IMPACT OF DIGITAL TECHNOLOGY-DRIVEN TOURISM AND PHYSICAL ACTIVITY ON ACTIVE AGING

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Abstract:

As the global population ages, achieving active aging has become a key component of sustainable development worldwide. Our research aims to understand the preferences of elderly tourists by investigating their participation in activities and use of digital technology during travel, thereby offering better services in this field. Utilizing the Technology Acceptance Model (TAM) and Active Aging Theory, we conducted a binary logistic regression analysis on data selected from the China Health and Retirement Longitudinal Study (CHARLS). Through quantitative data analysis, we discovered the exercise preferences of the elderly and the positive impact of digital technology on senior tourism.

Keywords: Elderly tourism; Tourism Service; Active Aging

1. INTRODUCTION

As the global population undergoes a significant shift, the phenomenon of aging is emerging as an important topic across all industries (Sie et al., 2021). According to United Nations Sustainable Development Group (2023), by 2030, it's projected that around 16.7% of the global population will be 60 years old or older, marking a significant rise in this age group's numbers from 1 billion in 2020 to an estimated 1.4 billion. The current demographic transition calls for an examination of appropriate sectors and stages of development that can efficiently involve and harness the skills and requirements of the elderly group. Qiao et al. (2022) argue that the notion of active aging has arisen within this framework, with the objective of augmenting the social involvement and overall physical and mental welfare of older individuals (Foster & Walker, 2015). Patterson et al. (2021) have illustrated how tourism has a great impact on the well-being of the elderly. They have observed that tourism not only brings momentary joy to the elderly but also has a sustained influence on promoting an active lifestyle among them.

As the population of senior individuals increases, academic interest in tourism tailored for the elderly is also on the rise. While the benefits of travel in enhancing the well-being of the elderly are broadly recognized, there remains a gap in understanding the role of digital technology-based services in increasing the tourism experiences for this demographic. The scholarly and professional literature widely acknowledges the distinct attributes and requirements of the older tourism sector.

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Nevertheless, a precise delineation of elderly tourism remains problematic. In a general sense, elderly tourism encompasses travel endeavors pursued by individuals in their senior years, motivated by a range of factors such as recreational pursuits, health advantages, social interaction, and cultural immersion (Przybysz & Stanimir, 2022). To accurately address this demographic, it is crucial to first delineate the concept of 'elderly.' In the literature, 'elderly' often equates to terms such as 'seniors' and 'old people.' Following the categorization by Patterson and Balderas (2018), elderly individuals are segmented into three types: Empty nesters (ages 55–64), Young seniors (ages 65–79), and Seniors (age 80 and older), each reflecting different life stages and associated travel behaviors. According to Alén et al. (2012), the classification of individuals as elderly is proposed to be based on their retirement age. This study aims to categorize adults aged 55 and above, who have attained the retirement age, as elderly.

The study aims to investigate tourism among older adults, focusing on the context of active aging, while also analyzing the influence of digital technology-driven tourist services on the development of elderly tourism. The initial phase will examine the categories, occurrences, and levels of physical exercises while traveling. The second step will examine the role of digital technology among the elderly in planning and enhancing their tourism.

2. LITERATURE REVIEW

2.1Tourism and Active Aging

Worldwide population is steadily aging, and finding appropriate industries and appropriate development paths has become the key to improve the utilization rate of the elderly population (Schomakers et al., 2018). According to World Health Organization (WHO, 2002, p.12), Active aging is the process of optimizing opportunities for health, participation, and security to enhance quality of life as people age. Komatsu et al. (2017) found that maintaining not only physical but also cognitive health is highlighted under the concept of 'active ageing. Hung and Lu (2016) argue that tourism is recognized as a key element in pursuing a lifestyle full of activity during one's senior years, especially in mental health after retirement. (Nimrod, 2008) Patterson et al. (2021) found that travel was found to have a positive influence on seniors and helped to contribute to a healthy lifestyle. Chudnovsky et al. (2021) examine the positive impact of tourism on life quality and active engagement of the elderly population. Tourism possesses the capacity to bring about transforming effects on older adults, serving not only as a recreational activity but also as a substantial catalyst for their active aging journey.

