RESEARCH ON THE CORE FUNCTIONAL REQUIREMENTS AND USAGE PATTERNS OF BADMINTON CONSUMERS FOR SMART WEARABLE DEVICES

Yi Qi
Graduate School, Suan Sunandha Rajabhat University, Thailand
E-mail: s66567809025@ssru.ac.th
Pordee Sukpun
Graduate School, Suan Sunandha Rajabhat University, Thailand
E-mail: pordee.su@ssru.ac.th

Abstract

This study explores the core needs and usage patterns of badminton consumers regarding smart wearable devices, employing the Five-Stage Model in Consumer Behaviour and the Theory of Planned Behavior (TPB) as theoretical frameworks. The Five-Stage Model explains the sequential decision-making process of consumers, from need recognition to post-purchase behavior, which is crucial for understanding how badminton players adopt smart wearables. Meanwhile, TPB provides insights into how attitudes, subjective norms, and perceived behavioral control influence the intention and actual adoption of such devices in badminton training and gameplay. The subjects were adult athletes who participate in badminton activities at least once a week, with in-depth interviews conducted using the interview method with 30-40 badminton consumers. The results show that consumers core needs extend beyond health monitoring to include improvements in technical skills. Additionally, usage patterns should differentiate between basic equipment and specialized accessories to meet various requirements. This study provides theoretical support for the application of smart wearable devices in the field of badminton.

Keywords: Badminton consumers, smart wearable devices, The Five-stage Model in Consumer Behaviour

Introduction

With the rapid advancement of digital technology, smart wearable devices have become essential for monitoring health and improving athletic performance. In badminton, these devices, including smartwatches, fitness trackers, and specialized sensors, provide precise data and influence both training and purchasing habits. However, despite the wide range of available products, there is a lack of systematic research on whether their functions and usage patterns align with consumer needs (Gomes, G. M., Moreira, N., & Ometto, A. R. 2022).

The adoption of smart wearable devices began with fitness tracking but has evolved into advanced sports analytics through artificial intelligence, big data, and IoT technologies. In badminton, specialized sensors track key performance metrics like racket swing speed, number of hits, and heart rate, enhancing training effectiveness. However, two major issues persist: function compatibility—whether current designs truly meet players' needs—and usage variability—how different player levels and participation frequencies influence device selection. Existing research mainly focuses on public health and professional athletes, with limited attention to amateur and semi-professional players, leading to a gap between market supply and demand and hindering user experience optimization.

Understanding badminton consumers' preferences for smart wearables is crucial for both product development and market optimization. Identifying core consumer needs enables manufacturers to refine device designs, improve competitiveness, and cater more effectively to

different segments of the badminton market.Promote scientific training and health management: By analyzing usage patterns and functional preferences, personalized and scientific training suggestions can be provided for badminton players, and at the same time help them achieve their health goals (Xu, F., & Zhu, W. 2024).

The potential benefits of research The findings of this study not only help equipment manufacturers more accurately identify user needs but also provide guidelines for badminton players on selecting and using equipment. At the same time, the research conclusions are expected to be widely applied in educational training institutions, the fitness industry, and the smart sports equipment market, contributing to the modernization and digital development of badminton.

Research Objectives

1. Explore the demand preferences of badminton consumers for core functions of smart wearable devices
2. Analyze the usage patterns of different types of smart wearable devices by badminton consumers

Scope of the Research

1. Population range：The target population for this study consists of adult badminton enthusiasts who actively participate in the sport (aged 18 and above). The study will cover participants ranging from casual lovers to amateur and potential semi-professional levels, with a requirement of playing badminton at least once a week. These individuals represent consumer groups with higher demand for smart wearable devices. This study excludes professional badminton players who are active in international top-level competitions and those who play less than once a week, as their consumption needs and behavioral patterns do not align with the focus of this study.
2. Variable range: types of smart wearable devices and their core functions. Consumers perceived usefulness, perceived ease of use, subjective norms and behavioral intentions of the device. Badminton consumers preference for the functions of smart wearable devices, selection behavior and usage mode.
3. Time frame: Data collection and research analysis will be concentrated from January to March 2025 to ensure the timeliness and validity of the data.

