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Bridging Behavioral Sciences and Sports Sciences

Edited by
José Eduardo Teixeira, Luís Branquinho and Ricardo Ferraz

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Preface

In recent years, the integration of behavioural and sports sciences has garnered increasing attention. This Special Issue, entitled "Bridging Behavioural Sciences and Sports Sciences", brings together innovative research articles exploring interdisciplinary links. These studies aim to provide new insights into how behavioural sciences can enhance sports sciences, optimizing athletic performance, health, and well-being. This Special Issue commences with an investigation by Taveira et al., focusing on the continuance intentions of older adults for online physical exercise classes, analysing the psychological motivators and barriers that influence sustained engagement in digital exercise environments. Following this, Koybulan et al. examine the prevalence and factors associated with smartphone addiction among athletes. Their research highlights the implications of excessive smartphone use on athletes' performance and mental health, prompting discussions on necessary interventions to mitigate its negative effects. Deng et al. contribute a systematic review and meta-analysis on the efficacy of motor imagery training in improving athletic skills and performance among tennis players with mental rehearsal techniques. Calella et al. present a cross-sectional study that explores sedentary behaviours and eating habits among active and inactive individuals in Southern Italy, underscoring the relationship between physical activity levels, dietary patterns, and overall health. Costa et al. investigate psychophysiological predictors of performance among healthy university students, offering practical applications for optimizing training and performance strategies in educational settings. Kim et al. examine the impact of the met-expectation of athletic justice on athletic satisfaction and organizational commitment among elite Saudi Arabian athletes, highlighting the significance of fair treatment and leader–member exchange dynamics. Kulak et al. explore the effects of sustainable exercise on self-efficacy and life satisfaction in women before and after menopause, providing insights into how continuous physical activity can influence psychological well-being across different life stages. Moreover, Liu et al. examine the association between physical activity and interpersonal competence, quality of life, and survival beliefs in cancer patients, emphasizing the therapeutic potential of physical activity in improving holistic well-being. Batista et al. investigate physical activity and sedentary behaviour patterns in adults from Penafiel, Portugal, contributing to the understanding of regional variations in activity levels and their implications for public health strategies. Finally, Jee et al. present studies on sports fans' consumer behaviour, examining overconfidence bias in ticket purchase decisions and the impact of scarcity framing on perceptions of ticket availability. This Special Issue contributes to bridging the gap between behavioural and sports sciences.

José Eduardo Teixeira, Luís Branquinho, and Ricardo Ferraz
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Article

Older Adults' Continuance Intentions for Online Physical Exercise Classes

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Abstract: During the COVID-19 pandemic, lockdowns and social distancing measures drove the shift from in-person to online physical exercise classes, leading individuals to explore these digital alternatives. Guided by the Expectation-Confirmation Model, this article examines older adults' intentions to continue using online physical exercise classes. Semi-structured interviews were conducted with 17 adults aged 65 and older who had participated in online physical exercise classes during the pandemic. Transcripts were subject to thematic analysis using the NVivo software program. The results indicate that older adults recognize the usefulness of online physical exercise classes because of their ability to enhance their health and well-being. Their initial expectations were surpassed, and they were generally satisfied with the experience. However, in-person classes remained preferred due to their enhanced benefits. They also felt that the adoption of online classes was involuntary; instead of an autonomous decision guided by their needs and preferences, this was a viable solution imposed by the lockdown. Therefore, their continuance intentions are limited to specific conditions, namely a new lockdown or other physical impediments. Still, considering the flexibility that online physical exercise classes offer, accommodating time and physical constraints, participants highlighted the advantages of a hybrid approach for those who may face challenges attending in-person classes. Based on the findings, this article proposes that ECM provides a relevant, yet insufficient, framework for explaining older adults' continuance intentions for online physical exercise classes, suggesting the inclusion of additional explaining factors: perceived usefulness of non-technological alternatives, necessary conditions, and self-determination.

Keywords: older adults; qualitative research; silver economy; online services

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1. Introduction

The world population is aging at an unprecedented rate. According to the World Health Organization [1], by 2050, the number of people aged 65 and over is expected to outnumber children under five. In the case of the EU, this age segment is expected to almost double between 2020 and 2050. This prominent change in the demographic structure creates a higher demand for social and healthcare services, whose access and improved usage are critical to older people's physical, social, and mental health [2]. The Organization for Economic Co-operation and Development (OECD) defines the elderly as people aged 65 and over, representing a growing segment of older consumers with new and distinct needs that must be addressed [3].

The Sustainability Development Goals (SDG) defined by the United Nations include the objective to "ensure healthy lives and promote well-being for all at all ages" [4]. In contrast to sedentary lifestyles, physical exercise is a crucial element of a healthy lifestyle that enhances the quality of life and physical and psychological well-being and fosters positive emotional and social interactions [5].

Recently, the COVID-19 pandemic imposed social isolation, leading to the widespread introduction of digital alternatives to face-to-face interactions. Several organizations, including the World Health Organization, recommended remote physical exercise practices

through online platforms during isolation and social distancing. In fact, the pandemic has disrupted how individuals of all ages access digital services and interact with one another. Even older populations appreciated the value of technology, even though they historically used technology less frequently for everyday services and communication due to factors such as digital literacy and internet access. Overall, the increasing use of digital technology in daily activities and assisted living may facilitate a paradigm shift toward successful and healthy aging [6,7] and serve as an alternative to improving older individuals' physical and mental health [8–13]. Therefore, it is essential to understand the impact of this digital shift on older adults' health and wellness activities, including physical exercise.

As noted by Yap et al. [14], in the last few decades, researchers and practitioners have increasingly attempted to understand the factors that influence technology acceptance by the older population in e-commerce and e-health. However, the study of post-behavioral usage intentions regarding physical exercise in online contexts remains relatively unexplored. Recent contributions to the literature [9,10,15] have summarized the state of the art in online physical exercise classes for older individuals, highlighting a growing interest in the topic and stressing the urgent need for future research to address the remaining gaps. Dagenais et al. [9] and Gravesande et al. [10] conducted scoping reviews. Dagenais et al. [9] found that while existing literature explores the feasibility and the health-related impacts of online physical exercise classes, there is an urgent need to investigate further older adults' experiences and perceptions associated with participation in such programs. Gravesande et al. [10], who specifically examined online mind–body programs for older adults, confirmed the feasibility and acceptance of this type of physical exercise class, noting that the research is often exploratory and focuses on technical barriers and facilitators, ease of use, and satisfaction of the participants.

Additionally, de Lacy-Vawdon et al. [15] synthesized the literature on factors that explain older adults' engagement in group-based physical exercise classes. They identified critical elements such as the characteristics of the class, the instructor, the setting, social support, and perceived outcomes; however, they stressed the need for more high-quality studies, particularly regarding the methodological design. Moreover, the analysis of factors that explain continuance intentions is still lacking. Porter et al. [13] conducted a study with older adults who participated in online exercise classes during the pandemic and found that the majority were willing to continue participating in this type of class after that period. In line with these findings, a practical gap remains, as a clear understanding of the determinants of continuance intentions is necessary to guide practitioners and public stakeholders in their managerial decisions.

This article addresses these gaps by examining older adults' intentions to continue using online physical exercise classes. As the focus of the article is the continuance intentions, it adopts the Expectation-Confirmation Model (ECM) as its theoretical underpinning.

This article has three main contributions. Firstly, it extends the literature on online physical exercise classes by exploring factors that explain continuance intentions among older adults. The study's robust theoretical underpinning increases the relevance of the findings and provides a more substantial basis for future research. Secondly, this study also contributes to the scarce literature on technology acceptance by older individuals by exploring their experiences with online physical exercise classes. It further supports the adequacy of the ECM for explaining continuance intentions among older generations. It enables the identification of additional factors influencing technology continuance intentions: perceived usefulness of non-technological alternatives, necessary conditions, and voluntariness/self-determination. This finding is particularly interesting and can guide future research using ECM. Thirdly, this study provides relevant managerial contributions, as it offers evidence that can assist managers, policymakers, and other stakeholders interested in using technology to foster physical exercise among older generations to improve their well-being.

The remainder of the article is organized as follows. The next section provides a literature review on the ECM and explores the factors explaining intentions for post-

behavioral usage. Section 3 presents the method adopted for this study, and Section 4 presents the results. Section 5 is devoted to the discussion of findings. Finally, Section 6 presents the conclusions, including implications, limitations of the study, and suggestions for future research.

2. Background

2.1. Expectation Confirmation Model (ECM)

The Expectation-Confirmation Model (ECM) was adopted to guide this research. It is a technology post-acceptance model and stands out among the theoretical frameworks on consumers' post-adoption behaviors and intentions. As Mishra et al. [16] noted, the post-acceptance model is known in the academic literature by various names, including the expectation-confirmation model, information systems continuance theory, and information systems expectation-confirmation. For the purpose of this article, it will be referred to as ECM.

Bhattacherjee [17] developed the ECM as an adaptation of the Expectation-Confirmation Theory (ECT) initially proposed by Oliver [18]. In the Consumer Behavior literature, ECT is commonly applied to study consumer satisfaction and post-purchase behavior; it suggests that a consumer's intention to repurchase a product or service is determined by their prior experience. As Oliver (1980) explained, whenever the benefit exceeds the consumer's expectations, the resulting satisfaction leads to the continued intention to use it. By comparing their experience to their initial expectations, consumers will develop a favorable or negative impression of the product or service, affecting their satisfaction and, consequently, their willingness to repurchase the product or reuse the service.

Bhattacherjee [17] modified the ECT and proposed the Expectation Confirmation Model (ECM) as a post-acceptance model of information system continuance usage. In this context, continuance refers to individual users' long-term use of technology beyond its initial adoption [19]. Bhattacherjee [17] suggested that users' intention to continue using technology in the information systems domain resembled consumer repurchase decision-making behavior. From a long-term perspective, continued usage is essential for the technology to be truly accepted [17,20] and become a commercial success [16,21]. Compared to ECT, ECM places greater emphasis on post-adoption expectations than pre-adoption expectations. This is because a user's expectations regarding technology use evolve with experience, and after assimilating these experiences, a user's expectations may significantly differ from their initial assumptions [16,22].

Among the various perspectives examined in technology adoption research, perceived usefulness is the most consistent predictor of a user's intentions [23] and serves as a proxy for post-adoption expectations. As a result, in the information systems' setting, post-use perceived usefulness (PU) replaced the ECT expectation concept, and repurchase intention was also replaced by continued usage intention. Furthermore, and more crucially, the ECM defined confirmation as "the congruence between expectation and actual performance" [17] and eliminated the performance construct of ECT since the ECM considers that confirmation already explains the effect of perceived performance [17].

Hence, ECM asserts that an individual's continuance intention in using an information system depends on three variables: satisfaction, the degree of confirming users' expectations, and the users' post-usage beliefs regarding the benefits of the information system in the form of perceived usefulness [22].

The ECM is widely used in a variety of areas, including e-learning [24], e-commerce [21,25–29], m-commerce [30,31], s-commerce [32], shared transportation services [33–35], social media [36,37], e-banking services [38–41], wearable technology [42], and e-health systems [43–46]. Moreover, ECM has been proven beneficial in explaining topics related to fitness, namely fitness and health apps [46], and also in studies on older consumers, namely the adoption of e-banking [39] and social media [37].

2.2. Factors Explaining Post-Behavioral Usage Intentions

2.2.1. Post-Acceptance Perceived Usefulness

The literature frequently emphasizes perceived outcomes as critical factors influencing older adults' participation in online exercise classes [9,10,15]. ECM suggests that perceived usefulness is essential to understanding satisfaction and continuance intentions. Post-acceptance perceived usefulness (PU) reflects post-usage beliefs and refers to the users' perceptions regarding the benefits of using a system, service, or technological device [17]. Thus, it represents the expectation outlined as a belief about the importance of using certain technologies and serves as a point of comparison [22]. Users' beliefs and perceptions about technology shift throughout time and continue to change as they become more familiar with the technology [22]. It has been studied that the influence of PU on satisfaction decreases for long-term users since they have already gained a reasonable level of information about the systems. PU has been shown to improve satisfaction levels, particularly among early adopters and short-term users [16,47].

In a study that applied ECM, Chiu et al. [46] confirmed that post-acceptance perceived usefulness is a crucial determinant of older adults' continuance intention to use fitness and health apps, namely because it has a positive impact on users' satisfaction with the technology. It is worth noting that their sample included individuals of all ages and primarily involved users aged 26 to 35, leaving the perspectives of older users unexplored. However, studies that evaluate the feasibility of online physical exercise classes for older adults tend to highlight their usefulness, namely in terms of the physical well-being of the participants [10,13], demonstrating the importance of this variable in understanding continuance intentions.

2.2.2. Confirmation

Confirmation is the degree to which an individual's original expectation about a system's performance is confirmed after having an experience with the system [18]. These perceptions are shaped by comparing users' initial expectations and the post-usage benefits to create the confirmation/disconfirmation status regarding the reuse of the system in users' minds [17]. In the Expectation-Confirmation Model, confirmation describes an individual's affective state as a consequence of a cognitive assessment of the potential discrepancy between initial expectation and experienced performance [16,17]. To become successful, information systems should be capable of satisfying users by meeting their expectations through expected usefulness and benefits [16].

To the best of the authors' knowledge, the literature has not addressed confirmation in the context of online physical exercise classes, particularly regarding older adults. A relevant contribution was offered by Leung and Chen [44], who conducted a study on e-health/m-health adoption and lifestyle improvement in the general population of Hong Kong. They found that users' degree of confirmation was positively associated with satisfaction with health-related information platforms/apps, since once the initial expectation is met or exceeded, consumers are more likely to foster a positive feeling toward or be satisfied with the new technology and thus continue to use it [44]. A similar result was observed by Chiu et al. [46] in their study on fitness and health apps conducted in China, with the majority of participants being between 26 and 35 years old. They found that it positively affected user satisfaction, subsequently increasing the intention to continue using the apps. Hence, these studies empirically supported ECM assumptions on health-related topics. The gap remains regarding older adults, particularly online physical exercise classes.

2.2.3. Satisfaction

Lastly, satisfaction generally represents an individual's level of approval resulting from involvement in an activity, event, or matter. Bhattacherjee [17] defined this construct as "a psychological or affective state related to and resulting from a cognitive appraisal of the expectation-performance discrepancy (confirmation)" (p. 354). Individuals experience pleasure when information systems meet or surpass their expectations in terms of func-

tionality, performance, and benefits [16]. This post-acceptance satisfaction is grounded in users' first-hand experience and is, therefore, more realistic, unbiased, and less susceptible to change.

As Mishra et al. [16] noted, the literature generally supports the positive relationship between satisfaction with various information systems (e.g., social media, online apps) and usage continuance intentions. As mentioned above, this positive relationship was confirmed among users of e-health/m-health apps [44] and e-fitness apps [46] within general populations in Hong Kong and China, respectively. Furthermore, Cronin et al. [48] conducted a study with physiotherapy patients aged between 18 and 79 who participated in an online exercise program during the pandemic and found high levels of satisfaction that could be associated with positive intentions to use hybrid and online physiotherapy sessions. Gravesande et al. [10] and Dagenais et al. [9] stress that, generally, the literature shows that online physical exercise classes provide high satisfaction levels among older adults. Hence, it is essential to, in line with what was postulated by ECM, further explore the role of satisfaction with online physical exercise classes to explain continuance intentions.

3. Method

This study employed a qualitative exploratory approach, which aims to better understand the researched topic by exploring the experiences and perspectives of individuals [49]. This qualitative study relies on information gathered from semi-structured interviews with older adults (aged over 65, of both genders) who participated in online physical exercise classes during the COVID-19 pandemic. The interviews were conducted in May 2023.

3.1. Materials

The interview script was then divided into three main topics: (i) contextualization of the physical exercise experience before the pandemic, (ii) transitioning to online physical exercise classes during the pandemic, and (iii) exploring prospects for online physical exercise classes. An outline of the main questions is presented in Appendix A. Before the study, a pilot interview was conducted to assess the clarity of the questions and the consistency of the sequence. During each interview, the interviewer began with general questions and asked additional ones when necessary to elicit further details.

The researchers obtained informed consent from interested participants to ensure that participants fully understood the research objectives, procedures, risks, and benefits. The study was conducted in accordance with the "Declaration of Helsinki", following the ethical principles recommended for social research as outlined by Bryman [49], particularly informed consent, confidentiality, anonymity, and voluntariness. Participation in this study was entirely voluntary. Participants were informed that they had the right to decline participation and could withdraw at any time during the study. Data confidentiality and anonymity were guaranteed throughout all phases of the study.

3.2. Participants

The participants were selected through purposive sampling. As explained by Bryman [49], in purposive sampling, participants are strategically selected based on their experience and relevance to the research rather than through random sampling. Thus, the sample is of a convenience rather than a probabilistic nature. Participants were recruited based on the researchers' professional and personal networks, namely through a community exercise program offered by the University of Porto for individuals aged 65 or older. This program, which provided online physical exercise classes during the pandemic, qualified its participants for this study. A snowball sampling technique was also employed, wherein participants were asked to suggest other potential interviewees. The final sample (Table 1) comprised 17 volunteers aged 65 and older who participated in online physical exercise classes during the COVID-19 pandemic, representing diverse sociodemographic and urban characteristics. The sample size was deemed suitable for a qualitative study [49], as it allowed data saturation to be achieved, i.e., the final interviews did not provide any new

information or themes, making additional data collection redundant. Since the research objectives and the study population were very specific, data saturation tends to require a relatively small sample size [49]. It should be noted that sample sizes in qualitative studies vary significantly. Unlike quantitative research, which relies on statistical power calculations to determine sample size, qualitative studies focus on collecting rich, detailed data to understand the subject comprehensively. Qualitative studies do not aim to generalize findings [49]. In narrow-scope studies with specific populations, sample sizes can be under two digits and frequently less than twenty as long as data saturation is achieved [49]. In this study, data saturation was achieved in the fourteenth interview.