Within the framework of this prevailing pattern, it is imperative that tourism suppliers are cognizant of the significance of meeting the requirements and desires of elderly consumers. Realizing this objective requires a dedicated approach to deeply grasp the diverse characteristics of this demographic, since varying groups of senior travelers possess distinct requirements, desires, and inclinations (Balderas-Cejudo et al., 2021). Suban (2022) analyzes the evolving patterns in wellness tourism over the past two decades, with a particular focus on the preferences and needs of senior tourists. Ahn and Back (2019) emphasize the importance of practical utility and health-related benefits in influencing the fulfillment and action plans of elderly tourists. In the post-COVID19 era, the tourism landscape has undergone a significant transformation and has gained increasing popularity. Mohanan and Shekhar (2022) explore this surge in interest, attributing it to increased stress and anxiety due to the pandemic. These trends should be fully considered by the

tourism service industry.

2.2 Technology-Driven Service in Elderly Tourism

Previous research has indicated tight associations between technology and elderly tourism. Amendola and La Bella (2022) emphasize the significance of smart mobility systems for maintaining accessibility and safety in sustainable tourism. Sumaryadi and Sutono (2020) explore the importance of catering to cultural needs which are from food services to accommodation, through smart halal destination ecosystems aligning with the principles of sustainable tourism. Sedarati et al. (2021) and Buhalis et al. (2019) discuss the intertwined nature of social-economic and ecological subsystems within the tourism ecosystem, highlighting the role of emerging technologies such as 5G, AI, RFID, and blockchain. Chang et al. (2020) examine the influence of eco-friendly technology on sustainable travel practices in sustainable cultural tourism.

Except for the tight relationship between technology and sustainable ecosystem in elderly tourism, recent literature also linked technology with accessibility of tourism. Boes et al. (2016) highlight the importance of technology in improving accessibility and offering personalized support for senior visitors. Phuthong (2022) further emphasize on mobile technology which can enhance autonomy and customization options for senior tourists, offering them an improved travel experience. Sedarati et al. (2021) highlight the importance of fully leveraging networks to enhance accessibility for elderly tourists, thereby advancing the overarching sustainability of the tourism industry.

Current research primarily examines the nature of elderly tourism service from a singular perspective. The incorporation of technological advancements, the significance of balancing innovation with tradition, the role of co-creating value, and the emphasis on delivering consumer value and practicing sustainable tourism are all essential elements. Future research, by embracing a multidisciplinary and multi-dimensional perspective, should be directed towards the creation of service ecosystems.