Literature Review

As intelligent technology and the Internet of Things advance, smart wearable devices are gradually becoming important tools for promoting sports and health management. These devices integrate sensor technology, big data analysis, and wireless communication functions, providing users with real-time motion data feedback and health monitoring services. In the field of sports, smart wearable devices have been widely applied to various activities such as running, swimming, and soccer, gradually driving the training and data analysis in sports into an era of intelligence and personalization. In badminton, the application of smart wearable devices is also showing a growing trend, offering scientific training support to athletes by monitoring indicators like shot data, racket speed, and movement trajectories (Edriss, S., Romagnoli, C., Caprioli, L., Zanela, A., Panichi, E., Campoli, F., ... & Bonaiuto, V. 2024).

The functions and technological development of smart wearable devices

Smart wearable devices have evolved from simple fitness trackers to comprehensive devices integrating multiple functions. These devices can monitor basic data such as heart rate, steps taken, and calorie consumption in real time, and further expand to high-precision motion

analysis capabilities. (Prieto-Avalos, G., Cruz-Ramos, N. A., Alor-Hernandez, G., Sánchez-Cervantes, J. L., Rodriguez-Mazahua, L., & Guarneros-Nolasco, L. R. 2022). For example, devices designed for badminton can track key metrics like the number of strokes, racket speed, trajectory distribution, footwork patterns, and coverage distance . Through data recording and analysis, these devices help badminton players evaluate the efficiency of their techniques and provide optimization suggestions for training programs.

Users acceptance and use of smart wearable devices

User acceptance and usage of smart wearable devices are influenced by multiple factors. Among these, perceived usefulness and perceived ease of use are two key variables that affect user behavior. Users typically prefer devices that can significantly enhance physical performance or provide important health data, which highlights the impact of perceived usefulness. The ease of operation, user-friendly interface, and compatibility with other devices determine users evaluation of perceived ease of use. Additionally, behavioral intentions and subjective norms also play a crucial role in user behavior; for example, the influence of social circles and increased personal health awareness can increase users willingness to purchase and their frequency of use(Islam, M. S., Tan, C. C., Sinha, R., & Selem, K. M. 2024).

Research on badminton consumers shows that the specificity of device functions has a significant impact on user behavior. Casual enthusiasts tend to use easy-to-operate and reasonably priced devices, such as fitness bands or smartwatches, while semi-professional athletes pay more attention to the professionalism and precision of the equipment, such as dedicated badminton sensors that can record swing speed and shot trajectory(da Silva, L. 2024).

The application status of intelligent wearable devices in badminton

Badminton, as an intense and skillful sport, has characteristics that highlight the potential value of smart devices in training and data analysis. Some studies have shown that specialized badminton sensors can effectively assist athletes in improving the standardization of their technical movements (Seong, M., Kim, G., Yeo, D., Kang, Y., Yang, H., DelPreto, J., ... & Kim, S. 2024). For example, by analyzing swing speed and angle data, athletes can identify deviations in their technique and make targeted adjustments. Additionally, heart rate monitoring and exercise intensity recording functions help athletes optimize their training intensity, thereby avoiding overfatigue or sports injuries.

Smartwatches and fitness trackers are also widely used in badminton, typically recording overall activity data such as steps taken, calorie burned, and exercise duration. However, compared to specialized equipment, these general-purpose devices still have limitations in monitoring the technical details of badminton. As a result, different user groups exhibit significant differences in device selection and usage; casual players focus more on basic monitoring functions, while semi-professional players tend to prefer more professional equipment. The effect of smart wearable devices on athletes behavior (Carmen, P., Dănuț, M. G., Neculai, H., Constantin, U. B., & Alexandru, S. D. 2024). Smart wearable devices not only enhance athletes training efficiency but also have a profound impact on their movement patterns. By providing data feedback, athletes can gain a clearer understanding of their performance, allowing them to adjust their training plans and improve self-management skills. At the same time, this data serves as crucial reference for coaches, aiding in the design of more scientific training programs. Additionally, the social features of these devices (such as data sharing and comparison) increase interaction and competitiveness among athletes, motivating them to strive for higher levels of performance in their sports.

Research Methodology

The subjects are adult athletes who actively participate in badminton (aged 18 and above), ranging from recreational enthusiasts to amateur and semi-professional levels, with at least one badminton activity per week. This sample size of 30-40 participants was determined to ensure diversity in playing experience, training intensity, and familiarity with smart wearable devices. The exclusion of professional players and infrequent participants ensures the study remains focused on the segment of badminton consumers most likely to adopt such devices. Interviews are the primary method of data collection, with the research team conducting semi-structured in-depth interviews to explore consumer needs, device preferences, and decision-making patterns.