Table 1. Participants.

Code	Age	Gender	Education Level	Type of Online Class	Interview Duration	Number of Words
P1	73	Male	Primary	Aerobics	18:04	1415
P2	89	Male	Primary	Aerobics	12:49	1021
P2	75	Female	Primary	Aerobics	16:22	1083
P4	74	Male	Primary	Aerobics	14:10	1040
P5	72	Male	Secondary	Aerobics	17:09	1346
P6	83	Female	Primary	Aerobics	19:46	1357
P7	81	Female	Primary	Aerobics	16:36	1154
P8	77	Female	Secondary	Pilates	18:26	1494
P9	80	Male	Secondary	Pilates	24:33	1886
P10	72	Male	Secondary	Aerobics	27:33	2013
P11	82	Female	Higher education	Pilates	20:02	1258
P12	77	Female	Primary	Pilates	19:59	1256
P13	79	Female	Higher education	Aerobics	17:39	1052
P14	71	Female	Primary	Pilates; Aerobics	20:22	1368
P15	77	Male	Secondary	Pilates	23:19	1804
P16	74	Female	Higher education	Pilates	13:21	1002
P17	85	Male	Higher education	Pilates	22:53	1631
Total					05:23:03	23,180

3.3. Data Analysis Procedures

The interviews were recorded using an encrypted voice recorder, and the transcripts were systematically analyzed through thematic content analysis [49–51]. Overall, content analysis aims to uncover themes, patterns, and meanings from qualitative data. The identification of patterns and data codification were performed with the software tool NVivo (Version 12, QSR International, Southport, UK). The study employed a priori and posteriori categories in content analysis, starting with a theoretical framework and progressively refining our outcomes to align with the research objectives [50]. According to Hsieh and Shannon [52], inductive data-driven content analysis is particularly useful for underexplored topics with limited existing literature, as with this article. As recommended by the literature [49,50,53], coding was performed after data preparation procedures (e.g., verbatim transcription and anonymizing the data). The data were organized into main categories and subcategories, associating transcript passages with codes and identifying recurring themes and patterns. The analysis was followed by validation and reporting. Although software tools like NVivo can perform basic statistical analyses based on word counts (e.g., word frequency, coding frequencies, charts, and graphs), this analysis prioritizes interpreting meanings. Therefore, the results do not include quantitative approaches to the qualitative data.

4. Results

As indicated in the preceding section, every participant in this study had engaged in online physical exercise classes during the COVID-19 pandemic lockdown. This period was marked by substantial challenges due to the widespread transmission of the coronavirus. Social distancing measures led to the closure of public sports facilities, including gyms.

Several providers offered online exercise classes during that period to keep their customers engaged in physical activity, which all participants in this study chose to experience.

However, participants emphasized that adopting online physical exercise classes was not perceived as totally voluntary as, during the lockdown, this was the only alternative left for maintaining physical exercise routines. Overall, they perceived this alternative as an opportunity to exercise, socialize, and use their time.

> "We couldn't leave the house. At that time, we were obliged to be in front of the computer. . ." P9

> "And I enrolled [in online physical exercise classes] with pleasure, to socialize and keep up with the exercise, to maintain the discipline." P5

> "We saw our colleagues, we did something. It was not as good as being there, but at least we did something so that we wouldn't be sedentary for too long." P3

These findings align with Newbold et al. [54], who argue that the emergence of online physical exercise programs and recorded classes facilitated physical exercise routines despite lockdowns, social isolation, and gym closures.

In the following sections, we explore the participants' experience with online physical exercise classes and their continuance intentions.

4.1. Participants' Experiences with Online Physical Exercise Classes

Most participants had low or no initial expectations for online physical exercise classes due to their unexpected adoption. However, their overall experience was generally positive, as explained by the following transcripts.

> "It exceeded expectations. Honestly, I had no idea what an online class was like; it was a whole new world. (. . .) Given the circumstances, nothing was missing, with limitations, but nothing was missing." P3

> "I never thought it would work, and I think it worked very well. I know that my colleagues were also very happy to have been able to do it." P16

Similarly, the emotions conveyed during the interviews were very positive, as most participants expressed contentment and appreciation regarding the experience.

> "The gym offered this solution, which was great. It was different, but it was interesting." P8

> "It was one of the best things [during the pandemic]. I loved it." P3

> "It was great. Everything went well, and we were very well guided by the fitness instructor. I think we all collaborated very well; there were no flaws, nothing." P12

> "I liked it, of course. If I hadn't liked it, I would have quit." P2

According to the literature [17], and as participants pointed out, satisfaction fosters a positive relationship between the user and the technology, encouraging repeated usage and sustained adoption. However, if participants, such as P6, do not perceive benefits from the online service and have initial negative expectations, they may confirm those low expectations, resulting in an overall negative evaluation of the online classes.

> "I never thought I would like [online physical exercise] classes, and I really didn't. I felt like I didn't gain anything that would make me want to attend the class. We were just at home, moving from one place to another to do the exercises. But it tired me out, and I would leave." P6

In accordance with Mishra et al. [16], positive experiences and satisfaction encourage users to use technology more, whereas negative experiences may lead to technology discontinuation or avoidance.

4.2. Perceived Usefulness

The primary motivation for the participants' involvement in physical exercise classes was their health and well-being. Their experiences with online classes during the COVID-19 pandemic proved particularly useful, as these virtual alternatives allowed them to maintain physical activity and contribute to their overall well-being. Several participants, such as P3, expressed appreciation for this opportunity amidst the difficult times of lockdown and social isolation.

> "It was essential to keep us from being idle for too long. It was like giving a toy to a child who had nothing." P3

Besides the physical and emotional benefits of continuing their physical exercise activities, one factor that stood out as an explanation for satisfaction with the experience of online physical exercise classes was their perceived usefulness, particularly in the context of lockdown and social distancing.

> "It was very useful because we were confined at home for a long time, and it seemed likely to continue. So, it was useful in the sense that it kept us engaged in an activity similar to what we were accustomed to doing." P17

> "As we had to stay at home, which was mandatory, [having online physical exercise classes] was a privilege; we could stay home and keep exercising." P14

Moreover, participants pointed out the general advantages of online classes that demonstrate their usefulness beyond lockdown periods, particularly their convenience. One of the participants suggested that online classes could be a solution to avoid absenteeism, especially in bad weather conditions.

> "The advantages include the convenience of being in our own home, or any preferred location, where we feel comfortable and accustomed, eliminating the need for commuting. We don't have to travel, whether by public transport, private vehicles, or on foot." P10

> "Another advantage of online was that it could rain heavily, and we wouldn't miss a class. Because when it rains a lot, we usually skip class." P9

As highlighted by our participants, mobility challenges and limited access to reliable transportation often prevent older adults from attending in-person classes. By eliminating the need to travel, online fitness programs make exercise more accessible to those who participate. These findings corroborate the points made by da Silva et al. [55], who stressed that the convenience of exercising at home, the ability to avoid adverse weather conditions, and not facing transportation issues are significant advantages. Porter et al. [13] further suggest that convenience may lead older adults to favor the flexibility and accessibility of online options, even in the post-pandemic period. The following section explores, in detail, continuance intentions.

4.3. Continuance Intentions

The possibility of participating in online physical exercise classes in the future was presented as promising, yet as a last resort. This idea was shared even by participants who enjoyed online physical exercise classes, as was the case with P1.

> "If there were no other option, I would recommend it. But if there were [in-person classes], I would forget about the online. Even though I did it and liked it, it doesn't mean I would prefer it. . ." P1

Generally, participants felt that the benefits of in-person classes outweighed those of online ones. Despite the specific advantages of online classes, they prefer in-person sessions and would consider online options only if in-person participation becomes impossible for some reason.

> "Anything can happen. There are so many online classes now. It's a resource; it's never wasted time, but it's not as beneficial as in-person classes." P11

> "If I have to do it, I will. But not voluntarily. . ." P15

> "[I would consider it] only when I really can't come [to in-person classes] anymore because as long as I can, I prefer [in-person]. Because we have other things. We have machines and more diversified exercises. I think it's more useful here than at home." P4

Specific scenarios were identified in which this online format might be beneficial. Most participants recognized online physical exercise classes as useful and valuable. They suggested that these classes are particularly suitable for older adults with limited mobility, those living in distant locations, individuals who prefer to avoid commuting, or those caring for someone at home. The participants in this study suggested that individuals with certain health conditions or physical limitations might feel more comfortable and confident participating in online fitness programs. Yet, they generally did not favor this solution for themselves—at least for the time being, as they have the physical and material conditions to attend in-person classes.

> "I don't live nearby. I use public transport, which can still be expensive because I have to buy a monthly pass and all that. But it's an investment I'm willing to make. Coming here and taking classes gives me pleasure. Online is out of the question." P6

According to the literature (e.g., [56]), when older adults perceive the usefulness of online physical exercise classes, they are more likely to recommend them to others, such as friends and family, thereby contributing to the favorable reputation of these programs. This was evident in most of the interviews. Participants who enjoyed the experience and acknowledged the usefulness of online physical exercise classes indicated they would recommend them to others, especially those with any impediment to attending in-person classes.

> "I really prefer in-person classes. For those who can't make it, it's great. If a person has more difficulty, transportation issues. . . there are multiple situations, living far away. . . then, yes, I think it's better through the computer." P8

> "I would highly recommend it to those who can't come. People who don't have transportation or can't dislocate for any other reason, perhaps they may have sick family members. . . I would strongly advise them to take these online classes." P12

Ultimately, while online physical exercise classes offer numerous advantages, it is important to emphasize that they are most effective when used with in-person classes or activities. A hybrid approach combining both online and in-person options can allow older adults to enjoy the benefits of flexibility while also benefiting from the social interaction that in-person classes provide [13].

5. Discussion

Figure 1 summarizes the findings of this study. The scheme is adapted from Bhattacherjee [17] and his post-acceptance model of usage continuance to organize our findings.

In line with the theoretical underpinnings [17,18], this study confirmed that perceived usefulness and confirmation determine satisfaction, providing additional evidence on the adequacy of ECM to understand continuance intentions. Most participants shared positive experiences with online physical exercise classes, attesting to their satisfaction. This fact was primarily attributed to the usefulness of these classes in overcoming limitations imposed during the pandemic. Furthermore, satisfaction correlated with the confirmation of initial expectations, even among individuals who had very negative initial expectations and confirmed them during the experience. Hence, the basic relationships proposed by ECM [17] between perceived usefulness, confirmation, and satisfaction provide a relevant lens to analyze the participants' experience with online physical exercise classes.

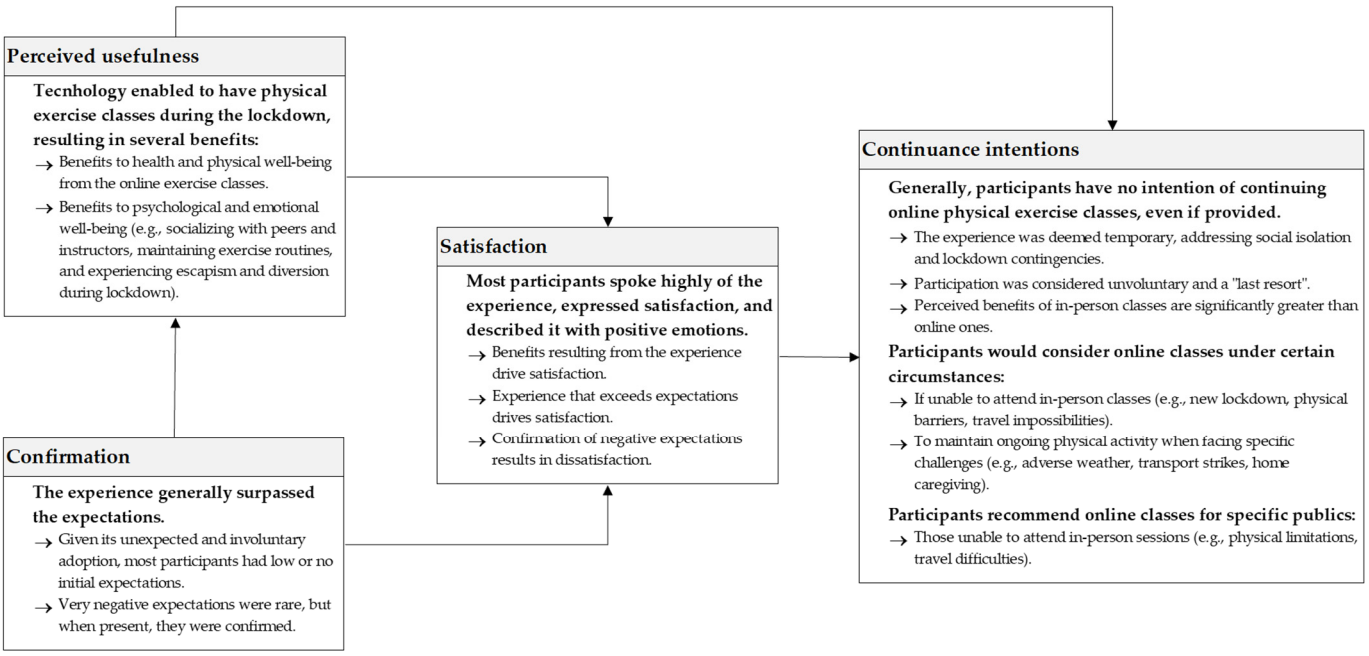

Figure 1. Summary of findings.

However, this study did not evidence the expected positive association between satisfaction and continuance intentions. Participants generally showed no intention of continuing with online physical exercise classes, even if they were available. The explanation is twofold. Firstly, participants did not consider their adoption of online physical exercise classes voluntary. To some extent, they felt forced to adopt this modality. This is an interesting result since anyone who decided to engage in online exercise could decline. All participants in this study had experience with this class type, whereas not all of their peers chose to participate. The feeling of involuntariness stems from the fact that the lockdown circumstances determined the solution. Even those who enjoyed and praised the experience emphasized that it was a "last resort" solution. Secondly, despite recognizing this solution's usefulness and its general benefits, participants also stressed their preference for in-person classes, which offer additional benefits and advantages.

Yet, participants would consider participating in online physical exercise classes again under certain circumstances, not just in the event of new lockdowns. They indicated that online classes could be a reasonable alternative for times when they are unable, for various reasons, to go to the gym (e.g., adverse weather, transport strikes, or physical limitations). Accordingly, they suggested that online classes are a good option for other individuals facing these limitations.

As such, this study contributes to the technology continuance intention literature, as it found three complements of the ECM model to explain continuance intentions. Firstly, contextual factors, particularly the lockdown and physical impediments, were highlighted as a condition for the continuance intentions regarding online physical exercise classes. Participants mentioned that they would continue if a new lockdown was imposed or if they could not participate in person. The arguments provided by the participants were coherent with the necessary condition logic proposed by Dul [57], which analyzes the importance of specific conditions essential for achieving a particular outcome. However, it is not sufficient by itself to trigger it. Hence, the physical impediment to attending in-person classes was described as a necessary yet insufficient condition for online class continuation attendance.

Secondly, while the perceived usefulness of online physical exercise classes is evident, participants' continuance intentions are shaped by the comparison with available alternatives, particularly in-person classes. The participants indicated that, although online classes were valuable, the face-to-face format not only provides additional benefits (e.g., access to

equipment, diverse modalities, personal support from the fitness instructor) but also amplifies similar benefits to a greater extent (e.g., socialization, health, and wellness benefits). Therefore, the usefulness of in-person classes is perceived as significantly superior. While ECM considers the perceived usefulness of technology, it overlooks its comparison with non-technological alternatives.

Thirdly, an unavoidable factor in explaining the participants' behavior was that the choice for online classes was not voluntary, as they repeatedly stated—this was the "last-resort" alternative they had during the lockdown. This result can be interpreted through the Self-Determination Theory (SDT) lens. As explained by Ryan and Deci [58], human behavior can be classified according to diverse levels of autonomy, ranging from external regulation, according to which behaviors are controlled by extrinsic factors, to integrated regulation, according to which the decisions are congruent to individual goals and needs. As stressed by Webb et al. [59], SDT suggests that any autonomously motivated behavior is more likely to endure over time and consequently be associated with higher continuance intentions.

Consequently, this study suggests that to explain the continuance intentions to attend online physical exercise classes, the ECM model should be extended by incorporating three additional factors: perceived usefulness of non-technological alternatives, necessary conditions, and voluntariness/self-determination (Figure 2).

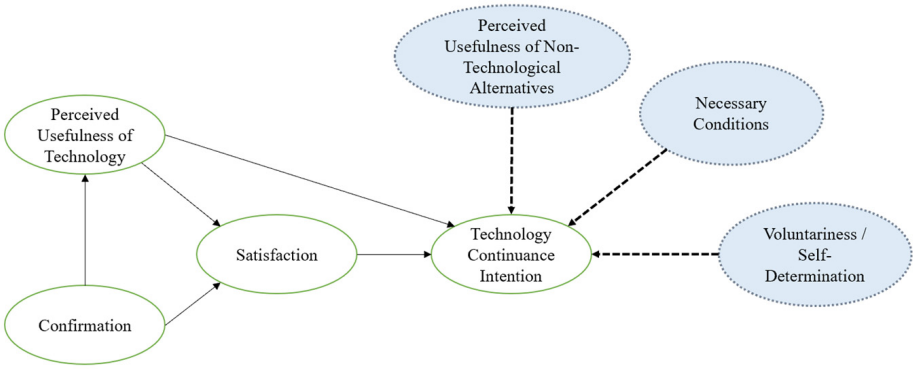

Figure 2. Proposed adaptation of the ECM model based on the findings. Note: The circles in green represent the original variables of the ECM model. Circles in blue are contributions of this study.