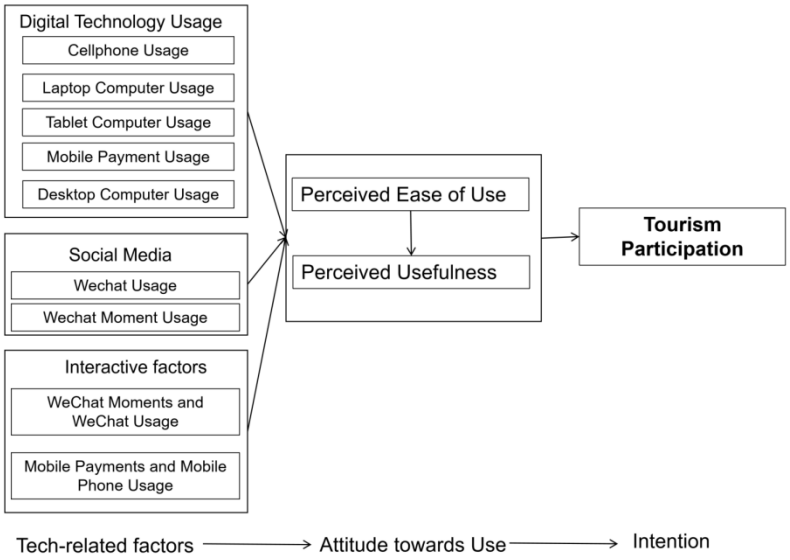
2.3 Service Design in Tourism

Recent years have seen considerable scholarly interest in the service design within the tourism industry. This approach integrates technologies, such as virtual reality, artificial intelligence, and digital technology, which are reshaping the conceptualization and delivery of travel services. Ivanova et al. (2021) argued that the crucial relationship between digital technology and travel services. The role of AI in service design, as thoroughly investigated by Wei et al. (2020) and Li (2022), shows promise in promoting the travel experience through intelligent personalization and enhanced operational efficiency. Moreover, the development of a cloud platform, as advocated by Wei et al. (2020), highlights the increasing significance of connectivity and data accessibility, underpinning the complex networks vital to modern travel services. Expanding upon this, Karadayi-Usta et al. (2020) argued that service design is an essential component of the tourism service supply chain, advocating for an inclusive approach to ensure accessibility in tourism.

The industry has also adopted sustainable service design principles, considering the affordances of technology (Tomej et al., 2020), the preservation of cultural tourism as described by Mariotti (2021), and the prioritization of user-centered experiences (Tomej et al., 2020). Van Rheede and Blomme (2012) highlighted the importance of service ecosystems, emphasizing the need for interconnected stakeholder processes in delivering sustainable tourism services. The tourism

services is now being shaped by an emerging trend towards interdisciplinary and transdisciplinary research that combined design management with insights from the humanities and social sciences.

Figure1. Theoretical Framework



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2.4 TAM in elderly tourism

The Technology Acceptance Model (TAM), introduced by Davis in 1989, is a theoretical framework for studying users' willingness to accept new technologies, systems, or tools (Davis, 1989). The TAM relies on two core variables: "Perceived Usefulness" and "Perceived Ease of Use" (Colvin and Goh, 2005), which explain users' attitudes and behavioral intentions toward technology. Perceived Usefulness reflects the extent to which a user believes a technology adds value to task execution or meets their needs, while Perceived Ease of Use indicates how intuitive and user-friendly a technology appears, influencing users' willingness to accept it (Legris et al., 2003).

According to the TAM framework, Perceived Ease of Use directly affects Perceived Usefulness (Liu and Ma, 2006), as users are more inclined to adopt technologies they perceive as simple to use. These two variables jointly shape users' attitudes and intentions toward using the technology. Our study establishes a theoretical framework (Figure 1) to test the impact of three sections on elderly tourism participation: the impact of digital technology, the role of social media, and interactive factors. The use of digital technologies like mobile phones, laptops, tablets, mobile payments, and desktop computers significantly influences the Perceived Ease of Use and Perceived Usefulness for older adults. If these tools are easy to operate and accessible, seniors are more likely

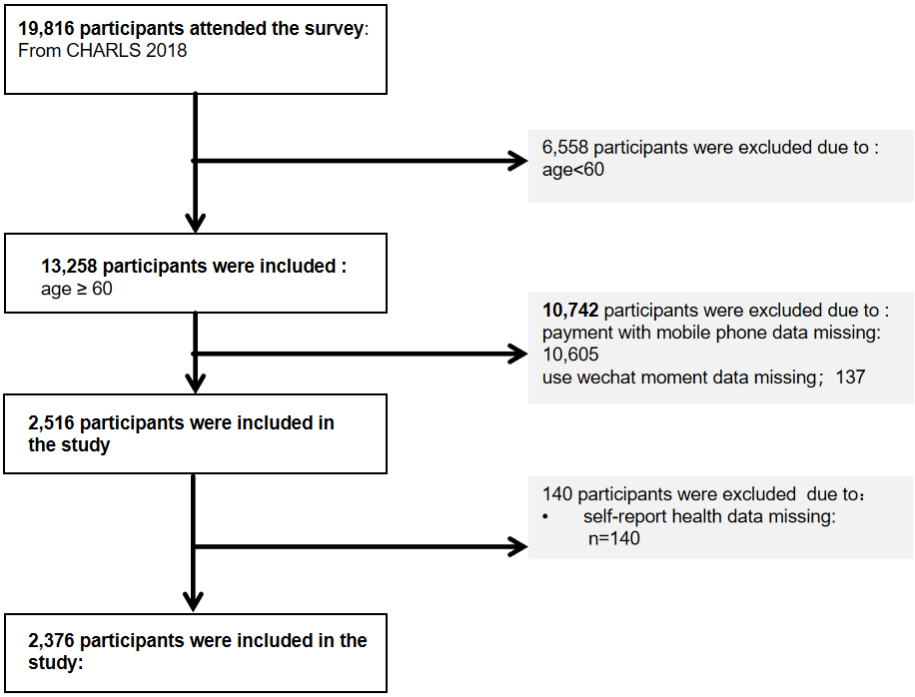
to find them valuable and use them actively. Social media platforms (such as WeChat and Moments) and interactive factors also shape the Perceived Ease of Use and Perceived Usefulness for older adults. These platforms enable them to share travel experiences, obtain travel information, and stay connected with friends and family easily. The social interaction and ease of access to travel information increase older adults' recognition of these tools and enhance their willingness to participate in tourism. Thus, the model hypothesizes that technology-related factors positively influence older adults' tourism participation by affecting Perceived Ease of Use and Perceived Usefulness.