Research Steps

This study constructs a theoretical framework based on the The Five-stage Model in Consumer Behaviour and the Theory of Planned Behavior (TPB), designing interview questions to clarify the core needs and behavioral patterns of badminton players in using smart wearable devices. The subjects are adult athletes who actively participate in badminton (aged 18 and above), including recreational enthusiasts to amateur and semi-professional levels, with at least one badminton activity per week, excluding professional athletes and those with less than one activity per week. Interviews are the primary method of data collection, and the research team will conduct semi-structured in-depth interviews with 30-40 badminton consumers to explore equipment needs, usage habits, functional expectations, and decision-making processes. Interview content covers factors such as equipment functionality requirements, technical performance expectations, ease of use, and price sensitivity, while observing participants usage and feedback on different devices (such as smartwatches, dedicated badminton sensors, etc.).

Data Collection

The interview data will be processed using thematic analysis, following a structured coding framework. Initially, responses will be transcribed and systematically coded to identify recurring themes related to consumer expectations, perceived benefits, and barriers to adoption. Thematic patterns will then be categorized to distinguish between general user preferences and specific functional demands across different player levels. This method ensures a rigorous approach to extracting key insights while preserving the richness of qualitative data.

Table 1: Statistical tables

question	option	Data representation	Score (average score)
What features do you value most in smart wearables?	Health monitoring Technical action analysis	1(not important at all) to 5 (very important)	4.3 4.5
What do you think is the role of smart devices in badminton?	lift technique health control	1 (completely useless) to 5 (very useful)	4.4 4.1
Which device do you prefer?	Basic equipment (such as smartwatches)	1 (not at all) to 5 (very much)	3.8

question	option	Data representation	Score (average score)
	Professional equipment (such as badminton sensors)	1 (not at all) to 5 (strongly)	4.2
What features do you want to add to the device?	Technical action analysis Real-time coaching feedback	1 (not at all) to 5 (very much needed)	4.6 3.9
What are your top device attributes?	brand function	1 (not important at all) to 5 (very important)	3.7 4.5

Data Analysis

It can be observed from the scores that the technical action analysis score is significantly higher than the health monitoring related function. For example, the average score of technical action analysis is 4.5, while the score of health monitoring is 4.3. Although both are important, the technical action analysis is slightly higher than the health monitoring.

In the interview, respondents preferences for basic and professional equipment reflect different usage scenario needs. Specifically: the score for basic equipment (such as smartwatches and fitness trackers) is 3.8, indicating that most badminton enthusiasts have a certain demand for these devices in their daily exercise, primarily for basic functions like health monitoring.

The score of professional equipment (such as badminton sensors) is 4.2, indicating that respondents tend to choose more professional and targeted equipment in improving technical movements. In particular, the demand for technical movement analysis (score 4.6) far exceeds that for general health monitoring functions (score 4.3).

Usage Scenario Analysis: From the respondents answers, most people prefer to choose different devices for specific scenarios. For example, badminton enthusiasts say they use basic devices (smartwatches, fitness trackers) for daily health monitoring, while during technical training, they opt for devices with professional features (badminton sensors). This indicates that smart devices are not a one-size-fits-all solution among badminton enthusiasts but vary according to different needs.

In addition, some respondents mentioned that their feedback needs during technical improvement training mainly focus on the optimization of technical movements (such as swing speed, action Angle, etc.), rather than simple health monitoring, which further proves the role of professional accessories in improving technology.

Research Results

1. The core needs of smart wearable devices in badminton are not limited to health detection, but more inclined to the improvement and improvement of technical movements.

Studies show that the core needs of badminton consumers extend beyond health monitoring functions, such as heart rate monitoring and step counting. They place greater emphasis on the role of smart devices in refining and enhancing technical movements. Athletes prefer equipment that can accurately record stroke speed, number of hits, and movement trajectories, helping them improve their athletic skills.