6. Conclusions

During the COVID-19 pandemic, the shift from in-person to online physical exercise classes was driven by lockdowns and social distancing measures, leading individuals to explore these digital alternatives. Our research indicates that older adults recognize the usefulness of online physical exercise classes, namely because of their ability to enhance their health and well-being; their expectations were surpassed; and they were generally satisfied with the experience. However, in-person classes remained preferred due to their enhanced benefits. They also felt that adopting online classes was involuntary; instead of an autonomous decision guided by their needs and preferences, this was a viable solution imposed by the lockdown. Consequently, their continuance intentions are limited to specific conditions, namely a new lockdown or other physical impediments. Still, considering the flexibility that online physical exercise classes offer, accommodating time and physical constraints, participants highlighted the advantages of a hybrid approach, accommodating those who face challenges in attending in-person classes.

Hence, the innovations emerging during this period have expanded opportunities for staying active and are expected to remain valuable as circumstances evolve. As such, online physical exercise classes can help maintain an active lifestyle by facilitating and democratizing access to physical exercise classes, contributing to older adults' sustainable health and well-being.

6.1. Theoretical Contributions

Yap et al. [14] have highlighted the lack of attention given to the specific service of online physical exercise classes and the factors influencing older adults' participation and engagement decisions. Additionally, recent reviews of online physical exercise classes for older adults [9,10,15] have uncovered a scarcity of studies, particularly those exploring participants' experiences. Although there is some evidence that older adults who have participated in online physical exercise classes reported high satisfaction levels and some willingness to continue using this type of class [13], to the best of the authors' knowledge, a study focusing on the determinants of continuance intentions is still lacking. This study provides valuable contributions to this field of research. It offers rich empirical data, contributing to the literature on online physical exercise classes. It enables a deeper understanding of seniors' experiences, including factors that influence their continuance decisions in this context. It also demonstrates the adequacy of the ECM in explaining consumer satisfaction. Furthermore, it highlights the limitations of the model in explaining continuance intentions in the case of technological adoption, which individuals feel are involuntary and a last resource. After the experience, they consider the non-technological alternative to be more advantageous. Also, the study identified the existence of necessary conditions to explain continuance intentions. As a result, this study makes a relevant contribution to the technology continuance intention literature by suggesting the inclusion of three additional factors to explain continuance intentions: perceived usefulness of non-technological alternatives, necessary conditions, and voluntariness/self-determination. In this regard, it stresses the possible complementarities between ECM, SDT, and necessary condition logic, contributing to future ECM model developments.

6.2. Practical Implications

Participants who have experienced both in-person and online physical exercise classes tend to prefer in-person interactions. However, the study highlights the timeliness of offering online classes for certain circumstances, leading this study to recommend the continuation of hybrid class models, which combine both formats. A hybrid model provides flexibility, expanding the potential audience by accommodating those who prefer the convenience of online classes while catering to those who value personal interactions. This approach also addresses mobility, location, and scheduling challenges some individuals face, thus enhancing their overall experience. Ultimately, offering online classes complements in-person offerings, increasing consumer loyalty and innovation and aligning with market demands. It also presents fitness centers with opportunities to enhance their business image.

This study also allows for important conclusions to be drawn for policymakers and those responsible for public policies, particularly in the direction of increasing physical activity and health, such as financial support for digital inclusion, technology training for seniors, the promotion of accessible online exercise programs, and the creation of participation incentives.

6.3. Limitations and Future Research Directions

Some limitations of this study must be acknowledged. First, this study is exploratory and includes a limited number of participants recruited using a convenience sampling technique. However, the sample size was considered adequate for this study, as participants have diversified profiles, the data captures diverse experiences and perspectives, and data saturation was achieved. Given its qualitative and exploratory nature, this study's findings are linked to the participants' context, views, and experiences and are not intended to be generalizable to a broader population. The extrapolation of the findings requires further validation, namely by replicating the study with distinct samples.

Future research may also consider different methodological approaches. This could involve using both qualitative and quantitative methods to provide comprehensive and detailed data collection methods and establish causal relationships. Another area for

additional research could be examining older adults' actual ongoing usage behavior. Longitudinal studies that track participants' experiences and participation over time may assist researchers in determining the long-term impact.

Finally, this study proposes the inclusion of new factors to explain continuance intentions. The quantitative test of the underlying hypotheses is beyond the scope of this study and should be addressed by future research. This could be conducted in the context of online physical exercise classes and other online services that gained popularity during the pandemic. Comparisons between different age groups could also provide valuable contributions to the literature and generate relevant managerial and societal implications.

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Institutional Review Board Statement: The study followed the Declaration of Helsinki. Ethical review and approval were waived for this study due to the nature of the data collected and the fact that the topic and the research objectives were not considered sensitive or pertained to any risks to participants. Ethical principles generally applied to social research were adopted: informed consent, confidentiality, anonymity, and voluntariness.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study, as participants manifested their agreement to participate in the research and the inclusion of their responses in the analysis and publication of results.

Data Availability Statement: Data are contained within the article.

Conflicts of Interest: The authors declare no conflicts of interests.

Appendix A. Interview Outline

1. Did your gym provide online exercise classes during the lockdown? Can you tell me more about this?
2. Overall, how would you describe your experience with online exercise classes?
    - 2.1 What were the main challenges you faced with online exercise classes?
    - 2.2 What do you consider the main advantages of online fitness classes?
    - 2.3 What are the main disadvantages of online exercise classes?
    - 2.4 Were your expectations met?
    - 2.5 What benefits did you gain from the online fitness classes?
3. What is your current opinion on online fitness classes?
    - 3.1 Would you recommend online fitness classes, and if so, to whom or in what situations?
    - 3.2 Will you likely participate in online fitness classes again, and if so, under what circumstances?
    - 3.3 How do you think online fitness classes could be improved?

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Article

Smartphone Addiction and Related Factors among Athletes

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Abstract: Smartphone addiction (SA) is increasing worldwide. The aim of this study is to determine the level of SA in athletes affiliated to the Turkish Handball Federation in Izmir and to examine its relationship with factors such as sociodemographic status, health status, eating attitude, and body perception. This cross-sectional study was conducted in March–April 2021 in Izmir Province. The sample of the study consisted of 212 licensed handball athletes. The short SA scale, three-factor nutrition scale, and body perception scale were used. A chi-square test was used for bivariate comparisons and logistic regression analysis was used for multivariate comparisons. The study was completed with 202 individuals (the coverage rate was 95.3%). The prevalence of SA was found to be 27.7%. The risk of SA increased 2.49-fold (CI: 1.17–5.31, $p = 0.018$) in female participants, 2.01-fold (CI: 1.01–4.06, $p = 0.048$) in participants with alcohol use, 2.17-fold (CI: 1.04–4.58, $p = 0.042$) in participants with low nutritional scores, 2.65-fold (CI: 1.15–6.10, $p = 0.022$) in individuals with high-income status, and 2.66-fold (CI: 1.07–6.64, $p = 0.036$) in individuals with high body perception scale score. In total, 27.7% of the athlete sample had scores above the SA threshold. These results point out that a behavioral addiction such as SA can occur even in professionals of an activity such as sports, known for beneficial effects in terms of healthy life.

Keywords: smartphone addiction; athletes; eating attitude; body perception

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Correction Statement: This article has been republished with a minor change. The change does not affect the scientific content of the article and further details are available within the backmatter of the website version of this article.

1. Introduction

In today's world, addiction includes behavioral addictions such as gambling, internet, shopping, eating, and smartphone addictions, in addition to substance use such as smoking, alcohol use, and drug use [1]. Behavioral addictions show psychological and physical symptoms (mood variability, mental preoccupation, interpersonal conflicts, tolerance, relapse, and withdrawal), which are the main components of addiction, as seen in alcohol and substance addictions [2].

Although the main purpose of the emergence of smartphone technology was to perform communication and reach information cheaply, easily, and safely, the rapid spread of use and pathological overuse has led to problematic internet use [3] and smartphone addiction (SA), which is a new type of addiction in the literature. SA can be defined as the inability to prevent the desire to use smartphones, excessive irritability and aggression in case of withdrawal, and the gradual negative impact and deterioration of the individual's work, social, and family life [4]. Although it is not defined in DSM-5-TR or ICD-11, several studies show that SA is a very common addiction and its prevalence is gradually increasing [5,6].

When studies on SA are examined, it has been observed that pathological conditions that progress with repetitive and impulsive behavior patterns that stimulate the reward system are similar to the pathophysiology of other behavioral addictions and substance use disorders, and multiple neurotransmitter systems are involved in their mechanism [7]. In light of these studies, it is seen that similar dopaminergic and serotonergic systems are

involved both in sports and eating [8,9]. In addition to the above-mentioned neurophysiological explanations for sport and eating, there are also scientific studies that contribute to psychological factors. Sport may increase the risk for eating disorders [10]. Athletes are exposed to sociocultural pressure to have an ideal body appearance [11]. It is also reported that psychological characteristics such as performance anxiety are risk factors for eating problems, and the onset of eating disorders coincides with the active-athlete age periods of adolescence and young adulthood [12].

Body perception, which is associated with the development of eating disorders [13] and has been evaluated as an important factor in an athlete sample [14], is defined as feelings, thoughts, and perceptions about one's own body [15]. It is stated that negative body perception leads to social appearance anxiety [16], and individuals with social appearance anxiety use smartphones more than usual to cope with real-life situations [17]. Individuals with long-term smartphone use are exposed to more idealized body appearances (social media, blogs, advertisements, etc.), which may lead to cognitive internalization of the ideal body appearance, and this body comparison may result in negative body perception [18]. Sociocultural ideals about body appearance imposed through smartphone use are particularly high in the athlete population and may cause the difference between actual appearance and perceived appearance to grow, thus resulting in negative body perception [14].

Sports are generally known to have beneficial effects on both prevention and rehabilitation processes from addictions [19]. However, there are studies showing a positive association between physical activity and types of problematic use of the internet [20]. These contradictory results need more clarification. Recent research findings demonstrate that smartphone addiction can escalate to levels as high as 40% among athletes in Singapore [21] and sports science students in Turkey [22]. Additionally, these studies delve into its correlations with various factors within athlete samples in Turkey [23]. Handball is evaluated as a sport with high levels of physical and mental stress [24], which are mediating factors for eating and internet addiction [25]. Being a team and competitive sport, requiring high motivation, a sense of achievement depending on the struggle, and a high level of physical contact are handball-specific features that can support the development of impulses for dopamine release in players [26]. The unique aspect of this study is that it examines the risk of SA in a population with intensive sporting activities in their lives and questions the associated factors. The main question of the study is the relationship of SA, important in terms of reward pathways in the athlete population, where neurotransmitters such as dopamine and serotonin are intensively activated, with eating status and body perception.

This study aimed to examine the levels of SA and the factors that may be related to SA in Turkish professional athletes in Izmir, affiliated to the Handball Federation. In this context, the study focused on the relationship between athletes' SAs and their socioeconomic and demographic characteristics, existing health status and habits, body perception levels and eating attitudes.

2. Materials and Methods

2.1. Research Design

This research was an analytical study planned with a cross-sectional design. It was conducted in the districts where there are sports clubs with licensed athletes in the handball branch in the province of Izmir, Turkey, in the 2019–2020 and 2020–2021 seasons (Supplementary Table S1).

2.2. Study Sample

The population of the study consisted of athletes born before 2007 who were licensed and active in sports clubs in Izmir Province, registered with the Handball Federation in the 2019–2020 and 2020–2021 seasons. Athletes playing in the Professional League and Youth League athletes who had the competence to play in the Professional League were included in the study. The number of licensed athletes (league athletes and licensed youth team

athletes) affiliated to the Handball Federation of Izmir Province is 212. The athletes were contacted by the federation's communication department and the sports clubs to which they were affiliated. No sample was selected in the study; we aimed to include the entire population of 212 people. All athletes who gave consent to participate were included in the study.

Approval was obtained from the Ege University Medical Research Ethics Committee for Research in February 2021 (approval number: E.43687). Necessary permissions were obtained from the Turkish Handball Federation. The study did not involve any animal or human experimentation and consisted entirely of data collection by questionnaire and an analysis of the results.

2.3. Procedure

The data collection process of the research took place between March and April in 2021, amidst the ongoing COVID-19 pandemic. Sports clubs that requested participation were visited during their training hours for face-to-face data collection. For sports clubs that preferred not to engage in face-to-face meetings due to the pandemic, data were gathered remotely through Google Form surveys. The data were gathered directly by the researcher without the involvement of surveyors or interviewers.

2.4. Variables

The dependent variable of the study was SA. The 10-question "SA Scale-Short Form (SA-SF)" developed by Kwon et al. was used to measure the SA variable. The scale is evaluated on a 6-point scale. Each item is scored from 1 to 6, and the total score is between 10 and 60. As the scores obtained by the individual increases, the risk of addiction increases. When an ROC analysis of the scale is performed, the cut-off point is 33 for women and 31 for men. The Cronbach alpha value of the scale was found to be 0.97 [27]. Turkish validity and reliability studies were completed by Noyan et al. in 2015. The scale is single-factor and has no subscales [4]. The Cronbach alpha coefficient of the Turkish scale consisting of ten items was 0.867. Thus, the scale was accepted as a valid and reliable scale to examine SA in young adults.

The independent variables were sociodemographic characteristics, current health status and behaviors, nutrition behavior/attitude, and body perception. Sociodemographic characteristics such as the age, gender, income level (those with a monthly income of TRY 750 or less were considered low and those with an income of more than TRY 750 were considered high), and education level of the participants were evaluated. On 31 March 2021, in the data collection period, USD 1 equaled TRY 8.32. In order to comprehensively integrate the participant's age into the study, an open-ended inquiry regarding their date of birth was employed. Participants' current body weight and height were initially gathered in an open-ended format, with a subsequent computation of Body Mass Index (BMI). Regarding the existing health status and behaviors variable, there were questions describing their habits and existing conditions, such as whether they had past diagnosed diseases, the number/hours of weekly training, and smoking/alcohol use. In this section, athletes were asked to answer a questionnaire consisting of open and closed-ended questions. For the assessment of the eating behavior and attitude variable, the short version of the 51-question three-factor eating questionnaire (TFEQ), developed by Messic and Stunkard in 1985, was used to examine and measure the behavioral and cognitive components of nutritional status [28]. Cronbach's alpha values of the cognitive restraint, uncontrolled eating, and emotional eating subscales are 0.76, 0.83, and 0.85, respectively [29]. Validity and reliability tests of the TFEQ in Turkish were conducted by Kirac et al. in 2015. The questionnaire consists of 18 questions and measures the degree of cognitive restraint of eating, the level of uncontrolled eating, and the degree of eating when one is emotional. It has also been reported to measure the level of sensitivity to hunger [30].

In the study, data on athletes' satisfaction with their bodies were measured with the body perception scale. The scale, whose original name is the body cathexis scale (BCS),

was first developed by Secord and Jourard in 1953 [31]. The reliability of the test for body image perception was determined to be r = 0.81. The body perception part of this scale developed by Secord and Jourand was translated into Turkish by Hovardaoğlu in 1989, and Turkish validity and reliability studies of the body perception scale were conducted by Hovardaoğlu in 1992 [32]. The scale consists of 40 items evaluating satisfaction with a part or function of the body. The scale is a 5-point Likert scale, and the total score can vary from a minimum of 40 to a maximum of 200 points. The scale includes the following: 1 = I like it a lot, 2 = I like it, 3 = I am undecided, 4 = I do not like it very much, and 5 = I do not like it at all, and those with high scores are defined as having low body perception. An increase in the total score indicates a decrease in satisfaction with body parts or functions, whereas a decrease in the total score indicates an increase in satisfaction. The cut-off point of the scale is 135 [33].

2.5. Statistical Analysis

Number, percentage, mean, minimum–maximum values, and standard deviation (SD) were used for the descriptive results of the study group. A chi-square test was used to evaluate the relationship between the independent variables and SA and for bivariate analysis. Effect sizes were calculated for establishing the differences between addicts and non-addicts in relation to the independent variables. The Φ (phi) coefficient was used for 2 × 2 contingency tables and Cramér's V was used for the tables larger than 2 × 2 for the estimation of effect size [34]. Logistic regression analysis was used for multivariate comparisons. The dependent variable of the study was binary, and the observations were independent. The independent variables included in the regression model were not correlated with each other. The sample size required was sufficient. Therefore, the assumptions for performing logistic regression analysis were met. The significance level was taken as $p < 0.05$. IBM SPSS Statistics for Windows, version 25.0 (IBM Corp., Armonk, NY, USA), was used for data analysis.

3. Results

From the group of 212 people included in the research, 202 people were interviewed. Accordingly, the coverage rate of the study was determined as 95.3%. The SA status of the study group according to the sociodemographic characteristics and health data is presented in Table 1.

Table 1. SA status of the study group according to socioeconomic, demographic, and health data.