3.METHODOLOGY

3.1 Sample and Data Collection Procedure

Data were collected through the 2018 China Health and Retirement Longitudinal Study (CHARLS) which aims to provide foundational data for researching issues related to population aging. This database is one of the most used databases in China to study the health of the middle-aged and older population and provides high-quality microdata representing households and individuals aged ≥45 years in China. (Li et al., 2022, p. 3) The survey collected the health status of 10,706 seniors aged 60 and above from 449 village or community units across 150 county-level units and 7,040 households in 28 provinces and autonomous regions (Fig.2).

Figure 2. Flowchart of the enrollment of this study population



Source:Author's own work

During the initial data processing phase of this study, we selected our target sample based on a key variable: participation in travel-related activities. The original dataset comprised 19,763

independent records, managed and preliminarily analyzed using Excel. Only those records that explicitly indicated participation in one or more travel activities were selected. Based on this criterion, a total of 2,653 records were ultimately included in our study. Among the records, we specifically extracted items pertinent to physical activities during travel and digital technology usage. The Global Wellness Institute (2023) analyzes the importance of physical activity in enhancing wellness among the elderly, highlighting it as a crucial indicator for senior tourism. The use of digital technology can break geographical boundaries, thereby reducing the likelihood of social isolation and enhancing the quality of life (Greysen et al., 2014). Consequently, digital technology usage serves as an important measure in the evaluation of senior tourism. These variables included Self-reported health status, the duration of vigorous, moderate, and mild physical activities, tourism participation, Desktop Computer Usage, Laptop Computer Usage, Tablet Computer Usage, Cellphone Usage, mobile payment Usage, Wechat Usage and Wechat Moment Usage as shown in Table 1.

3.2 Measurement

We utilized the activity intensity classification as outlined by Hao et al. (2014) to analyze the existing data on physical activities. This classification divides activities into three intensity levels: vigorous, moderate, and mild. Vigorous intensity activities are those that can cause shortness of breath and include actions such as carrying heavy items, digging, aerobic workouts, fast bicycling, and similar strenuous tasks. Moderate intensity activities are identified by causing faster-than-

Table 1. Details of variables

Categories	Variables	Key references
Physical activities during travel	More than 4 hours exercise 2 to 4 hours exercise Less than 2 hours exercise Vigorous activities Moderate activities Light activities Self-reported health status	Hao et al. (2014) The Global Wellness Institute (2023)
Digital technology usage	Desktop Computer Usage Laptop Computer Usage Tablet Computer Usage Cellphone Usage Mobile payment Usage Wechat Usage Wechat Moment Usage Self-reported health status	Technology Acceptance Model Greysen et al. (2014)

Source: Author's own work

normal breathing and include carrying light items, regular-speed bicycling, mopping, practicing Tai-Chi, and speed walking. Mild activities are less strenuous, typically involving leisurely walks and other forms of light exercise or entertainment. The dataset inherently categorizes the duration of these activities into three ranges: more than 4 hours, 2 to 4 hours, and less than 2 hours. This inherent classification within the dataset facilitated a detailed analysis of exercise patterns among the traveling population without the need for additional data extraction or categorization methods, allowing for an insightful exploration into their health implications. Similarly, all variables related

to digital technology usage were inherently present in the data, without the need for additional extraction or analysis.

