall satisfaction with their workouts, the majority of respondents (46.56%) reported a moderate level of satisfaction, while only a small percentage (7.81%) expressed being very satisfied or very dissatisfied. This outcome suggests that there is considerable room for improvement in enhancing the exercise experience and meeting personalized needs. By providing more accurate and personalized exercise guidance and feedback mechanisms, as well as continuously optimizing workout environments and facility conditions, more people can be encouraged to enjoy the benefits and pleasure of healthy exercise.

Table 1 Demographic Statistics

Demographics	Categories	Frequency number	Percentage
Gender	Male	210	65.63%
	Female	110	34.38%
Age	18-25 years	180	56.25%
	26-33 years	79	24.69%
	34-41 years	40	12.50%
	Over 41 years	21	6.56%

Exercise Frequency	0-1 times/week	185	57.81%
	2-3 times/week	75	23.44%
	4-5 times/week	25	7.81%
	6-7 times/week	35	10.94%
Personalized Training Plan	Yes	131	40.94%
	No	189	59.06%
Exercise Data	Yes	161	50.31%
	No	159	49.69%
Exercise Feedback	Yes	211	65.94%
	No	109	34.06%
Exercise Satisfaction	1(Very low)	28	8.75%
	2(Low)	38	11.88%
	3(Average)	149	46.56%
	4(High)	80	25.00%
	5(Very high)	25	7.81%

Reliability test

Reliability is a key indicator used to assess the stability, consistency, and accuracy of a measurement tool in capturing the true characteristics of the object being measured. At its core, reliability evaluates the degree of consistency between repeated measurements of the same object. This concept emphasizes internal consistency, which is quantified by examining the degree of agreement between different measurement attempts. The level of reliability is directly related to the presence and magnitude of random errors. Theoretically, if the results of two or more measurements show a high degree of consistency, it indicates that random errors are effectively controlled, resulting in a high reliability value for the test. In other words, the level of reliability reflects the extent to which measurement results are affected by random fluctuations, making it an essential component in evaluating measurement quality. To quantify this indicator, the reliability coefficient is introduced as an evaluation standard, with its value ranging from 0 to 1. The closer the coefficient is to 1, the stronger the consistency, stability, and reliability of the measurement results, indicating higher reliability of the test. Conversely, a lower value suggests the presence of significant random errors or systematic biases in the measurement process, affecting the reliability of the results.

In academic practice, Cronbach's alpha has become a widely recognized standard for assessing the reliability of questionnaires. Specifically, when the Cronbach's alpha value reaches or exceeds 0.9, it indicates excellent reliability of the questionnaire; a value below 0.6 is considered insufficient in terms of internal consistency, suggesting that the researcher should reevaluate the questionnaire design or data collection methods; values between 0.6 and 0.8, while acceptable, still offer room for improvement; and a value of 0.8 or higher is generally regarded as a reliable level of consistency, sufficient to meet the needs of most research studies.

Table 2 shows the reliability of each scale in this questionnaire based on Cronbach's alpha. The results indicate that the Cronbach's alpha value for each factor exceeds 0.8. Therefore, this suggests that all factors are reliable and exhibit strong internal consistency.

Table 2 Reliability Statistics

Scales	Cronbach's
Smart Sports Facilities	0.931

Exercise Satisfaction	0.917

Validity test

Validity typically refers to the effectiveness and accuracy of a questionnaire, meaning the extent to which a questionnaire measures the characteristics it is intended to measure. The goal of a survey questionnaire is to achieve high validity in measurement and conclusions. The higher the validity, the more accurately the questionnaire results represent the behaviors it aims to assess, thereby fulfilling the purpose of the questionnaire, making it correct and effective. The accuracy or validity of a questionnaire is characterized by its validity, which reflects the degree of control over systematic errors in the questionnaire.

Convergent Validity reflects the degree of correlation between different items within the same scale. Specifically, it can be tested using three indicators: Average Variance Extracted (AVE), Composite Reliability (CR), and factor loadings. If AVE > 0.5, CR > 0.7, and factor loadings > 0.7, it indicates that the scale has good convergent validity. As shown in the table, the CR, factor loadings, and AVE values for all variables are greater than 0.7, indicating that the scales used in this study meet the requirements for convergent validity.

Table 3 Convergent Validity

Construct	Item	Factor Loading	AVE	CR
Smart Sports Facilities	A1	0.910	0.81	0.96
	A2	0.907		
	A3	0.916		
Exercise Satisfaction	B1	.785	0.64	0.91
	B2	.887		
	B3	.844		

Discriminant Validity refers to the degree of difference between variables. The main criterion for testing discriminant validity is to compare the square root of the AVE values of each variable with the correlation coefficients between variables. If the square root of a variable's AVE is greater than its correlation with other variables, it indicates that the scale has good discriminant validity. From the test results shown in the table, it is evident that the square root of the AVE values for all variables is greater than their correlations with other variables, demonstrating that the scale has good discriminant validity. Based on these test results, the questionnaire is of high quality and is suitable for the next step of path analysis.