Sociodemographic and Economic Characteristics		Addicted to Smartphones		Not Addicted to Smartphones		Total **		Effect Size	*p*
		N	%	N	%	N	%		
Age	23 years and under	48	28.2	122	71.8	170	84.1	0.026	0.708
	24 years and older	8	25.0	24	75.0	32	15.9		
Sex	Female	43	33.9	84	66.1	127	62.9	0.178	0.011 *
	Male	13	17.3	62	82.7	75	37.1		
Education Status	Middle school–high school	38	27.7	99	72.3	137	67.8	0.000	0.995
	University and above	18	27.7	47	72.3	65	32.2		
Monthly Average Income	Low	10	17.2	48	82.8	58	28.7	0.149	0.035 *
	High	46	31.9	98	68.1	144	71.3		
Active Training/Sports	Yes	50	26.2	141	73.8	191	94.6	0.144	0.041 *
	No	6	54.5	5	45.5	11	5.4		
Diagnosed Disease	Yes	7	31.8	15	68.2	22	10.9	0.032	0.649
	No	49	27.2	131	72.8	180	89.1		
BMI Groups	17.00–18.49	1	20.0	4	80.0	5	2.5	0.034	0.887
	18.50–24.90	44	27.5	116	72.5	160	79.2		
	25.00 and above	11	29.7	26	70.3	37	18.3		
Cigarette Use	I don't smoke	43	25.9	123	74.1	166	82.2	0.087	0.215
	Smoking	13	36.1	23	63.9	36	17.8		
Alcohol Usage	Yes	25	38.5	40	61.5	65	32.2	0.165	0.019 *
	No	31	22.6	106	77,4	137	67.8		

$p < 0.05$ for the data indicated with *. ** Percentage of columns used.

A total of 84.1% of the participants were high school students and under the age of 23, and 62.8% of the participants were female. When the educational status of the participants was analyzed, it was found that 67.8% were middle/high school graduates and 32.2% were university graduates. When the amount of income per capita was analyzed, it was found that 28.7% of the participants stated that they had a low-income level. The BMI of 79.2% of the participants was between 18.50 and 24.99, which is the ideal level. A total of 89.1% of the participants did not have any disease, and 17.8% of them smoked at least one cigarette a day. While 67.8% of individuals did not consume alcohol at all, 32.2% consumed alcohol at different frequencies, including rare consumption. It was also noted that all participants (100%) used smartphones.

In our study, SA was found to be higher in females than males, indicating a significant association of small effect size (p = 0.014, phi = 0.178). In the study group, those with a higher per-capita monthly income were found to have a higher level of phone addiction with a small effect size (p = 0.038, phi = 0.149). There was no statistically significant relationship between the participants' age, educational status, financial status perception, and the occurrence of SA ($p > 0.050$).

While SA was found to be higher in individuals with alcohol use (p = 0.020, phi = 0.165), SA was found to be lower in individuals who actively trained/ participated in sport (p = 0.041, phi = 0.144), indicating small effect sizes for both associations. There was no statistically significant relationship between the variables of BMI, medication use, the presence of a diagnosed disease, and smoking and SA ($p > 0.050$).

The distribution of the scores obtained by the research group from the SA scale is presented in Figure 1.

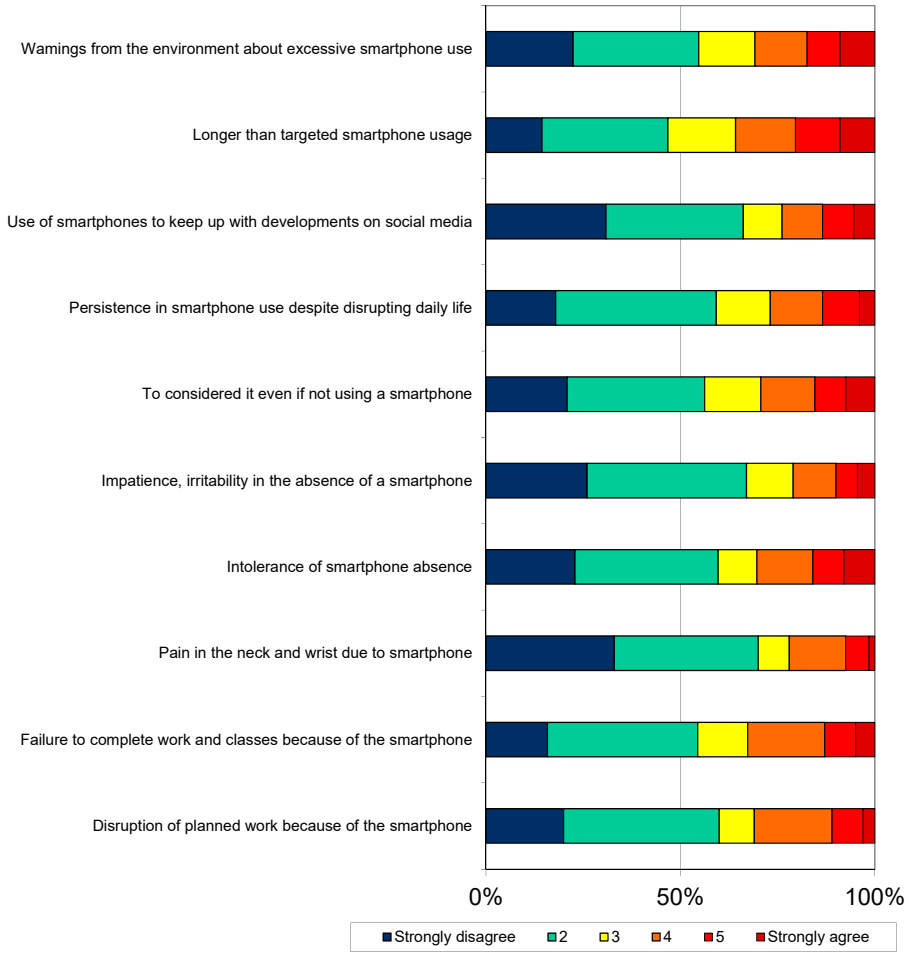

Figure 1. Distribution of the scores obtained by the research group from the SA scale.

According to the data, 28.2% of the participants reported that they disrupted their planned work because of their smartphone, 32.7% reported that they could not complete their lessons and work because of their smartphone, 29.3% reported that they thought about their smartphone even if they did not use it, and 26.8% reported that they insisted on using the smartphone despite it disrupting their lives (Figure 1).

Body perception values were 87.2 ± 29.4 on average, with a minimum of 40 and a maximum of 192. According to nutritional data, individuals consume an average of 2.58 ± 0.70 meals per day, with a minimum of 1 and a maximum of 5 main meals. They consume an average of 1.86 ± 1.07 snacks, with a minimum of 0 and a maximum of 6 snacks. The mean total score of the three-factor nutrition scale was 41.89 ± 11.2, and the mean subscale scores of the athletes were 11.84 ± 3.69 for uncontrolled eating/inability to restrain eating, 6.61 ± 2.94 for emotional eating, 15.04 ± 4.21 for conscious restriction, and 8.39 ± 3.82 for hunger (Supplementary Table S2).

SA was found to be lower in individuals with adequately balanced nutrition (p = 0.002). SA was statistically higher in individuals with higher scores on the nutritional status scale (p = 0.017, Cramer's V = 0.244), on the uncontrolled eating subscale (p = 0.002, Cramer's V = 0.244), and on the emotional eating subscale (p = 0.001, Cramer's V = 0.290), with a medium effect size, whereas on the hunger subscale, a small effect size was observed (p = 0.030, Cramer's V = 0.184). No significant relationship was found between the inability to restrict eating subfactor and SA (p > 0.050).

When body perception and SA were examined in the study group, liking one's own body structure and body perception scale score were found to be statistically significant with SA. SA was found to be lower in individuals who stated that they liked their own body structure (p = 0.019). SA was found to be higher in individuals with higher body perception scale scores (p = 0.030) (Table 2).

Table 2. SA status of the study group according to nutrition and body perception data.

Nutrition Specifications		Addicted to Smartphone		Not Addicted to Smartphone		Total **		Effect Size	*p*
		n	%	n	%	n	%		
Body perception score	48–134 points	48	25.5	140	74.5	188	93.6	0.179	0.025 *
	135–192 points	8	57.1	6	42.9	14	6.4		
Three-factor nutrition score	20–29	3	10.0	27	90.0	30	14.8	0.244	0.017 *
	30–39	11	20.0	44	80.0	55	27.1		
	40–49	28	38.4	45	61.6	73	36.1		
	50–59	7	25.9	20	74.1	27	13.4		
	60–69	7	41.2	10	58.8	17	8.4		
Uncontrolled eating factor	5–9 points	7	12.1	51	87.9	58	28.7	0.244	0.002 *
	10–14 points	29	30.2	67	69.8	96	47.5		
	15+ points	20	41.7	28	58.3	48	23.8		
Emotional eating factor	3–6 points	17	15.7	91	84.3	108	53.5	0.290	<0.001 *
	7–10 points	27	39.7	41	60.3	68	33.7		
	11 + points	12	46.2	14	53.9	26	12.8		
Inability to constrain factor	4–7 points	11	24.4	34	75.6	45	22.3	0.075	0.567
	8–11 points	30	31.3	66	68.8	96	47.5		
	12+ points	15	24.6	46	75.4	61	30.2		
Hunger factor	4–7 points	16	18.4	71	81.6	87	43.0	0.184	0.033 *
	8–11 points	23	33.3	46	66.7	69	34.2		
	12+ points	17	37.0	29	63.0	46	22.8		

* $p < 0.05$. ** Percentage of columns used.

The regression analysis results of the variables associated with SA in the research group are presented in Table 3.

Table 3. Regression analysis results of the variables associated with SA.

Variables		OR	(%95 GA)	*p*
Sex	Ref: Male	1		
	Female	2.49	GA: 1.17–5.31	0.018 *
Alcohol use	Ref: No alcohol consumption	1		
	Alcohol consumption	2.01	GA: 1.01–4.06	0.048 *
Active training/sports	Ref: Regular sports are practiced	1		
	Lack of regular exercise	2.04	GA: 0.50–8.39	0.320
Three-factor nutrition score	Ref: Low-scale score	1		
	High scale score	2.17	GA: 1.04–4.58	0.042 *
Income	Ref: Low income	1		
	High income level	2.65	GA: 1.15–6.10	0.022 *
Body perception score	Ref: Low scale score	1		
	High scale score	2.66	GA: 1.07–6.64	0.036 *

* $p < 0.050$.

In order to examine the variables that were found to be statistically significant as a result of binary analyses in detail, the variables associated with SA were evaluated by regression analysis. When the factors affecting SA were examined, statistical significance was found in the regression analysis between SA and gender, alcohol use, three-factor nutrition scale score, income status, and body perception scale score variables ($p < 0.050$).

In our study, the risk of SA increased 2.49-fold (CI: 1.17–5.31, $p = 0.018$) in female participants, 2.01-fold (CI: 1.01–4.06, $p = 0.048$) in participants with alcohol use, 2.17-fold (CI: 1.04–4.58, $p = 0.042$), 2.65-fold (CI: 1.15–6.10, $p = 0.022$) in individuals with high-income status, and 2.66-fold (CI: 1.07–6.64, $p = 0.036$) in individuals with high body perception scale score. In the regression analysis, the variable of doing active sports lost its significance for SA ($p > 0.050$).

4. Discussion

This study was conducted in the districts where there are sports clubs with licensed athletes in the Handball Branch in the province of Izmir in the 2019–2020 and 2020–2021 seasons. The study aims to examine the relationship between SA and factors such as socioeconomic status, health status, eating attitude, and body perception that may be related to SA in athletes residing in Izmir Province affiliated to the Handball Federation. Within the scope of the study, 202 handball athletes were interviewed.

As a result of the analysis, the frequency of SA of the participants was found to be 27.7%, and it was seen that all four hypotheses were confirmed in terms of certain variables. The risk of SA was higher in women, in individuals with high income, in participants with alcohol use, in individuals with low nutrition scale scores, and in individuals with low body perception scale scores.

4.1. Strengths and Limitations

Since this study was conducted among the athletes affiliated to the Handball Federation in Izmir Province, its generalizability is limited. Since the research was planned cross-sectionally, the cause-and-effect relationship was examined at the same time, so its causality and examination power are limited. The answers given to the questions in the questionnaire were limited to the accuracy of the answers given by the subjects. As a limitation specific to SA-SF, while it provides an effective means to predict smartphone addiction tendencies, it does not diagnose clinical addiction due to not being performed in clinical settings [27]. Regarding the body perception scale, it primarily focuses on percep-

tual aspects of body image, possibly not capturing other important dimensions such as the emotional impact of body image concerns. Cultural variabilities in body ideals, norms, and attitudes may also cause validity and reliability concerns in different cultural contexts [35]. The TFEQ, being a Likert-type scale to assess eating behaviors, may not fully capture the complexity and variability of individuals' eating patterns and motivations, which may also be a limitation for the abovementioned two scales utilized in the research as well [36]. When the study is examined in terms of its originality, it is one of the first studies to examine SA, which is a behavioral addiction, as well factors such as socioeconomic status, health status, eating attitude, and body perception that may be related to it, in an athlete sample. In our study, it was observed that the female population was higher than the examples in the literature. This higher proportion of women is due to the lower number of male handball players in Izmir Province.

The frequency of players' participation within the team, whether as regular players or as substitutes, as well as the success or failure of their team, may influence addictive behaviors. However, it is important to note that we did not inquire about these factors, representing another limitation of our study.

In the research design, it was planned to collect the data face to face. However, the working period coincided with the COVID-19 pandemic period. Therefore, 15% of data were collected online from participants. While there may be biases stemming from different data collection methods, it is believed that these differences did not significantly affect our results. Apart from the data collection procedure, the pandemic may be a factor affecting behavioral addictions as a coping mechanism for mental distress prevention [3,37,38]. The onset of the COVID-19 pandemic furnished an unprecedented opportunity for researchers worldwide to delve into the effects of stressful life events on individuals' psychological reactions and addictive inclinations. During the COVID-19 pandemic, lockdown measures compelled individuals to spend extensive periods in front of screens, particularly smartphones, to sustain social connections, communication, and fulfill work and educational obligations. Hence, it becomes imperative to grasp the gravity of these addictive behaviors and their interplay with other pandemic-induced factors [37].

4.2. Comparison of the Results with the Literature

Among the socioeconomic variables, gender and average monthly income variables were found to be associated with SA. According to the data obtained in the study, SA risk was high in women. When the literature data are examined, gender, especially being male, is reported to be risky for pathological internet use [39]. In contrast to internet addiction and use, in SA studies, women were found to have a higher risk of addiction than men [40]. When the literature is evaluated in terms of the basis of this difference, it has been reported that the purpose of men's smartphone use may be different from women's; men use smartphones more as a tool, while women use them for the continuity of communication with their loved ones, and therefore, women have higher addiction levels [41]. In another study in which the difference in the purpose of use was reported, it was stated that women mostly used their phones for social media purposes, while men used their phones more intensively for gaming purposes [42]. In this context, studies in the literature have frequently found that women have a high level of SA. Another situation that supports the high prevalence of SA in women is that women have higher levels of self-awareness about their addictions and are more open about explaining their problems [27]. Our results are in line with the literature in terms of indicating that women are more addicted to smartphones.

4.2.1. Socio-Demographic Variables and Prevalence of Smartphone Addiction

The prevalence of SA of the participants was found to be high. This high prevalence of SA in handball players can be explained in different ways. Firstly, behaviors with addictive potential such as exercise, eating, and internet use have common characteristics with addictions caused by substances in terms of affecting brain reward systems. The brain

stimulation required for the reward (reward threshold) increases with the repetition of the addictive behavior [43]. Considering the professional athlete group that constituted the sample of the study, it can be said that they have highly activated reward systems due to their regular and intensive training programs. In our study, it is thought that the athletes choose SA as an easily accessible source of dopamine that would not harm their sportive performance during non-sporting hours as a result of the increase in the reward threshold caused by long-term sports. Another explanation for this high prevalence could be associated with the exacerbating effect of COVID-19 on SA [3]. The lockdown and social distance measures taken during the COVID-19 pandemic forced people to use their smartphone as a means of secure communication and access to information.

Another important finding of the study is that the risk of SA is higher in individuals with high-income status. According to a study conducted on middle school students in South Korea, high-income status is associated with intensive smartphone use [44]. The literature and study data on income status are in parallel. The main reason for this similarity may be related to the fact that individuals with high-income status have more access and tendency to use smartphones [45]. Financial affordability is cited as another factor contributing to the association between smartphone addiction and a higher income level [46].

4.2.2. Alcohol Use and Smartphone Addiction

In this study, it was found that SA was 2 times more common in those who consumed alcohol. Studies have shown that there is a relationship between SA and alcohol use [47]. There are studies suggesting that this significant relationship can be explained by a potential psychosocial process that may contribute to behavioral addictions such as anxiety, depression, and neuroticism [48,49]. It is stated that alcohol use in athletes is stress-related. Especially in team games such as handball, alcohol use was found to be high [24]. Alcohol use, similar to SA, is reported to occur for the control of internal dysphoric states [50]. The COVID-19 pandemic, which aligns with the data collection period of this research, could serve as another factor exacerbating both alcohol consumption and smartphone addiction, thereby bolstering their correlation. This pandemic is notorious for instigating stress as a result of lockdown measures, uncertainties, social isolation, and grave health risks. Research has shown increases in the number of people with alcohol use problems [51] and smartphone addiction [52] during the pandemic. Alcohol and smartphone use can be a coping mechanism for pandemic-specific conditions. Sport increases the level of reward components (dopamine and endogenous opioids). However, when reward components are not activated, athletes turn to alcohol, which results in an increase in these secretions [53]. There are studies suggesting that alterations in this reward system may underlie substance and behavioral addictions [54]. Studies showing that "reward deficiency syndrome" resulting from such changes in dopaminergic receptor levels leads to substance seeking and other behavioral patterns [7] are also supported by findings on genetic determinants [55]. In light of these studies, it can be said that the relationship between SA and alcohol use in handball players may be related to reward deficiency syndrome and may be aimed at coping with internal dysphoric moods and stress, which are seen at higher levels in team sports.

4.2.3. Eating Behavior and Smartphone Addiction

In this study, individuals with a high mean total score on the three-factor nutrition scale (TFEQ) were found to be at higher risk for SA. In studies conducted with different athletes and student groups, including handball, total TFEQ scores were found to be associated with SA [56,57]. When different studies were examined, TFEQ scores and subscale scores were found to be associated with SA, in line with the literature. It is thought that this relationship between problematic eating behavior and SA can be explained by common pathways involved in brain reward systems [58]. Another explanation for the association between eating and internet addiction is the mediating effect of psychological distress [25].