Initially, the dataset was subjected to a thorough cleaning process, addressing issues such as missing values, errors, and outliers. For our study, we coded missing values as 0 to ensure data integrity and consistency. Regarding the health-related data (denoted as "da002"), responses indicating good and very good were coded as 1, while those for poor and very poor were coded as 2. For the "Physical Activities During Travel" section, we use Excel to conduct a comparative analysis of the activity behaviors between healthy and unhealthy elderly tourists. In the "Digital Technology Usage" section, due to the binary nature of the dependent variable, "Tourism Participation", we conducted a binary logistic regression analysis to examine the impact of digital technology usage on the likelihood of participating in tourism activities. The model comprised independent variables, including Desktop Computer Usage, Laptop Computer Usage, Tablet Computer Usage, Cellphone Usage, mobile payment Usage, Wechat Usage, Wechat Moment Usage, and their interaction terms to examine their combined influence on tourism participation decisions.

3.3 Analysis

Variables were binarized (0 for non-participation, 1 for participation) to facilitate logistic regression, performed using SPSS version 29.0. The model included an intercept to represent the log odds of participation when all predictors are absent, serving as a baseline probability. Model fit was assessed through likelihood ratio tests contrasting the full predictive model against a null model. Pseudo R-squared values, namely Cox & Snell and Nagelkerke, quantified the variance explained by the model. Bootstrap resampling, with 1000 iterations, validated the robustness of parameter estimates. For instance, the coefficient for Mobile Payment usage was 0.375 with a standard error of 0.121, and a 95% confidence interval ranging from 0.126 to 0.615, signifying a significant predictive value ($p = 0.002$). The bootstrap results substantiated the intercept's significance, reinforcing the overall interpretive strength of the model.

4. RESULTS

The data obtained from the analysis using Excel. The findings indicate that there is no significant difference in the duration and intensity of physical activities chosen by elderly individuals in both healthy and unhealthy groups during travel, suggesting no significant positive correlation between the health status of the elderly and their choice of activity duration and intensity while traveling. Elderly travelers tend to prefer engaging in mild activities for no more than two hours.

To further investigate the relationship between physical activity during travel and the health of elderly individuals, the study employed binary logistic regression analysis. The logistic regression analysis (Table 2) revealed a significant correlation between mild physical activity and improved health conditions ($B = 0.501$, $p = .006$), indicating that individuals who engage in mild physical activities experience a significant improvement in health conditions compared to those who do not. Specifically, the odds of having a good health condition among participants in light physical activities are 65.1% higher than non-participants (with an Exp(B) of 1.651 for mild activities).

The binary logistic regression analysis, inclusive of all 2653 cases, examined the likelihood of individuals choosing to participate in tourism activities. Results indicated that the independent variables significantly predicted tourism participation (χ^2 (7) = 53.624, p < .001). The model explained between 2.0% to 3.4% of the variance in participation decisions, as indicated by Cox & Snell 0.020 and Nagelkerke R-squared values 0.034. Furthermore, the classification accuracy of the model was 84.0%, with a cut value of .500, suggesting a robust predictive capability.

Specific predictors including Mobile Payment usage (B = 0.375, p = .003), WeChat Moments engagement (B = 0.026, p = .005) and Tablet Computer Usage (B =0.694, p <.001) were found to significantly increase the odds of participating in tourism activities, as reflected by the odds ratios

Table 2. Logistic regression analysis
Dependent variable: Health Condition

Independent variables	B	S.E.	Wald	df	Sig.	Exp(B)
High Intensity Activity	-.126	.134	.892	1	.345	.881
Moderate Intensity Activity	.182	.125	2.132	1	.144	1.200
Mild Intensity Activity	.501	.181	7.689	1	.006	1.651
Constant	-2.631	.333	62.608	1	<.001	.072
Dependent variable: Tourism Participation						
Independent variables	B	S.E.	Wald	df	Sig.	Exp(B)
Mobile Payment Usage	.375	.124	9.124	1	.003	1.455
Wechat Usage	.026	.281	.009	1	.925	1.027
Wechat Moment Usage	.401	.144	7.783	1	.005	1.493
Desktop Computer Usage	.243	.135	3.240	1	.072	1.275
Laptop Computer Usage	.275	.208	1.741	1	.187	1.317
Tablet Computer Usage	.694	.193	12.948	1	<.001	2.001
Cellphone Usage	.356	.284	1.569	1	.210	1.428
WeChat Moments and WeChat Usage	.497	.128	14.984	1	<.001	1.643
mobile payments and mobile phone usage	.361	.093	14.946	1	<.001	1.435