Table 4 Discriminant Validity

	Smart Sports Facilities	Exercise Satisfaction
Smart Sports Facilities	0.90	
Exercise Satisfaction	0.471**	0.80

Note(s): CR, composite reliability; Italic diagonal elements are the square root of AVE; $p < 0.05$

** *** $p < 0.01$; $p < 0.001$

The AMOS 23.0 test results are shown in the figure. The results of the structural model test are presented in Table 8. The findings of the study indicate that the personalized training plans

provided by smart sports facilities have a significant impact on exercisers' satisfaction ($\beta1 = 0.25$, $p < 0.01$), supporting Hypothesis H1. The exercise data provided by smart sports facilities have a significant impact on purchase intention ($\beta1 = 0.42$, $p < 0.01$), supporting Hypothesis H2. The feedback on exercise performance provided by smart sports facilities also has a significant impact on exercisers' satisfaction ($\beta1 = 0.42$, $p < 0.01$), supporting Hypothesis H3.

Table 5 Path Coefficients

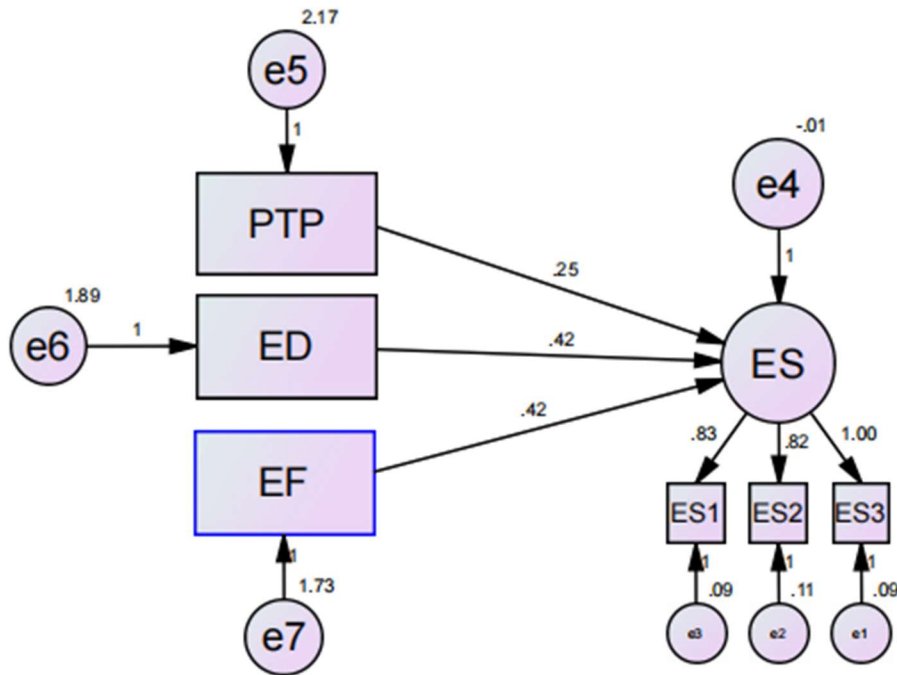| Hypothesis	Path	Path coefficient	P-values	Result
H1	Personalized Training Plan--Exercise Satisfaction	0.25	p＜0.01	Accepted
H2	Exercise Data--Exercise Satisfaction	0.42	p＜0.01	Accepted
H3	Exercise Feedback--Exercise Satisfaction	0.42	p＜0.01	Accepted

Figure 1 Results of path analysis

CONCLUSION

Based on the empirical analysis presented, it is evident that personalized training programs, exercise data recording, and feedback from intelligent sports facilities significantly positively impact exercisers' satisfaction.