Emotional eating often arises due to heightened levels of the stress hormone cortisol, which subsequently amplifies both our appetite and inclination for food consumption. Engaging in stress-induced eating, particularly amidst the onset of an infectious disease outbreak, is a prevalent occurrence [59]. Moreover, both eating and smartphone usage can serve as a means of diversion or relief from the isolation imposed by the pandemic. There are also studies showing that athletes with eating disorders have a higher need for social approval [60]. Problematic smartphone use is associated with the need for social approval [48]. These data suggest that the need for social approval may mediate the relationship between SA and eating scale scores in athletes.

4.2.4. Body Perception and Smartphone Addiction

In this study, a high mean body perception scale score for athletes was found to be riskier in terms of SA. In a study conducted on university students, similarly, individuals with negative body perception were found to have high levels of SA [61]. It is thought that the basis of this relationship may be the pathological desire to be liked, changing popular understanding of beauty, and social perceptions that increase with developing technology and smartphone use. Individuals with a negative body perception may have low self-esteem in real life and may need to receive more positive reactions through smartphones. Individuals with low self-esteem and limited social skills, driven by a strong need for social approval and a sense of belonging, are more predisposed to developing a smartphone addiction [62]. Social networks provide individuals with an opportunity to show only their positive characteristics and can facilitate them to create the perception they desire [63]. Body perception is another factor shown to be affected by the COVID-19 pandemic. The pandemic has ushered in shifts in lifestyles [38], notably characterized by heightened sedentary behaviors such as extended periods spent at home, which have been linked to a generally unfavorable perception of body image [64].

5. Conclusions

In this study conducted on handball athletes, the prevalence of SA was found to be 27.7%. The risk of SA was found to be higher in women, those with higher income levels, those with alcohol use, those with higher eating scores, and those with negative body perception. These results regarding the comorbidity of SA with eating problems, alcohol use, and negative body perception indicate the presence of a reward system disorder. This study contains striking results in terms of pointing out that addiction is not a problem that affects only certain segments of society and that a behavioral addiction such as SA can occur even in professionals of an activity such as sports, which is known to have beneficial effects on health. There is a need for interventions that will allow those working in the field of guidance and counseling to approach the risk groups defined above with special care and to create healthy resources that individuals can use to stimulate their reward systems.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/bs14040341/s1.

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behavioral sciences

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Review

Does Motor Imagery Training Improve Service Performance in Tennis Players? A Systematic Review and Meta-Analysis

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Abstract: Motor imagery training is a common mental strategy used by tennis players and coaches to improve learning and performance; however, the effect of motor imagery training on service performance in tennis players is questionable. This review aims to consolidate existing research regarding the effects of motor imagery training on the service performance of tennis players. A systematic search was conducted following the PRISMA guidelines, using PubMed, Web of Science, SCOPUS, and SPORTDiscus to identify articles published until December 2023. Eligible studies comprised controlled trials that investigated the impact of motor imagery on service performance outcomes in tennis players. The methodological quality of individual studies was assessed using the Cochrane RoB-2 and ROBINS-I tools. GRADE was applied to assess the certainty of the evidence. Nine trials including 548 participants met the inclusion criteria. The results indicated that motor imagery training improved service accuracy and technique but did not affect service speed or return accuracy in tennis players. In conclusion, the certainty of the evidence that motor imagery training may be effective in improving service accuracy and technique in tennis players is low to very low. However, more experimental work is needed to obtain stronger conclusions.

Keywords: motor imagery; mental training; tennis service; sports psychology; performance

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1. Introduction

In tennis, every point begins with the service, making it the pivotal shot and a crucial determinant of success in the game [1]. A scientific finding has pointed out that approximately 25% of tennis scores originate from the service [2]. However, mastering the service poses a formidable challenge, given the intricate coordination of limb and joint movements needed to accumulate and transfer forces effectively from the ground up to the racquet head. This process is referred to as the kinetic chain [3]. The acquisition of proficient skills is frequently credited to extensive periods of physical training, demanding high levels of attention and effort [4,5]. An alternative that sports psychologists and coaches have widely used to improve athletic performance is motor imagery training [6,7]. Motor imagery entails mentally envisioning an action without physically carrying it out [8,9], triggering activity in brain regions typically engaged during the actual execution of the task [10]. Motor simulation theory proposes that imagined actions are functionally equivalent to actual ones in terms of intention, planning, and the involvement of neural pathways [11–13]. Indeed, motor imagery training can aid in the development of motor expertise, which in turn facilitates activity-dependent neural reorganizations in the brain, controlling both imagined and real performances [14]. From a practical standpoint, the application of motor imagery practice plays an important role in various sports, contributing to the acquisition of motor skills, and preparation before competitions [15,16]

The effectiveness of motor imagery training in learning and performance improvement is supported by previous meta-analyses. Behrendt et al. [17] concluded in their meta-

analytic study that motor imagery practice helps improve the motor learning of children and adolescents. Lindsay et al. [7] emphasize that motor imagery training could serve as an effective strategy for cultivating sport-specific motor skills. Simonsmeier et al. [18] found that imagery interventions notably improved motor performance, motivation, and affective outcomes in sports. On the other hand, many individual studies have suggested that motor imagery intervention has positive effects on skill performance among athletes. For example, Fazel et al. [19] highlight the positive impact of employing motor imagery to improve free-throw shooting performance in basketball players. Fortes et al. [20] concluded that imagery training enhances the passing decision-making performance of volleyball players. Björkstrand & Jern [21] reported that an imagery intervention can improve the penalty-taking ability of soccer players.

Recently, there has been increasing interest in examining the impact of motor imagery practice on tennis service performance. However, the results and conclusions drawn were partly contradictory. For example, although studies indicated improved service speed following motor imagery training [22,23], researchers in other investigations did not observe an increase in service speed after motor imagery training [24,25]. Therefore, there is a need for thorough meta-analyses to consolidate findings from previous studies and investigate whether motor imagery training could yield performance benefits for tennis players, specifically in terms of service. The present meta-analysis seeks to provide a comprehensive, evidence-based synthesis of the efficacy of motor imagery training programs in enhancing tennis service performance. It addresses the question: Does motor imagery training improve service performance in tennis players compared to controls? Consequently, we hope that this meta-analysis offers novel and valuable insights into the impact of motor imagery on service outcomes in tennis.

2. Materials and Methods

The present review is reported following the updated PRISMA statement [26], and the review protocol has been registered in PROSPERO (identifier CRD42023490406).

2.1. Search Strategy and Study Selection

A comprehensive search using specific keywords was conducted on four databases (PubMed, Web of Science, SCOPUS, and SPORTDiscus) to identify peer-reviewed journal articles in English from the databases' inception until 6 December 2023. Boolean search strategies incorporated the following search terms: ("motor imagery" OR "mental training" OR "movement imagery" OR "mental practice" OR "mental simulation" OR "cognitive training" OR "mental imagery" OR "mental rehearsal" OR "mental movements" OR "visual imagery" AND tennis. Furthermore, we manually searched Google Scholar and the reference lists of all chosen papers to ensure that no pertinent publications were overlooked. In cases where the full text of a publication was not available, we contacted the corresponding author via email or ResearchGate. Table S1 contains the search strings used for each database.

As depicted in Figure 1, the databases provided a total of 280 publications, and we obtained an additional 10 papers through references and Google Scholar. After the manual removal of duplicates, there were 206 unique records remaining. The titles and abstracts of these records were assessed, resulting in 46 publications deemed suitable for full-text examination. After a thorough review of all the texts, 37 documents were excluded, leaving nine trials that fulfilled all the criteria established for the systematic review and meta-analysis.

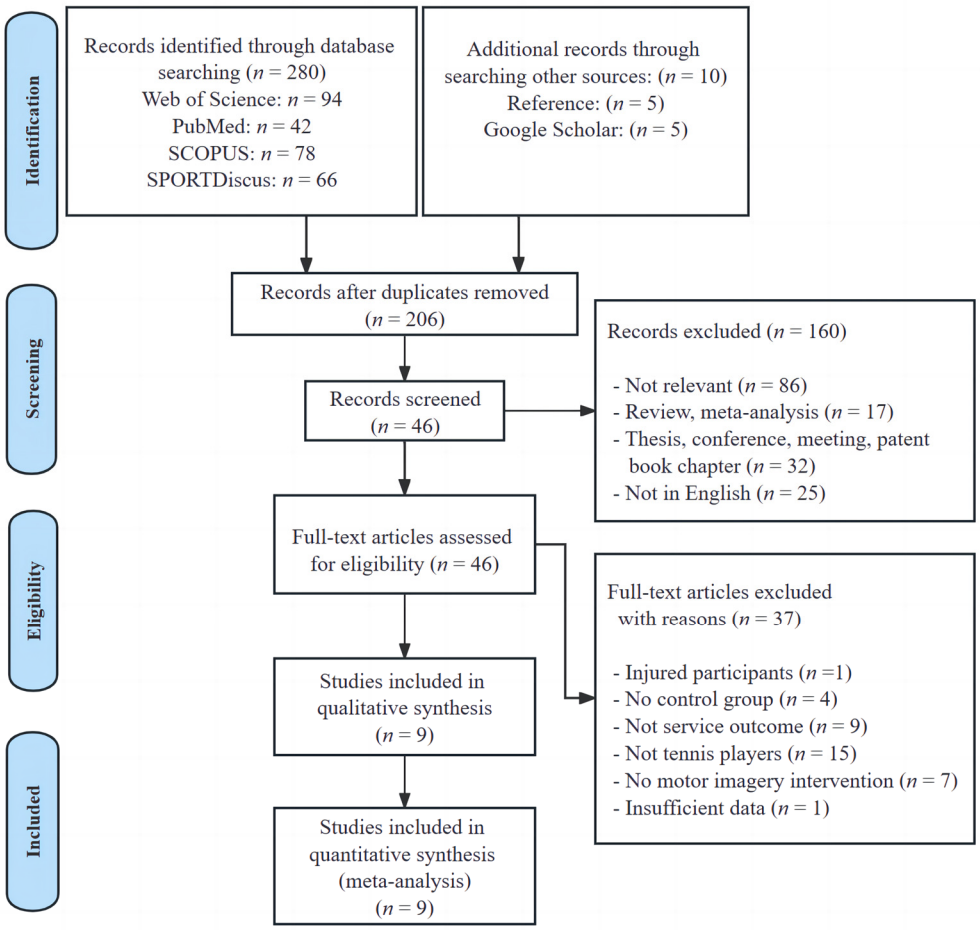

Figure 1. PRISMA flow diagram.

2.2. Eligibility Criteria

The inclusion criteria were chosen according to the PICOS approach [27]: (a) The study recruited female and/or male tennis players in any age category. (b) The study's training group participated in motor imagery practice. Motor imagery could be implemented as an independent intervention or in conjunction with physical practice. Motor imagery interventions that included the combination of motor imagery and action observation (e.g., observing a video) were also included. (c) The study included a control group. (d) The study included at least one measure of tennis service performance at baseline and follow-up. (e) The study was a randomized controlled trial (RCT) or non-RCT.

The studies were excluded if (a) the tennis players who participated in the study were injured; (b) the motor imagery intervention was combined with other aerobic training in order to avoid contamination of the motor imagery effect from other interventions; (c) the study lacked a control group; and (d) the study lacked sufficient data to compute the effect size (ES).

2.3. Data Extraction

Two reviewers (ND and DH) were tasked with extracting participant information, including sample size, sex, age, training experience, competition level, a description of the intervention, and study outcomes. In studies presenting data in visual formats such as graphs or figures, the reviewers either reached out to the corresponding author to get the numerical data for analysis or used the Web Plot Digitizer program (DigitizeIt, Version 4.6, Germany) to extract the required data [28]. A third reviewer (KGS) was responsible for verifying all the extracted information and data.

2.4. Risk of Bias in Individual Studies and Certainty of the Evidence

The updated Cochrane Risk of Bias assessment for randomized trials (RoB-2) was utilized to evaluate the bias risk in each of the selected RCTs [29]. Using the RoB 2.0 tool, studies were awarded an overall risk of bias grade of either high risk of bias, or some concerns of bias or low risk of bias. This comprehensive rating was determined through the evaluation of five domains: bias arising from the randomization process, bias due to deviations from intended interventions, bias due to missing outcome data, bias in measurement of the outcome, and bias in selection of the reported result.

For non-RCTs, the Risk of Bias In Non-randomized Research of Interventions (ROBINS-I) tool was employed [30]. This tool evaluates seven domains of bias, encompassing bias due to confounding, bias in selection of participants, bias in classification of interventions, bias due to deviations from intended interventions, bias due to missing data, bias in measurement of outcomes, and bias in the selection of reported results. Signaling questions aid in evaluating each domain, with the risk of bias for each study being classified as low, moderate, serious, or critical.

The certainty of the evidence was analyzed and summarized following the guidelines outlined in the GRADE handbook [31]. GRADE evaluates the certainty of the evidence for each specific outcome as very low, low, moderate, or high. Two reviewers (ND and DH) independently evaluated the risk of bias for each selected trial. Any differences of opinion were recorded and discussed within the research team until an agreement was reached.

2.5. Statistical Analyses

Consistent with the guidelines outlined in the Cochrane Handbook [32], meta-analyses can be conducted with a minimum of two studies [33]. Consequently, we conducted meta-analyses in cases where two or more studies provided baseline and follow-up data for the same measure. Mean and standard deviation data were employed to compute ESs (i.e., Hedges' g) for tennis service outcomes in both the motor imagery and control groups. A random-effects model was used to account for the anticipated heterogeneity among studies [34,35]. The ES values were presented with 95% confidence intervals (CIs) and interpreted based on the following scale: less than 0.2 was considered trivial, 0.2 to 0.6 was small, 0.6 to 1.2 was moderate, 1.2 to 2.0 was large, 2.0 to 4.0 was very large and greater than 4.0 was extremely large [36]. In trials with multiple intervention groups, the sample size of the control group was divided proportionately to facilitate equitable comparisons among all subjects [37]. We evaluated study heterogeneity using I2 statistics. Values below 25% indicated low heterogeneity, 25–75% suggested moderate heterogeneity, and above 75% reflected high heterogeneity [38]. We utilized the extended Egger's test to assess the studies' publication bias risk [39]. A sensitivity analysis was performed when Egger's test showed a significant outcome.

3. Results

3.1. Risk of Bias in Individual Studies and Certainty of the Evidence

RoB-2 assessments were conducted on four RCTs [23,40–42], while ROBINS-I assessments were employed for five non-RCTs [22,24,25,43,44]. Out of these trials, only three displayed a low risk of bias, while six demonstrated an overall moderate risk of bias or some concerns, as illustrated in Figure 2. The results of the RoB-2 assessments are depicted in Figure 2A. Among these RCTs, only one reported their randomization sequence generation method [23]. In contrast, the randomized procedures in the remaining three papers were not comprehensively described [40–42]. A visual depiction of the findings of ROBINS-I assessments is shown in Figure 2B. Three non-RCTs [22,24,43] indicated a moderate risk of bias attributed to concerns about the selection of reported outcomes. Two studies [24,43] demonstrated a moderate risk of bias due to confounding. Furthermore, one trial [43] exhibited a moderate risk of bias in selecting study participants.

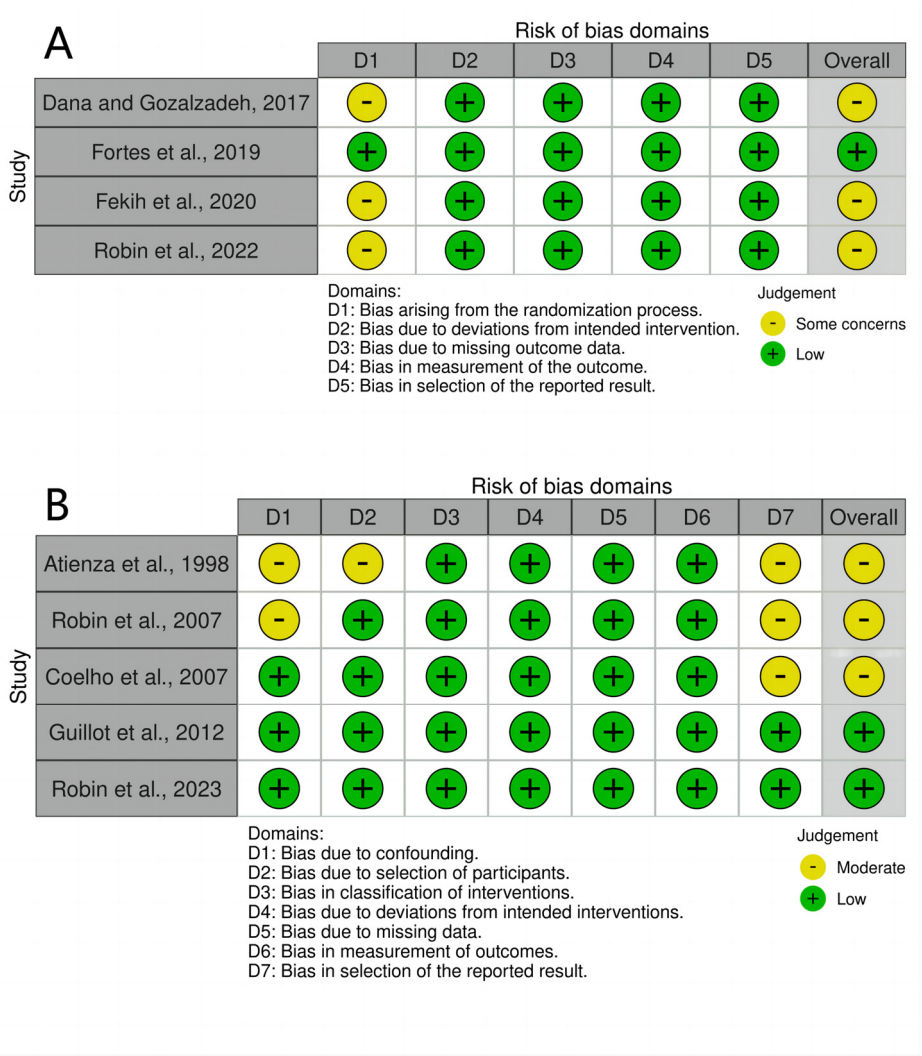

Figure 2. (**A**): RoB–2 assessments [23,40–42], (**B**): ROBINS–I assessments [22,24,25,43,44]. Created using the Robvis tool.