Source: Author's own work

of 1.455 1.027 and 2.001, respectively. The effects of Desktop Computer Usage (p = 0.072) and Laptop Computer Usage (p = 0.187) are positive but not statistically significant, indicating that their predictive power for Tourism Participation in the model is not evident. The results for Wechat Usage (p = 0.925) suggest that this variable does not have a significant impact on the dependent variable, Tourism Participation, and its role in the model could potentially be considered negligible.

To further explore the behavior of choosing option 2 in Tourism Participation because of multiple factors rather a single variable, further verification of interaction effects is warranted. Davis (1989) introduced the Technology Acceptance Model (TAM), which is grounded on two fundamental beliefs: perceived usefulness and perceived ease of use. From the standpoint of perceived usefulness, although the sole use of WeChat was not associated with an increase in travel activity, the capability of WeChat Moments to share travel stories and tips could potentially elevate.

This finding indicates that individuals who use both WeChat and WeChat Moments have a 64.3% higher likelihood of choosing to participate in travel compared to those who do not. The robustness of this finding is further supported by the results of the bootstrap method. Across 1,000 resampling samples, the coefficient of the interaction term remained consistent (B = 0.497) with very small bias (Bias = -0.002), a smaller standard error (Std. Error = 0.130), and a 95% confidence interval (0.248, 0.743) well away from 0, indicating statistical significance ($p < .001$).

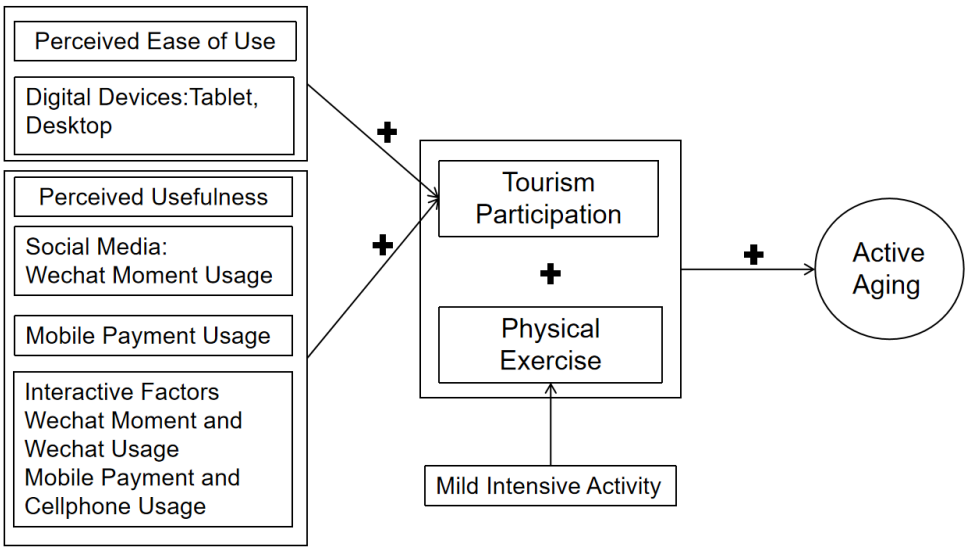
In line with the concept of perceived ease of use within the Technology Acceptance Model (TAM), our study examines the combined effect of using mobile payments and mobile phone usage as an interaction term to assess their impact on tourism. Subsequent logistic regression analysis revealed that the interaction between using mobile payments and mobile phone usage significantly predicts tourism participation, with B = 0.361, S.E. = 0.093, Wald = 14.946, df = 1, $p < .001$, Exp(B) = 1.435. This suggests that individuals who use both mobile phones and mobile payments have a significantly increased likelihood of participating in travel. Bootstrap analysis further confirmed this finding, with resampling results from 1,000 samples showing the interaction term B = 0.361, bias = 0.005, S.E. = 0.104, and a 95% confidence interval [0.178, 0.583], maintaining its significance. This indicates that the result is robust.