2. The use mode of intelligent wearable devices in badminton should distinguish between the basic equipment and professional accessories

The study also found that badminton consumers prefer a dual-use model: combining basic equipment with professional accessories. This pattern aligns with findings in other sports, such as running and cycling, where athletes integrate general fitness trackers with sport-specific sensors to optimize training outcomes. Basic equipment (e.g., smartwatches, fitness trackers) is commonly used for health monitoring and general activity tracking, while professional accessories (e.g., badminton sensors, smart rackets) are favored for their detailed motion analysis. Similar to tennis and golf, where players rely on swing analyzers alongside general health trackers, badminton consumers adopt a layered approach based on their performance needs and training frequency.

Discussion

The results of this study show that the core needs of badminton consumers for smart wearable devices have gradually shifted from health monitoring functions to a focus on technological advancements, particularly in motion analysis and technical optimization. Additionally, there is a trend towards combining basic equipment with specialized accessories, with consumers selecting different devices based on various usage scenarios. These findings provide valuable theoretical support for the application of smart wearable devices in badminton training, aligning with trends observed in other sports. For instance, in running, athletes combine GPS-enabled smartwatches with foot sensors to monitor speed and stride, while in cycling, riders use general fitness trackers alongside power meters to assess performance. Similarly, badminton players require both basic monitoring and advanced motion-tracking tools, reinforcing the need for multi-device integration in sports technology.

Limitations

Despite its contributions, this study has several limitations. First, as interviews rely on self-reported data, there is a potential for response bias, where participants may overstate the usefulness of smart wearables or underreport negative experiences. Additionally, subjective interpretations may vary among respondents, influencing the consistency of findings. Second, while the sample size ensures representativeness within the targeted consumer group, the absence of professional players and highly casual users may limit the generalizability of the results to a broader badminton audience. Future research should consider incorporating observational methods or experimental designs to mitigate these biases and enhance result validity.

References

Carmen, P., Dănuț, M. G., Neculai, H., Constantin, U. B., & Alexandru, S. D. (2024). Monitoring the effort curve in physical education for normal and overweight students using smartwatches and mobile applications. *Indonesian Journal of Physical Education and Sport Science, 4*(4), 324-340. Available at: http://journal.unucirebon.ac.id/index.php/ijpess/article/view/821

da Silva, L. (2024). Wearable technology in sports monitoring performance and health metrics. *Revista De Psicología Del Deporte (Journal of Sport Psychology), 33*(2), 250-258. Available at: https://rpd-online.com/manuscript/index.php/rpd/article/view/1718

Edriss, S., Romagnoli, C., Caprioli, L., Zanela, A., Panichi, E., Campoli, F., ... & Bonaiuto, V. (2024). The role of emergent technologies in the dynamic and kinematic assessment of human movement in sport and clinical applications. *Applied Sciences, 14*(3), 1012. Available at: https://www.mdpi.com/2076-3417/14/3/1012

Gomes, G. M., Moreira, N., & Ometto, A. R. (2022). Role of consumer mindsets, behaviour, and influencing factors in circular consumption systems: A systematic review. *Sustainable Production and Consumption, 32*, 1-14. Available at: https://www.sciencedirect.com/science/article/pii/S2352550922000938

Islam, M. S., Tan, C. C., Sinha, R., & Selem, K. M. (2024). Gaps between customer compatibility and usage intentions: The moderation function of subjective norms towards chatbot-powered hotel apps. *International Journal of Hospitality Management, 123*, 103910. Available at: https://www.sciencedirect.com/science/article/pii/S0278431924002226

Prieto-Avalos, G., Cruz-Ramos, N. A., Alor-Hernandez, G., Sánchez-Cervantes, J. L., Rodriguez-Mazahua, L., & Guarneros-Nolasco, L. R. (2022). Wearable devices for physical monitoring of heart: A review. *Biosensors, 12*(5), 292. Available at: https://www.mdpi.com/2079-6374/12/5/292

Seong, M., Kim, G., Yeo, D., Kang, Y., Yang, H., DelPreto, J., ... & Kim, S. (2024). MultiSenseBadminton: Wearable sensor–based biomechanical dataset for evaluation of badminton performance. *Scientific Data, 11*(1), 343. Available at: https://www.nature.com/articles/s41597-024-03144-z

Xu, F., & Zhu, W. (2024). Evaluation of neurodiagnostic insights for enhanced evaluation and optimization of badminton players' physical function via data mining technique. *SLAS Technology, 100138*. Available at: https://www.sciencedirect.com/science/article/pii/S2472630324000207