The results obtained through the GRADE analysis are presented in Table 1. The GRADE assessments indicated evidence supporting the outcomes, with levels of certainty ranging from very low to low.

3.2. Study Characteristics

Table 2 summarizes the participants' characteristics and the motor imagery programs utilized. The data used in the meta-analysis, extracted from the original articles, can be found in Table S2. Publications were released between 1998 and 2023. Across all the studies included, there were a total of 548 participants. The participants' ages ranged from 9 to 18 years old, and the sample sizes of the research groups varied from 12 to 48 individuals. Out of the nine studies, one focused on females [43], five examined males [22–24,40,41], and three investigated mixed gender [25,42,44]. The length of motor imagery programs was documented in nine studies, with an average of 10.9 $\pm$ 8.0 weeks (range: 4–24). The number of motor imagery sessions per week was reported in nine studies, with an average of 2.2 $\pm$ 0.8 sessions (range: 1–3). Among these, seven studies provided information on the duration of each motor imagery session, averaging 13.3 $\pm$ 6.8 min (range: 3–25), while two studies [42,44] did not report the duration of motor imagery session.

Table 1. GRADE analyses.

Outcomes	Certainty Assessment					No of Participants and Studies	Certainty of the Evidence (GRADE)
	Risk of Bias	Inconsistency	Indirectness	Imprecision	Risk of Publication Bias		
Service speed follow-up: range 4 to 24 weeks	Serious [a]	Not serious	Not serious	Serious [b]	Not serious	192 (7 studies)	⊕⊕◯◯LOW
Service accuracy follow-up: range 4 to 24 weeks	Serious [a]	Not serious	Not serious	Serious [b]	Not serious	237 (8 studies)	⊕⊕◯◯LOW
Service return accuracy follow-up: 8 weeks	Serious [a]	Not serious	Not serious	Serious [b]	Not serious	78 (2 studies)	⊕⊕◯◯LOW
Service technique follow-up: 24 weeks	Serious [a]	Not serious	Not serious	Serious [b]	Not serious	41 (2 studies)	⊕◯◯◯VERY LOW

GRADE, Grading of Recommendations Assessment, Development and Evaluation; [a] Downgraded by one level due to overall moderate or some concerns risk of bias; [b] Downgraded by one level, as < 400 participants were available for a comparison or a wide confidence interval (CI) around the effect estimate; we considered a CI to be wide if it included both a small (0.2–0.6) and large effect size (>1.2–2.0). Downgraded by two levels in case of imprecision based on both assessed points. GRADE Working Group grades of evidence: High certainty: we are very confident that the true effect lies close to that of the estimate of the effect. Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different. Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect. Very low certainty: we have very little confidence in the effect estimate, the true effect is likely to be substantially different from the estimate of effect.

Table 2. Characteristics of the studies examined in the present review.

Study	Population Characteristics				Intervention	Type of Exercise	Outcome (s)
	n	Sex	Age	Level			
Atienza et al., 1998 [43]	12	Female	9–12 years	Tennis school	Freq: 2 times/week Time: 15 min Length: 24 weeks	EG1: physical practice +video EG2: physical practice +video + imagery training CG: physical practice	EG1: service speed ↑, service accuracy →, Service technique ↑; EG2: Service speed →, service accuracy →, service technique ↑
Robin et al., 2007 [24]	30	Male	19 ± 2.5 years	Regional or national level ≥7 years	Freq:1 time/week Time: 3 min Length: 8 weeks	EG1: motor imagery + physical training (good imagers) EG2: motor imagery + physical training (poor imagers) CG: reading a magazine	EG1: service speed →, service return accuracy ↑; EG2: service speed →, service return accuracy ↑

Table 2. *Cont.*

Study	Population Characteristics				Intervention	Type of Exercise	Outcome (s)
	n	Sex	Age	Level			
Coelho et al., 2007 [22]	48	Male	16–18 years	National	Freq: 3 times/week Time: 25 min Length: 8 weeks	EG: imagery + technical practice CG: technical practice	Service accuracy ↑, service return accuracy →
Guillot et al., 2012 [25]	22	Mixed	EG1: 14.25 ± 2.60 years EG2:14.43 ± 3.05 years CG: 16.29 ± 5.50 years	3.0 ± 1.2 years	Freq: 2 times/week Time: 15 min Length: 6 weeks	EG1: motor imagery EG2: imagery + placebo racket CG: physical practice	EG1: service speed →, service accuracy ↑; EG2: service speed →, service accuracy ↑
Dana & Gozalzadeh, 2017 [40]	36	Male	15–18 years	Novices	Freq: 3 times/week Time: 15 min Length: 6 weeks	EG1: internal imagery EG2: external imagery CG: physical practice	EG1: service accuracy ↑; EG2: service accuracy ↑
Fortes et al., 2019 [23]	28	Male	15–16 years	≥2 years	Freq: 3 times/week Time: 10 min Length: 8 weeks	EG: motor imagery + physical/technical training CG: videos (Olympic history) + physical/technical training	Service speed ↑, service accuracy ↑
Fekih et al., 2020 [41]	38	Male	EG: 16.9 ± 0.6 years CG: 16.7 ± 0.8 years	Tennis clubs EG: 5.4 ± 1.3 years CG: 5.7 ± 1.2 years	Freq: 3 times/week Time: 10 min Length: 4 weeks	EG: motor imagery CG: videos about the history of the Olympic Games	Service speed →, service accuracy↑
Robin et al., 2022 [42]	33	Mixed	15.9 ± 2.1 years	Regional and national 9.5 ± 1.8 years	Freq: 2 times/week Time: NR Length: 10 weeks	EG1: motor imagery EG2: motor imagery+ self-talk CG: physical practice	EG1: service speed →, service accuracy ↑; EG2: service speed →, service accuracy ↑
Robin et al., 2023 [44]	33	Mixed	9–13 years	Novice 1–2 years	Freq: 1 time/week Time: NR Length: 24 weeks	EG1: motor imagery + physical training (good imagers) EG2: motor imagery + physical training (poor imagers) CG: reading a magazine	EG1: service speed ↑, service accuracy ↑, service technique ↑; EG1: service speed ↑, service accuracy ↑, service technique ↑

EG, experimental group; CG, control group; years, years; Freq, frequency; NR, not reported.

3.3. Effects of Motor Imagery Training on Service Speed

Seven studies were included in the service speed meta-analysis, including ten experimental groups and seven control groups (pooled n = 192). The motor imagery training showed no change (p = 0.076) in service speed with small effect (ES = 0.25, 95% CI = −0.03–0.54; Egger's test p = 0.392; Figure 3) and low heterogeneity (I^2 = 0.00%).

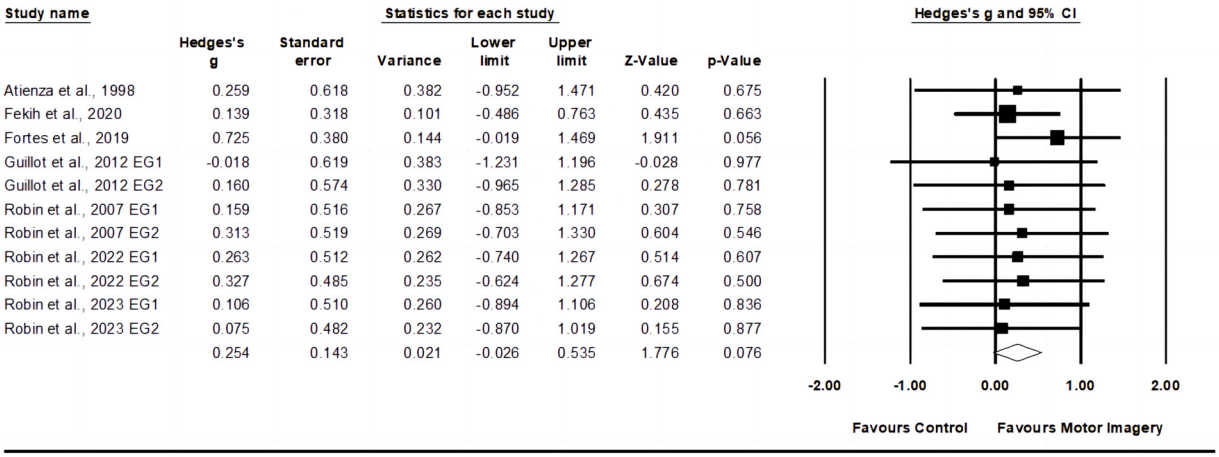

Figure 3. Forest plot and effect sizes for motor imagery training compared with controls for service speed [23–25,41–44]. EG = experimental group.

3.4. Effects of Motor Imagery Training on Service Accuracy

Eight studies were included in the service accuracy meta-analysis, including twelve experimental groups and eight control groups (pooled n = 237). Greater values of service accuracy (p < 0.001) were observed after motor imagery training (p = 0.007) with moderate effect (ES = 0.99; 95% CI = 0.68–1.30; Egger's test p = 0.368; Figure 4) and moderate heterogeneity (I^2 = 26.34%).

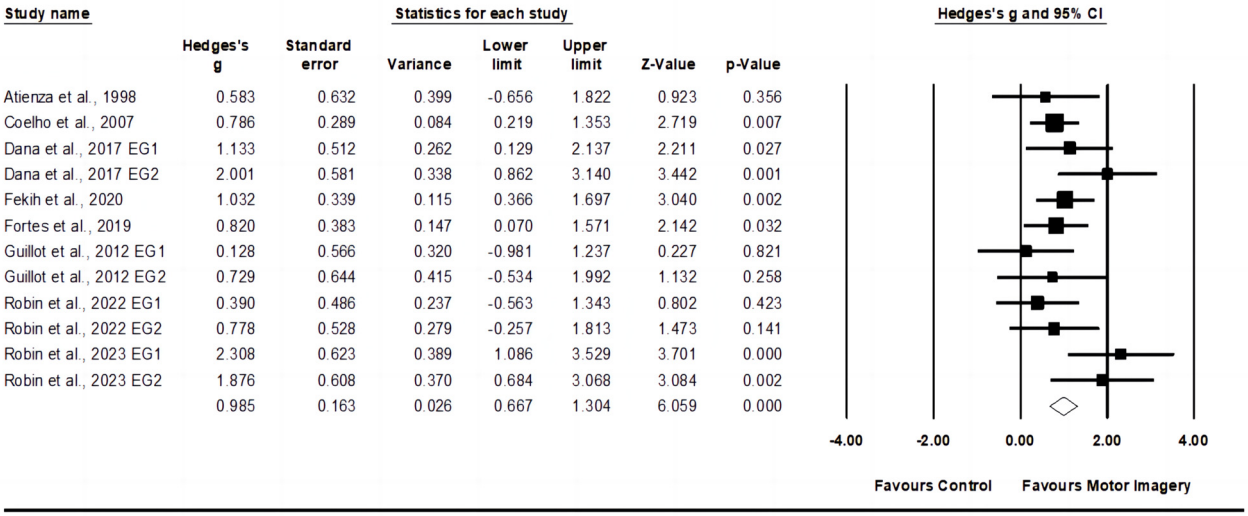

Figure 4. Forest plot and effect sizes for motor imagery training compared with controls for service accuracy [22,23,25,40–44]. EG = experimental group.

3.5. Effects of Motor Imagery Training on Service Return Accuracy

The service return accuracy meta-analysis comprised two studies involving three experimental groups and two control groups (pooled n = 78). The motor imagery training showed no change (p = 0.86) in service return accuracy with trivial effect (ES = 0.04; 95% CI = −0.40–0.48; Egger's test p = 0.472; Figure 5) and low heterogeneity (I^2 = 0.00%).

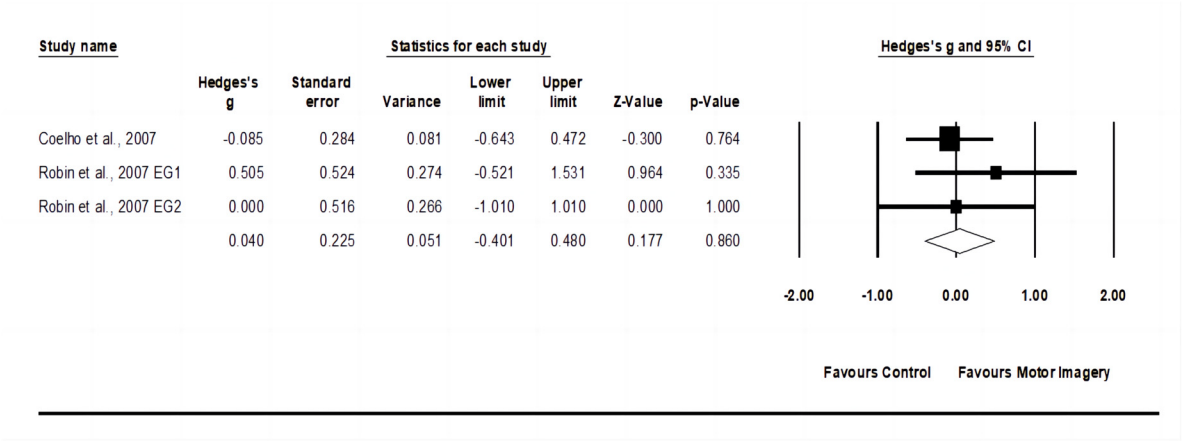

Figure 5. Forest plot and effect sizes for motor imagery training compared with controls for service return accuracy [22,43]. EG = experimental group.

3.6. Effects of Motor Imagery Training on Service Technique

The service technique meta-analysis comprised two studies, involving three experimental groups and two control groups (pooled n = 41). The motor imagery training showed an increase (p = 0.003) of service technique with moderate effect (ES = 0.97; 95% CI = 0.33–1.61; Egger's test p = 0.487; Figure 6) and low heterogeneity (I^2 = 0.00%).

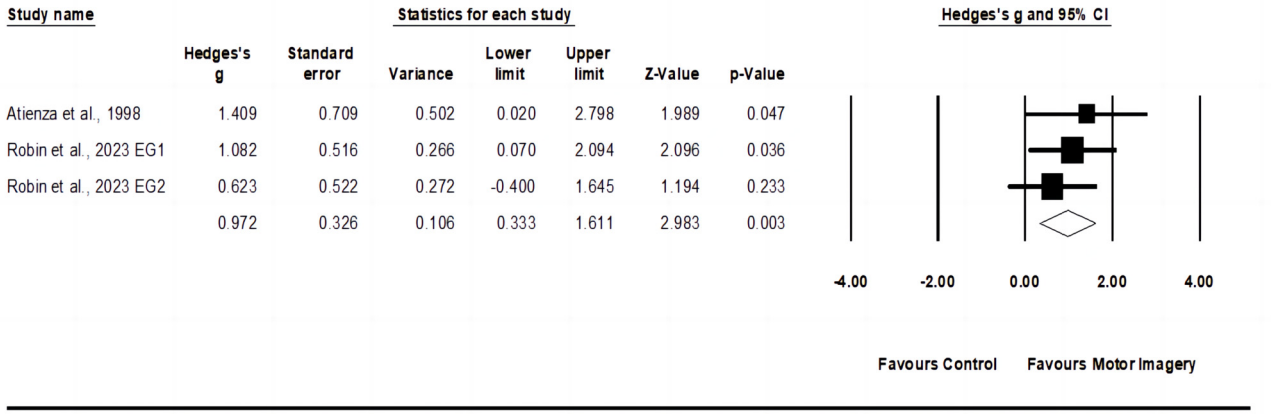

Figure 6. Forest plot and effect sizes for motor imagery training) compared with controls for service technique [43,44]. EG = experimental group.

4. Discussion

This systematic review provides evidence that motor imagery training can improve measures of service accuracy and technique in tennis players. However, its impact on service speed and return accuracy was not found to be statistically significant. The GRADE evaluation found that the level of the evidence for the examined outcomes varied from very low to low.

The initial findings of this review indicated that motor imagery training did not affect service speed. The results could be elucidated by the observation that the enhancement of stroke speed is typically achieved through technical advancement and/or strength growth [45,46]. Motor imagery training was not intended to influence these aspects directly [25]. Nevertheless, conflicting outcomes exist in the literature, as some studies indicate that motor imagery enhances strength, mainly when movements are controlled by extensive cortical regions in the primary motor cortex [47,48]. Moreover, motor imagery is inclined to generate subtle yet potentially significant improvements in performance, especially when applied to enhance or rectify specific technical elements of motor skills [15]. Furthermore, according to some authors, the limited improvement in service speed might

stem from an insufficient distribution of the weeks assigned to practicing each aspect of tennis service skills [42]. Challenging movements from a technical standpoint can potentially slow down the imaging process, extend the duration of imagery trials, and increase the risk of inaccuracies in imaging speeds, causing a retroactive interference effect that negatively impacts performance [49,50]. Robin and colleagues suggest that prolonging the acquisition phase, which consists of 20 sessions spread across three months, might be essential to significantly increase the service speed of tennis players [42]. Notably, while some investigators have noted no alteration in service speed among skilled players following motor imagery training [24,42], others, as indicated by Robin et al. [44], have demonstrated improvements in novice tennis players. This disparity in results could be explained by a potentially more limited scope for improvement among skilled players compared to beginners [42].