5. DISCUSSION

This study (Fig.3), based on the Technology Acceptance Model (TAM) and Active Aging Theory, constructs a theoretical framework to explore the positive impact of digital technology on the tourism participation of the elderly, as well as the effects of different types of physical activities on their health. Perceived Ease of Use (PEOU) and Perceived Usefulness (PU) are key factors influencing the acceptance of technology by the elderly.

Figure 3. Digital Technology-Driven Tourism and Physical Activity Enhancing Active Aging

Our research findings indicate that the use of digital devices (tablets and d



Source: Author's own work

sktop computers) significantly enhances PEOU. Meanwhile, the use of social media, particularly WeChat Moments, and the prevalence of mobile payments are crucial for enhancing PU. Additionally, the interactive use of digital technologies has been shown to be a significant factor in promoting tourism participation among the elderly. In terms of physical activities, the study reveals that engaging in less than two hours of mild physical activity per day has a positive effect on the health of the elderly. Given that tourism has been proven to positively influence active aging, this study further proposes designing tourism types that meet the needs of the elderly, including providing specific digital technology services and arranging health-beneficial activities during travel to promote active aging among the elderly.

The results highlight the negligible difference in activity choices among elderly tourists, irrespective of their health status, with a preference for engaging in mild activities. Crucially, mild physical activities are linked to a 65.1% improvement in health outcomes. Significantly, technological adoption, specifically Mobile Payment, WeChat Moments, and Tablet Computer Usage, emerges as a key driver in increasing elderly tourists' participation in tourism activities. In contrast, Desktop and Laptop Computer Usage showed positive yet statistically insignificant effects. The results underscore the vital role of technology in enhancing tourism experiences for the elderly, indicating a marked influence of technology use on their travel participation.

This study introduces new dimensions to the framework of active aging theory. WHO (2002) identified participation, health, and security as the three pillars of an active aging policy framework. Participation is deemed a critical component in the aging process, yet WHO's framework does not explicitly associate elderly travel with participation. Developing travel programs and services tailored for the elderly can effectively enhance their social engagement, thereby enriching the active aging theory framework with novel insights.

Given the preference of elderly individuals for light physical activities lasting no more than two hours during tourism activities, this insight offers valuable guidance for the planning of tourism services. Future research could consider quantitatively assessing the duration and intensity of activities elderly individuals engage in across various tourism projects and environments. This approach would allow for better adjustment of tourism services to meet the specific needs of the elderly. Qiao et al. (2022) verified that existing media communication channels could promote a constructive mindset and actions that amplify the personal capabilities of the older population, thus increasing the sense of their travel happiness. Based on it, our study further discusses into the effects of media applications and technology acceptance on the travel choices of the elderly. Utilizing the TAM as a theoretical framework, our analysis reveals that the use of WeChat and Moments has a significant positive impact on travel decisions. This finding suggests that tourism companies should carefully consider this aspect when designing their services. By establishing social platforms that facilitate the sharing of travel experiences among the elderly and investigating ways to improve user experience, tourism companies can develop platforms that are friendly to older users. Such initiatives not only foster active social participation and contribute to positive aging but also enable tourism companies to enhance their service design, thereby improving their reputation and cultivating brand loyalty.

6. CONCLUSION

In summary, this research investigated the convergence of technology-driven tourism services

and active aging, with a particular focus on the role of Service-Dominant Logic and active aging theories. By investigating the impact of technology, physical activity, health, and travel preferences on the choices and preferences of elderly tourists, we propose new possibilities for enhancing senior tourism services.

Despite the abundant research on elderly tourism, there are still substantial knowledge gaps regarding to the financial effects of tourism for the elderly, the psychological and emotional advantages it provides, and the creation of specialized infrastructure and services. Thus, it is recommended that upcoming investigations employ a multidisciplinary framework to examine the enduring impacts of tourism on the loyalty and wellness of the elderly to meet their diverse requirements. By doing so, we can ultimately improve the quality of life and encourage active engagement in tourism among senior adults by cultivating a tourism environment that is more inclusive, supportive, and enlightening.

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