The primary advantage of personalized training programs lies in their ability to tailor training plans according to each exerciser's physical condition, exercise capabilities, interests, and specific goals (such as fat reduction, muscle gain, or physical fitness improvement). This precise

customization not only enhances the relevance and effectiveness of the training but also greatly stimulates the exerciser's engagement and motivation. For exercisers aiming for specific fitness outcomes, seeing their efforts directly aligned with their goals undoubtedly increases their satisfaction with the sports facility (Slade, 2010). Intelligent systems can also dynamically adjust training programs based on exercisers' progress and feedback. For instance, by monitoring physiological indicators such as heart rate and strength output, the system can automatically assess the exerciser's fatigue and recovery status, adjusting the training intensity and content as needed to prevent overtraining or insufficient training (Philips, 2001). This flexibility and adaptability provide a more considerate and professional service, further enhancing satisfaction and loyalty to the sports facility. Facilities should establish a comprehensive user information management system, collecting detailed information about exercisers through surveys, health check-ups, and fitness assessments. This information should include, but not be limited to, age, gender, weight, body fat percentage, exercise experience, health status, personal interests, and specific fitness goals. Utilizing big data analytics to deeply mine this information can help construct user profiles, enabling precise customization of training programs. Each training plan should be targeted, scientific, and sustainable to ensure that each exerciser receives the most suitable training regimen. Personalized training programs should not be static but dynamically adjusted based on the exerciser's physical condition, progress rate, and feedback (Perry, 2002). Facilities should introduce advanced intelligent assessment systems to monitor exercise data in real-time, such as heart rate, blood pressure, and muscle activity, integrating performance metrics and video analysis to make intelligent adjustments to training plans. For example, if the system detects excessive fatigue or a plateau in performance, it should promptly adjust the training intensity and content to ensure the program continuously matches the exerciser's actual needs and physical state (Gunnell, 2012).

The implementation of personalized training plans requires professional guidance and support from coaches. Facilities should enhance the professional training of their coaching teams, improving their expertise in sports science, nutrition, psychology, and other relevant areas. Coaches should be proficient in using intelligent sports facilities and be able to provide personalized guidance and recommendations based on user profiles and training plans. Additionally, establishing a robust communication mechanism between coaches and exercisers is crucial, encouraging exercisers to actively provide feedback on their training experiences and needs so that coaches can timely adjust the training plans to meet individual requirements.

Recording exercise data is a vital means of quantifying training outcomes. The data recorded by intelligent devices (such as steps, calorie expenditure, exercise duration, speed, distance, etc.) allows exercisers to clearly see their progress trajectory (LaCaille, 2004). These specific and detailed data not only affirm the efforts made but also serve as a motivational source for continued progress. When exercisers see improvements in their performance or achieve specific milestones, their satisfaction with the sports facility naturally increases. The recording of exercise data also facilitates self-reflection and adjustment. By analyzing the data, exercisers can identify their strengths and weaknesses, understand their performance differences under various exercise modes, and thus target their training or adjust strategies accordingly (Downs, 2008). This data-driven self-assessment and optimization process not only enhances training effectiveness but also gives exercisers a sense of continuous improvement and refinement, thereby increasing their trust and reliance on the sports facility.

Facilities should integrate various intelligent devices to establish a unified exercise data recording system. This system should comprehensively record exercisers' data, including but not

limited to, steps, calorie expenditure, exercise duration, speed, distance, heart rate, and blood pressure (Unger, 1995). The system must also be highly accurate and stable to ensure the authenticity and reliability of the data recorded. Exercisers should be able to view their exercise data at any time via mobile apps, smart wristbands, wearable devices, etc., to track their progress and achievements. Exercise data is not only a testament to the exerciser's efforts but also a valuable resource for optimizing training plans and improving service quality. Facilities should strengthen the deep analysis of exercise data using big data and artificial intelligence technologies to uncover valuable insights. For example, by analyzing exercisers' exercise habits, physical changes, and disease risks, facilities can predict potential future trends and needs; by comparing exercise data across different groups, common issues and individual differences can be identified to inform the development of more scientific and reasonable training plans. Converting complex exercise data into intuitive and comprehensible charts and reports is crucial for enhancing exerciser satisfaction. Facilities should provide personalized exercise data report services, including weekly/monthly/annual summaries, physical fitness assessment reports, and performance comparison charts. These reports should clearly present exercisers' achievements and progress, making it easy for them to see their results and future directions. Additionally, reports should include targeted recommendations and guidance to help exercisers better plan their fitness journey.