The current findings indicate that motor imagery training had a positive effect on service accuracy. The findings are consistent with previous research demonstrating the benefits of mental training in improving tennis shot accuracy [51]. Internal visual imagery positively impacts the acquisition and execution of tasks that rely heavily on perception for accurate performance [52]. In tasks of this nature, engaging in mental rehearsal of actions helps participants anticipate environmental changes more effectively and envision their own actions under specific conditions [53]. Moreover, neural adaptations induced by motor imagery training may improve muscle coordination, such as a decrease in activity of antagonist muscles when agonist muscles are applied [54,55], which may explain the increase in tennis service accuracy in the motor imagery training group. Interestingly, in this review, Guillot and colleagues found that imagining the tennis service with a placebo racket resulted in higher service accuracy scores compared to motor imagery training alone [25]. This may be attributed to the placebo racket enhancing visualization and promoting relaxation before serving, indicating that players' belief in additional benefits helped alleviate anxiety during the serving process [25]. Notably, the study by Guillot et al. [25] reports that players' perceptions of their serve quality significantly improved after motor imagery practice, and this enhancement was also observed in the placebo group. Some other researchers have indicated that elite sports performance fundamentally relies on the intricate interplay of brain functions, with the perception-action cycle being a prime example [56]. The optimal coupling between perception and action could potentially explain the improved service accuracy of tennis players, as some studies in our review have integrated motor imagery with physical practice [22–24,43,44]. However, these studies did not provide information on players' sensory and perceptual experiences. Hence, the role of the perception-action cycle in such combination interventions warrants further research. Furthermore, sports practitioners and coaches commonly employ motor imagery training, either independently or as part of mental training programs integrated with other cognitive skills (e.g., concentration, self-talk, or relaxation) [6,57]. In a study conducted by Robin et al. [42], combining self-talk with motor imagery indicated that the improvement in tennis service accuracy was comparable to that achieved through motor imagery training alone. This similarity in improvement may be attributed to a plateau effect [58], which can be attributed to the participants' expertise level (i.e., skilled tennis players) limiting further progress. Overall, the present review offers evidence supporting the positive effects of mental imagery on the service accuracy of tennis players.

Drawing from the findings of the current meta-analysis, our analysis reveals that motor imagery training did not impact a more intricate and externally oriented skill (i.e., service return accuracy). When returning a service, receivers confront tight time constraints, with services reaching high speeds and exhibiting variations in trajectory (e.g., amplitude, spin, and direction). The receiver must execute a precise shot to thwart the serving pair from strategically placing the ball in an advantageous area [59]. It seems that this mental representation would not be helpful for improved performance when the movement calls for several factors to be considered [22]. Moreover, previous investigations have shown that variances in individual visualization capacity might influence the difficulty level in learning complex motor actions [60,61]. Zapała et al. [62] found that elevated visual motor imagery

scale scores were associated with quicker reaction times and improved coordination in the study group. Similarly, the findings from Robin et al.'s [24] study suggest that imagery ability plays a crucial role in determining the effectiveness of motor imagery in enhancing service return performance.

Present results show that motor imagery training significantly improved the service technique in tennis players. The positive impact of motor imagery may stem from either its motivational influence or cognitive processes that complement those generated by physical practice [50,63]. Motor imagery training for improving tennis service technique involves mental rehearsal and visualization of the critical components of the service motion [64]. During motor imagery, the brain activates neural pathways similar to those during actual physical execution [65], reinforcing the motor patterns associated with each stage of the service. Consequently, this mental practice contributes to overall technical proficiency, translating into an improved tennis service technique. Simonsmeier et al. [18] conducted a meta-analysis, revealing a positive association between motor imagery training and significant improvements in motor learning and performance. Hence, mental imagery may be an effective strategy for enhancing the service technique of tennis players. Given the restricted number of experimental trials on this aspect, additional research is required to obtain more definitive results.

Some limitations are acknowledged. Firstly, a limited number of studies (n = 9) were reviewed. Secondly, the impact of moderator variables (e.g., players' age, sex) on tennis service measures could not be ascertained due to the limited number of studies. Thirdly, some trials lacked a comprehensive description of the training protocol. For example, the weekly session time for the intervention was not specified in two of the nine articles [42,44]. Fourthly, even though pooling included studies that measured the same outcome, these studies were somewhat heterogeneous with regard to training protocols (e.g., length, motor imagery combined with physical practice or implemented independently). It is possible that training-related factors might also play a role in and contribute to the effectiveness observed in motor imagery programs. Finally, the review solely considered English publications, potentially restricting the comprehensiveness of the results.

The findings of this review have practical implications for tennis practitioners, coaches, and players. The review to date has contributed to a better understanding of the relationship between motor imagery training and tennis service performance. However, limited research hinders the formulation of specific suggestions. In light of the current meta-analysis, a few suggestions for future research can be proposed. Firstly, the review only incorporates one study specifically focusing on female tennis players [43], highlighting a potential gap for future research to investigate the impact of motor imagery on this particular group. Secondly, future investigations should offer improved insight into the relationship between imagery ability and the service performance of tennis players. Thirdly, as motor imagery training programs are not homogeneous and include a variety of training modalities, further studies are needed to examine the effects of different motor imagery approaches on tennis service performance outcomes.

5. Conclusions

The present systematic review and meta-analysis showed the positive effects of motor imagery training in improving service accuracy and technique in tennis players. However, it appears to have no significant effect on service speed or return accuracy. Given the limited number of related studies and the evidence ranging from very low to low certainty, caution is advised in interpreting these results. Therefore, more experimental work is needed to obtain stronger conclusions.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/bs14030207/s1, Table S1: The detailed primary databases search strategy; Table S2: Data for meta-analysis.

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Article

Sedentary Behaviors and Eating Habits in Active and Inactive Individuals: A Cross-Sectional Study in a Population from Southern Italy

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Abstract: The aim of this study was to analyze sedentary behaviors and dietary habits assumed by individuals regularly practicing exercise in a gym, sports athletes and inactive individuals. The Sedentary Behavior Questionnaire and the Healthy Dietary Habits Index were administered online to evaluate the time spent in sedentary activities during the week and the habits of food consumption among adult individuals from the Campania region, in the south of Italy. Of the 411 participants, 25% were inactive, 34% were gym practitioners and 41% practiced different sport disciplines. Significant differences were found for sedentary habits adopted during the week and diets between athletes and inactive participants. However, no significant differences were observed for sedentary activities on the weekend and some sedentary behaviors such as video gaming or working/studying during the week. With regard to diet, athletes showed healthier food choices, such as fruit and vegetable consumption. The findings of this study underline the need for enhancing the awareness of the local population regarding the detrimental effects of unhealthy dietary behaviors and sedentary time, especially but not exclusively among inactive individuals.

Keywords: dietary habits; sedentary behaviors; physical activity; exercise; sport; gym practitioners; athletes

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1. Introduction

According to the World Health Organization, as many as 3.2 million deaths a year are attributable to a sedentary lifestyle [1]. In adults, higher amounts of sedentary behaviors (SBs) are associated with several adverse outcomes, such as all-cause mortality, cardiovascular disease and cancer mortality, and higher incidences of cardiovascular disease, cancer and type 2 diabetes [2]. The term sedentary lifestyle refers to the time devoted to activities with energy expenditure ≥1.5 Metabolic Equivalent of the Task—MET in a sitting or lying position [3]. In the adult population, most of the time of daily life is spent adopting SB, such as PC use, TV viewing, recreational activities related to screen use or driving [4], whereas physical inactivity (PI) is referred to as an insufficient physical activity (PA) level to meet present recommendations [2]. Therefore, SB is a component of PI.

There is a substantial difference between engaging in SBs and not engaging in PA. On the other hand, playing sports or doing exercise for some hours during the week does not make one exempt from leading a sedentary life and therefore from implementing typical sedentary behaviors in daily life and for most of the day. PI speaks to a failure to meet

the recommended levels of overall bodily movement for health, whereas SBs specifically pertain to low-energy activities performed while sitting or lying down. Importantly, the distinction between engaging in PA and adopting an active lifestyle emphasizes the significance of incorporating movement into daily routines beyond structured exercise sessions. This nuanced understanding is crucial for designing effective health interventions and promoting well-being.

Changes in sedentary habits may not correspond with changes in moderate to vigorous leisure-time physical activity since SBs and PA are actually two separate and non-opposing functional constructs [5]. In particular, it appears that SBs are associated with adverse health outcomes different than those attributed to the lack of PA [6].

Furthermore, SBs and PAalso seem to influence eating habits in different ways; those who exercise are oriented towards healthier food choices, while those who adopt SBstend to make unhealthy food choices [7]. Typical SBs, such as spending time in front of a screen or watching TV, have been associated with low consumption of fruits and vegetables; heavy consumption of high-energy snacks, beverages and fast food; and high total energy intake [8].

With regard to this, it should be taken into consideration that the use of electronic devices consistently exposes people to advertisements for high-energy, low-nutritional-value foods [9]. Therefore, the health risks related to sedentary habits are added to those resulting from an incorrect diet, mainly related to the development of obesity, diabetes, cardiovascular diseases and some types of cancer [10].

As recently reported, increased PA is favorably and strongly correlated with eating behaviors that are determined by oneself [11]. Increased PA is a key factor in facilitating the development of more positive eating behaviors and self-determined eating habits, which may help to reduce the risk of issues like obesity and eating disorders. On the other hand, however, regular PA seems to positively influence dietary behaviors by improving the sensitivity of the physiological satiety signaling system, modulating the requirements of macronutrients and food choices and modifying the hedonic response to food stimuli [12,13]. Furthermore, as argued by Drenowatz et al. [14], it appears that specific types of exercise influence the frequency and intensity of food cravings. A systematic review by Noll and colleagues highlighted that, although sports modalities have a major impact on nutrient intake, athletes do not modify their diet to meet the demands of the training load [15]. The authors, however, underlined that studies on athletes have focused more on nutrient consumption than on eating habits.

Given the impact that lifestyle can have on people's health, the evaluation of the relationship between PA, SBs and eating habits may represent a research area that needs to be further explored.

Therefore, assuming that active and non-active individuals can adopt different health-related behaviors besides exercise, the aim of this study was to analyze SBs and dietary habits adopted by individuals regularly practicing exercise in a gym, sports athletes and inactive individuals. Possible differences among gender, age and type of PA or sport subgroups were also assessed.

2. Materials and Methods

During the period from January to May 2023, an anonymous online survey was used to collect sociodemographic and behavioral information among adult individuals from the Campania region, in the south of Italy. The survey was performed using the Google Module platform.

To enroll participants, QR codes were strategically placed in specific locations, including university classrooms, gyms, sports clubs, stores and restaurants. Each QR code was accompanied by a concise survey description. Participants accessed the questionnaire upon granting their informed consent to data treatment.

The Ethics Committee of the University of Campania "Luigi Vanvitelli" approved the protocol of this study (approval no. 28480/2022).

Age and gender were collected for each participant. Then, the PA level was investigated by using three questions: 1. "Have you been practicing physical activity or sports regularly for more than six months?"; 2. "If yes for how long?"; 3. "What kind of activities do you practice?" [16].

The Sedentary Behavior Questionnaire (SBQ) was used to evaluate the time spent in SBs, and the Healthy Dietary Habits Index (HDHI) was used to collect information about food consumption [17,18].

The SBQ measures the amount of time spent engaging in nine sedentary activities on an average weekday and weekend (watching television; playing computer or video games; sitting while listening to music; talking on the phone; doing paperwork or office work; reading; playing an instrument; doing arts and crafts; and driving/riding in a car, bus or train). We have made changes to the original version of the questionnaire by dividing the question aimed at investigating "the use of the PC in general and for playing video games" into two questions, one investigating video gaming and the other exploring the use of PCs to watch films, TV series and videos. The question "talking on the phone" was also changed specifically asking how much time participants spend on smartphones making phone calls or chatting, using social networks and watching videos. Finally, the question regarding arts and crafts was removed because this activity was included in the question regarding the sitting time to study, work or practice artistic activities. The SBQ asks participants how much time they spend "from when you wake up until you go to bed" engaging in each of the indicated SBs during a typical weekday and a typical weekend day. The response options were none, 15 min or less, 30 min, 1 h, 2 h, 3 h, 4 h, 5 h and 6 h or more. Each response was converted into hours, and the total numbers of hours of SB were summed separately for weekday and weekend days for each item. Next, weekly estimates were calculated by multiplying weekday hours by five and weekend day hours by two. Finally, another variable was created for the total number of hours spent in sitting behaviors per week. Answers representing more than 24 h/day were coded as 24 h/day [17].

The fifteen-item HDHI was used to investigate the frequency of consumption of red meat fat, chicken fat, low-fat foods, energy drinks, soft drinks, breakfast, fast foods, added salt, sweets, fruits and vegetables, fish, milk, fatty condiments and bread. Only one change was made to the question concerning fatty condiments, to which extra virgin olive oil was added. A score between 0 (least healthy) and 4 (most healthy) was allocated to each item, with a maximum reachable score of 60. For seven questions, the two healthiest answers were added together because they were considered equally healthy (trimming meat fat before consumption, trimming chicken fat before consumption, fish intake per week, use of low-fat products, fruit intake per day, vegetable intake per day, breakfast consumption per week) [18]. The higher the score was, the healthier the food habits.

Statistical Analyses

This study followed a cross-sectional design. The software IBM SPSS version 28 for Windows (IBM Corp., Armonk, NY, USA) was used for the analysis. Statistical significance was considered when $p < 0.05$. The variables that had a normal distribution were expressed as mean and standard deviation. The ANOVA was performed to compare SBQ and HDHI scores among groups, using the post hoc Dunn–Bonferroni approach for pairwise comparisons. The chi-squared test was used to compare gender distribution and percentage of subjects choosing the healthiest habits to the HDHI questionnaire between groups. Furthermore, two multiple logistic regressions were performed to identify significant predictors of SB and dietary habits (SBQ total score, HDHI total score). Independent variables entered in the model were gender (0 = male, 1 = female), age (1 = lower than median value, 2 = higher than median value) and exercise practice (0 = inactive, 1 = gym practitioner/sports athlete).

3. Results

A total of 411 participants completed the questionnaire. The mean age of the total sample was 30.5 ± 13.3 years (18–73 years), 52% were females, 25% of participants were inactive, 34% were gym practitioners and 41% practiced different sports disciplines (gymnastics, athletics, cycling, dance, fencing, football, kickboxing, karate, running, skating, swimming and volleyball). Table 1 presents the main characteristics of the three groups. A higher proportion of males was observed in the athletes' group, while the inactive group showed a higher mean age.

Table 1. Demographic information and information related to exercise practice in the three groups of participants.

	Athletes N = 169	**Gym Practitioners N = 140**	**Inactive N = 102**	***p* Value**
Gender M/F	98/71	63/77	36/66	0.001
Age	29.6 ± 13.6	28.1 ± 11.5	35.5 ± 13.8 *	0.001

* Inactive vs. gym practitioners and athletes.

Table 2 shows the comparison of sedentary and dietary behaviors assessed through the two questionnaires among PA groups. As for the results of the SBQ, significant differences were found among groups considering the weekdays but not the weekend days. With regards to HDHI, significant differences were also observed. In particular, the post hoc analysis showed that these differences emerged from the comparison between inactive participants and athletes.

Table 2. Differences in SBQ and HDHI scores between the three participant groups.

	Athletes	**Gym Practitioners**	**Inactive**	***p* Value**
SBQ weekdays (hours/day)	12.7 ± 6.8	13.9 ± 6.6	15.9 ± 8.6 *	0.001
SBQ weekend days (hours/day)	11.7 ± 7.1	12.2 ± 6.4	13.6 ± 8.5	0.115
HDHI	41.9 ± 4.5	40.7 ± 5.7	39.3 ± 6.6 *	0.001

* Inactive vs. athletes.

In detail, Table 3 shows the group differences related to the time spent in the different SBs investigated with the SBQ for weekdays. Watching TV, videos or series; using smartphones for chat and social media; reading; and sitting after moving from one place to another showed significant differences between groups. In particular, the inactive group spent more time watching TV with respect to the two groups of active individuals. Additionally, they used PCs to watch series and videos and read more than gym practitioners. In addition, inactive individuals made wider use of smartphones for chatting and social media and spent much more time to move from one place to another compared to sports athletes.

Considering the HDHI questions, significant differences were detected for type of bread, fruit, vegetable and salt consumption, as well as breakfast habits (Table 4). In particular, post hoc analyses revealed a significantly lower consumption of fast food, pizza and hamburgers ($p = 0.048$) and a higher choice of light products ($p = 0.015$) among gym practitioners compared to inactive participants, while athletes showed significantly higher consumption of fruits and vegetables compared to both inactive participants and gym practitioners ($p = 0.011$ and $p = 0.002$, respectively), and they reported consuming breakfast more than gym practitioners ($p = 0.045$).

As for the regression analyses, age and exercising in a gym/sport were found to be inversely related to total sedentary time (Table 5) in fully adjusted regression models, while engagement in exercise in a gym or practicing sports was positively associated with the HDHI score (Table 6).

Table 3. Mean values at the SBQ questions for each group expressed in minutes per day on a typical weekday.