Immediate feedback from intelligent sports facilities is a key factor in motivating exercisers to persist in their efforts. Whether through voice prompts, screen displays, or mobile app notifications, exercisers receive timely evaluations and suggestions about their performance. This immediate positive feedback (e.g., "You're doing great, keep it up!") or constructive feedback (e.g., "Try adjusting your breathing rhythm to improve exercise efficiency") effectively stimulates exercisers' enthusiasm and confidence, encouraging them to engage more fully in their workouts. Beyond basic feedback, intelligent systems can provide personalized guidance and recommendations based on specific performance metrics (Cheon, 2020). For instance, during strength training, the system might suggest adjustments based on strength output and movement accuracy; during aerobic exercises, it could recommend changes in exercise intensity based on heart rate fluctuations. This personalized guidance not only enhances the scientific and safe nature of the training but also provides a more thoughtful and professional service experience, further improving satisfaction with the sports facility. The core of effective feedback lies in its efficiency and accuracy (Tsitskari, 2014). Facilities should invest in advanced sensor technology and data analysis algorithms to ensure that intelligent sports facilities can monitor exercisers' exercise states in real-time and provide timely feedback. This feedback could be direct voice prompts, such as "Your form is correct, keep it up!" or "Your strength output is slightly insufficient, try increasing the intensity," or screen displays showing heart rate curves and strength output charts, allowing exercisers to see their performance visually. Mobile app notifications can also provide detailed exercise reports post-workout, including exercise duration, calorie expenditure, average heart rate, and other key data, further deepening the understanding of their exercise status. Providing only basic immediate feedback is insufficient; facilities should also strive to achieve a deep integration of personalized feedback and guidance. By collecting and analyzing exercisers' exercise data, intelligent systems can develop personalized feedback reports and recommendations. These recommendations should cover not only training plan optimization but also specific training methods, dietary advice, and rest arrangements, providing comprehensive support for exercisers to achieve their fitness goals. For example, for exercisers aiming to increase muscle mass, the system might suggest increasing the proportion of weight training and recommend nutritional supplements that aid muscle growth; for those seeking fat loss, the system would emphasize the

importance of aerobic exercise and provide corresponding intensity and duration suggestions. Besides technical support, facilities should also focus on the development and operation of interactive communities. An active community can enhance communication and connection among exercisers and stimulate their enthusiasm and motivation. Within the community, exercisers can share fitness insights and success stories or seek advice from other members or experts. To boost the community's appeal and cohesion, facilities could regularly organize expert lectures, online guidance sessions, and challenge competitions. These activities not only provide opportunities for learning and growth but also offer a sense of warmth and support from the community. Additionally, facilities can leverage social media and other channels to expand the community's influence. By publishing high-quality fitness content and organizing online interactive activities, they can attract more potential users to join the community and gradually build brand recognition. This approach will not only increase satisfaction and loyalty among existing exercisers but also continuously expand the user base, ensuring sustainable development.

Research Limitations

Sample Representation: The study's sample may not fully represent the diverse population of fitness enthusiasts, particularly in terms of geographic location, socioeconomic status, and cultural background. The findings might be biased towards certain demographics, limiting the generalizability of the results.

Self-Reported Data: The research relies on self-reported data from survey participants, which can be subject to biases such as social desirability, recall bias, and inaccuracies in self-assessment. These factors might affect the reliability of the data regarding satisfaction levels and the usage of smart sports facilities.

Technological Variability: The study does not account for the variability in the types and quality of smart sports facilities across different gyms. Variations in technology implementation and maintenance could influence user experiences and satisfaction differently, which might not be fully captured in the research.

Short-Term Perspective: The research focuses on a snapshot of user experiences and satisfaction without considering long-term effects. The impact of smart sports facilities on satisfaction and user behavior might evolve over time as users become more familiar with the technology and as technological advancements occur.

Limited Scope of Variables: While the study examines personalized training programs, exercise data recording, and workout feedback, other factors influencing user satisfaction, such as facility ambiance, staff interactions, and overall gym environment, are not considered. These factors might also play a significant role in shaping the overall user experience.

Future Research Directions

Diverse Sampling: Future studies should aim for a more representative sample by including participants from various geographic regions, socioeconomic backgrounds, and cultural contexts. This approach would provide a more comprehensive understanding of the impact of smart sports facilities on diverse populations.

Longitudinal Studies: Conducting longitudinal studies would allow researchers to track changes in user satisfaction and behavior over time. This approach would provide insights into the long-term effects of smart sports facilities and how user experiences evolve with sustained use and technological advancements.

Comparative Analysis: Future research could benefit from comparing different types of smart sports facilities and their specific features. Analyzing how various technologies and

implementations affect user satisfaction could provide valuable insights for optimizing facility design and service delivery.

Additional Variables: Expanding the scope of research to include other influencing factors, such as facility ambiance, staff interactions, and overall gym environment, would provide a more holistic view of the factors contributing to user satisfaction. This comprehensive approach could help identify additional areas for improvement.

Impact on Different User Groups: Investigating how smart sports facilities impact various user groups, such as different age demographics, fitness levels, and personal goals, could offer more targeted recommendations for facility design and service provision. Understanding the needs and preferences of diverse user segments could enhance the effectiveness of smart sports facilities in meeting varied fitness goals.

By addressing these limitations and exploring these future research directions, scholars can further enrich the understanding of how smart sports facilities influence user satisfaction and contribute to the advancement of the fitness industry.

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