Sedentary Behaviors (Minutes/Day)	Sport Athletes	Gym Practitioners	Inactive	*p* Value
Watching TV	49.6 ± 50.4	64.9 ± 65.9	97.3 ± 96.7 [c]	<0.001
PC use to watch videos or series	52.6 ± 57.7	47.1 ± 52.6	68.3 ± 75.9 [b]	0.033
Video gaming	25.1 ± 49.0	27.8 ± 60.9	24.8 ± 60.7	0.888
Listening to music	48.5 ± 77.0	36.4 ± 53.3	58.3 ± 96.2	0.083
Smartphone use to chat	116.1 ± 107.4	145.7 ± 118.6	155.6 ± 124.9 [a]	0.012
Smartphone use to navigate social media	110.5 ± 105.7	136.3 ± 105.1	150.6 ± 122.1 [a]	0.010
Smartphone use to watch videos	62.4 ± 81.9	71.6 ± 89.1	88.2 ± 104.1	0.077
Reading	49.7 ± 62.1	34.6 ± 45.1	55.3 ± 68.1 [b]	0.014
Playing a musical instrument	8.2 ± 35.1	5.9 ± 35.1	2.8 ± 14.1	0.389
Sitting to move from one place to another	51.4 ± 53.6	63.5 ± 71.9	72.8 ± 93.8 [a]	0.051
Sitting to study or for job	186.7 ± 124.7	198.3 ± 113.4	185.7 ± 141.5	0.661

[a] Inactive vs. athletes; [b] inactive vs. gym practitioners; [c] inactive vs. athletes and gym practitioners.

Table 4. Percentage of subjects who reported the healthiest habits to the HDHI questionnaire.

	Sport Athletes	Gym Practitioners	Inactive	*p* Value
Trimming red meat fat before consumption	63	61	60	0.350
Trimming chicken fat before consumption	75	63	69	0.888
Fish intake per week	36	32	30	0.721
Types of bread consumed	33	24	18	0.046
Soft drink consumption per week	51	64	52	0.076
Energy drink consumption per week	73	69	80	0.290
Sweets, snack and chocolate consumption per week	37	30	37	0.079
Purchasing fast food or takeaways such as hamburgers, fries, pizza	33	44	34	0.079
Types of fat spreads used	91	90	89	0.359
Use of low-fat products	53	59	44	0.335
Types of milk consumed	61	59	61	0.822
Fruit intake per day	34	32	25	0.016
Vegetable intake per day	48	40	34	0.006
Breakfast consumption per week	89	80	80	0.032
No salt added	31	12	16	0.001

Table 5. Results of the logistic regression analysis with the total sedentary time as a dependent variable.

Explanatory Variables	Odd Ratio	95% Confidence Interval		*p* Value
		Lower Limit	Upper Limit	
Age	−0.931	0.394	0.258	<0.001
Gender	0.153	0.778	1.747	0.458
Exercise in a gym/sport	−0.884	0.252	0.678	<0.001

Table 6. Results of the logistic regression analysis with the Healthy Dietary Habits Index as a dependent variable.

Explanatory Variables	Odd Ratio	95% Confidence Interval		*p* Value
		Lower Limit	Upper Limit	
Age	0.135	0.764	1.714	0.512
Gender	0.324	0.931	2.054	0.108
Exercise in a gym/sport	0.500	1.024	2.653	0.040

4. Discussion

Concerning the intricate connection between PA, SB, social media usage and dietary choices, the existing literature provides limited evidence, often concentrating on individual aspects of these relationships. In this study, health-related behaviors were compared between individuals practicing sports, attending gyms and not practicing any form of exercise. We aimed to explore the impact of a sedentary lifestyle on dietary choices but also to differentiate between various types of SBs. Moreover, we utilized a sedentary lifestyle questionnaire, which aided in identifying primary sedentary activities and gauging the extent of social media usage.

Our findings highlight several differences among these groups. First of all, inactive participants reported significantly higher amounts of weekly time spent in sedentary activities and significantly lower adoption of healthy dietary habits than active ones. Inactive individuals were more highly engaged in smartphone use and passive transport than athletes, in watching videos on a PC and reading than gym practitioners and in watching TV than both the other groups.

Notwithstanding these differences, it should be noted that for weekend days, total sedentary time, and for some specific habits, such as playing a musical instrument, studying or working, no differences were detected between the three groups. In line with previous studies, these outcomes show that sports athletes such as gym practitioners can be highly active and at the same time highly sedentary because of the independent relationship existing between exercise time and sitting time [19–21]. Indeed, people can be physically active and even achieve the recommended amount of PA but still be sedentary. This kind of SB can be considered a risk factor as well as inactivity. Therefore, in order to reduce its negative effects, it is even more important to comply with the PA recommendations [22]. Although attention towards the adoption of healthy lifestyles is growing over the last century, rapid technological and social changes are increasingly leading us to adopt behaviors characterized by low energy expenditure.

While various studies, both cross-sectional and longitudinal, suggest that SB is generally linked to negative physical and psychological consequences, it is important to consider that complete avoidance of SB in modern daily life may not be feasible [23,24]. Today, in fact, people frequently use SB to perform a variety of daily tasks, including working, driving, studying, eating and watching TV. Varied SB domains may have varied effects on mental health [25]. For example, screen-based SBs, which includes activities like watching TV, using a computer and using a smartphone or tablet, has been linked to detrimental impacts on mental health since it promotes social isolation and a sense of separation. A reduction in social support and communication may result from increased screen-based SB. Furthermore, certain screen-based behaviors might be considered largely passive activities that encourage indifference and favor other concurrent risky behaviors. Instead, by meeting fundamental social needs and offering opportunities for social support, certain screen-based SB may improve mental health [26].

Concurrently, SBs involving low-energy activities, primarily in a sitting or supine position, have been linked to the consumption of unhealthy foods in youth [27] but also in adults [3], as well as to an increase in obesity and a higher risk of chronic disease [28]. The most used metric for SB in earlier research has been the amount of time spent watching television, revealing links between TV viewing frequency and cardiovascular risk factors, obesity, metabolic syndrome and type 2 diabetes [29]. It has been demonstrated that watching TV increases calorie intake, also because of ads promoting foods high in fat, sugar and salt that are increasingly common when viewing TV, which encourage the consumption of these foods [30]. Furthermore, not only watching TV but also social media use may have some impact on teenagers' and children's dietary choices and desires [31,32]. In addition, the latest research in the field shows that healthy young adults may have unfavorable body images and eating choices as a result of social media activity or exposure to image-related content [33].

As for the dietary habits assessed in this study, inactive participants showed lesser attention to the choice of bread, lower intake of fruit and vegetables and less common consumption of breakfast during the week. Athletes, instead, were those who added salt less frequently to their plates. The association between healthier dietary habits and sports is not new in the scientific literature. In previous studies, athletes showed a nutritional status closer to dietary recommendations [34], better dietary habits [35] than sedentary subjects and even good adherence to the Mediterranean diet model [36,37]. Practicing a sport may allow athletes to make healthy dietary choices and reach the recommended nutritional status, balancing energy expenditure and intake.

In the regression analyses, exercise was negatively related to sedentary time and positively related to healthy dietary habits. These results confirm the differences found between active and inactive participants. However, another outcome could be worthy of concern. Although not significant, some differences were observed in both sedentary and dietary habits even between athletes and gym practitioners. This suggests that healthier habits could be associated with sports engagement more than with exercising in a gym, as previously reported [38].

However, it should be considered that this study did not take into consideration some variables that could be associated with the habits investigated. In particular, we did not explore the socioeconomic status of participants, which may be a determinant for engagement in sports, attendance of gyms or SBs. In fact, evidence shows that a sedentary lifestyle is associated with a low income [39,40]. Therefore, it is possible that our findings were in part related to the socioeconomic status of participants.

Additionally, concerns about the cost of healthy food can lead to differences in food purchasing based on household income [41]. Commonly, unhealthy behavioral clusters comprising low levels of moderate to vigorous PA, low consumption of fruits and vegetables and high screen time are prevalent in individuals from lower socioeconomic status [42].

Moreover, nutritional choices in the adult population are also dependent on educational attainment [43]. Therefore, even this variable could have influenced our results and should have been added to the regression models.

However, in light of these considerations, the lack of significant differences observed in the comparison of SBs assumed during weekend days by active and inactive individuals from our sample becomes more important. This could suggest that active behaviors are not adopted in daily life by athletes and gym practitioners beyond the time spent exercising. The use of accelerometers to assess the weekly PA level of individuals in future studies could help to better understand this finding [44].

Other than these limitations, some other aspects hinder the validity of this study. First of all, the width of the sample and the convenience sampling did not allow us to obtain a representative sample of the population examined. Furthermore, an electronic self-administered questionnaire was used to collect information. Therefore, it is possible that only individuals familiarized with the use of electronic media were involved, which limits the representativeness of the sample. Moreover, data were not objectively assessed, and a certain level of inaccuracy should be considered. Further research in this field, perhaps including analyzing more representative and wider samples through objective methods such as accelerometry, is needed to confirm our results. However, the sedentary and dietary behaviors of the three subgroups were examined in detail in our study, uncovering specific patterns associated with each group. Moreover, the findings of this study underline the need for enhancing the awareness of the local population regarding the detrimental role of sedentary time and unhealthy dietary behaviors, especially among inactive individuals.

5. Conclusions

This study delved into the comparison of health-related behaviors among individuals engaging in sports, attending gyms and those with no exercise routine. The findings revealed notable differences between these groups, particularly emphasizing the higher sedentary activity and poorer adoption of healthy dietary habits among inactive participants.

However, it is noteworthy that no significant differences were observed among the three groups for total sedentary time on weekends and certain specific habits, indicating the complexity of the relationship between PA and SB. This study highlighted the independent nature of exercise time and sitting time, illustrating that individuals can be physically active yet still engage in SBs, which poses its own set of health risks.

Furthermore, the dual nature of certain sedentary behaviors, which can either contribute to social isolation or fulfill basic social needs, was recognized, depending on the nature of the activity. Moreover, this study underscored the intricate relationship between health, PA, sedentary lifestyle and dietary habits. Social media and screen time were also implicated in shaping dietary preferences, especially among younger populations.

Although future research is needed to identify the determinants of these behaviors in the examined population, this study suggests that fostering awareness of health risks related to lifestyle, especially but not exclusively among inactive individuals, is needed for mitigating the detrimental effects of sedentary habits and unhealthy dietary choices.

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Article

Looking for the Key to Winning: Psychophysiological Predicting Factors in Healthy University Students

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Abstract: Performance in competitive situations has been linked to various psychobiological factors such as personality traits (e.g., competitiveness), situational appraisal (e.g., motivation), and cardiovascular response (e.g., heart rate). However, it remains unclear whether these factors can predict competitive success. This paper aims to assess, through discriminant analysis, the predictive capacity of these psychobiological variables regarding the likelihood of winning, ultimately delineating a psychophysiological profile associated with success. Across three distinct studies, a total of 154 participants (66 men) engaged in a face-to-face laboratory competition. Prior to the competition, assessments of competitiveness traits, anxiety, self-efficacy, and motivation were conducted, and heart rate reactivity during the competition was measured. These variables collectively formed the basis for constructing the predictive model. The results of the initial study demonstrated that our model accurately classified 68.8% of the cases. Specifically, high levels of competitiveness, self-efficacy, motivation, and heart rate reactivity, coupled with low anxiety, were predictive of winning. These findings were subsequently replicated in two independent validation samples involving both men and women (studies 2 and 3), thereby reinforcing the robustness of the earlier results. In conclusion, our findings suggest that the psychological state preceding competition, along with cardiovascular reactivity, may serve as predictors for the probability of winning.

Keywords: winner–loser; competitiveness; self-efficacy; motivation; anxiety; heart rate reactivity

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1. Introduction

Competitive situations are present in many areas of our lives, such as sports, academics, and work life. They constitute a prevalent means of attaining significant objectives, including but not limited to status, economic remuneration, and emotional well-being [1]. Due to its significance, the exploration of competition has a rich historical trajectory, and in recent years, there has been a growing recognition of the pivotal role played by individual differences when confronting competitive situations [2]. The coping competition model (CCM, [3]) proposed that the psychobiological response to competition would be better understood within a general stress model. According to the CCM, psychological and cognitive factors (e.g., perceived self-efficacy, motivation, or competitiveness) are core variables in explaining response to competition and its result. Prior to the commencement of the competition, an assessment of the contest takes place, considering both distal factors (e.g., prior history or personality) and proximal factors (e.g., motivation), culminating in a situational appraisal. This cognitive appraisal stems from an equilibrium between the

demands of the situation and the perceived resources to manage it. When an individual perceives the situation as significant and controllable, the likelihood of a challenge appraisal rises, accompanied by the adoption of active coping strategies characterized by an increase in positive mood and activation of the sympathetic nervous system [4]. On the other hand, an imbalance between demands and resources leads to a threatening appraisal, related to passive coping strategies [3]. This different perception could influence the probability of winning or losing.

According to the CCM model, distal factors, such as personality, influence and modulate the appraisal of the specific competition. The literature underscores the significance of traits like competitiveness and anxiety. Competitiveness is characterized by the enjoyment of interpersonal competition and the desire to win and surpass others [5]. This personality trait is considered a predictor of achievement approach–performance motivation [6]. Elevated competitiveness has the potential to induce a challenge state when resource appraisals are also high, thereby facilitating victory. Moreover, individuals with high levels of competitiveness may perceive a competitive situation more positively, prompting them to set more ambitious objectives, which are correlated with enhanced performance [7]. In the competitive context, the data indicate that there is a positive relationship between competitiveness and performance [6,8]. Anxiety has also received attention from researchers in the field of competition but for different reasons. Specifically, trait anxiety is considered a reflection of the individual's tendency to perceive the situation as threatening, experience higher state anxiety, and have lower performance during competitive tasks. In sports competitions, a relationship has been observed between trait anxiety and self-efficacy, confidence [9], and state anxiety [10], indicating that people with low anxiety showed lower levels of state anxiety than those with moderate or high anxiety, as well as higher positive self-efficacy levels. These results could reflect the impact of trait anxiety on the situational appraisal, increasing the probability of a threat assessment. In addition, trait anxiety has been negatively related to performance [11], suggesting that it could have an indirect influence on performance and outcome. In this sense, higher levels of pre-competitive anxiety have been found in losers than in winners [12], and anxiety has been established as a discriminant factor that can classify winners and losers [13,14]. In sum, personality traits can modulate the way individuals perceive and cope with competition, so they might have an indirect impact on performance and the outcome of the competition. Competitiveness and trait anxiety have been related to challenge and threat states, as well as to performance [8,10].

Challenge and threat states are also a consequence of proximal factors such as motivation or self-efficacy. In this scenario, motivation to compete is a necessary condition to elicit the psychobiological response related to competitive behavior and outcome. However, depending on the situation perception, the importance, and the task engagement, motivation can be related to challenge or threat states [15]. Approach goals would lead individuals to perceive an upcoming competition as a challenge [16,17], thus facilitating performance and victory. Self-efficacy perception before competition acts as a moderator of the effort and resources invested to win the competition [18]. It has been identified as an important component of the resource appraisal related to coping and performance in competitive situations [18,19]. Individuals possessing high levels of self-efficacy would perceive the situation as a challenge, predisposing them to confront it actively and enhance their likelihood of victory. Conversely, individuals with low self-efficacy would exhibit the opposite response [3]. Self-efficacy has been positively related to effort and performance [20] in learning contexts. Specifically in competition, higher levels of self-efficacy have been reported in winners [21].

Moreover, competition also entails significant physiological demands. A physiological challenge response is typically marked by heightened cardiac activity, while in contrast, a threat response is characterized by more modest increases in cardiac activity [22]. The challenge state would lead individuals to reach a higher performance level [23,24] and, consequently, increase the probability of winning. The reverse pattern would manifest in the threat state. Heart rate (HR) serves as a comprehensive index of mixed sympathetic–

parasympathetic activity widely employed in competition research, representing a significant variable in the assessment of challenge and threat responses. It has been posited that an increase in HR serves as an indicator of task engagement, a characteristic shared between both challenge and threat states [22], although it could be higher in challenge states [16], positively related to effort [25] and, in competitive contexts, with an outcome based on skills, as in our study, winners have shown higher HR than losers [21,26]. Hence, in a competitive setting, both winners and losers may experience increases in heart rate (HR), though these increments are expected to be more pronounced in winners.

In summary, researchers across diverse fields, including academia, sports, and the workplace, share an interest in investigating individual differences in coping with competition and performance to anticipate outcomes. Nevertheless, as the outcome of the competition is not solely contingent on individual performance, we deem it crucial to ascertain the specific influence of individual characteristics that forecast success or failure.

Hence, the overarching objective of our research was to scrutinize the impact of specific psychobiological factors on the likelihood of winning or losing in a competitive setting. More precisely, our aim was to elucidate the predictive efficacy of distal factors (trait competitiveness and trait anxiety) and proximal factors (self-efficacy, motivation, and HR reactivity) in achieving victory within a face-to-face laboratory competition conducted with a cohort of young, healthy university participants. To address this inquiry, we conducted a laboratory competition, capturing both psychological and cardiovascular variables. The selection of these variables was grounded in their significance within competitive contexts and their established associations with challenge and threat states, as well as performance outcomes. Our hypothesis is that winners will manifest elevated levels of competitiveness, self-efficacy, motivation, and HR reactivity, coupled with reduced anxiety levels.

2. Materials and Methods

2.1. Participants

To guarantee the consistency of the results, three independent studies were carried out with different samples, using a within-subjects random assignment design. These studies were approved by the Ethics Research Committee of the University of Valencia (protocol code H1393232860606) in accordance with the ethical standards of the Declaration of Helsinki (1964). All the participants received verbal and written information about the main characteristics of the study and signed an informed consent form before beginning the experiment.

To qualify for participation in these studies, individuals had to meet specific inclusion and exclusion criteria. Inclusion criteria encompassed being healthy young university students. On the contrary, exclusion criteria included smoking (more than 5 cigarettes per day), regular drug use, engaging in intensive exercise training (more than 10 h per week), having cardiovascular, neurological, or psychiatric diseases, and using medication that could potentially impact psychophysiological responses.

2.1.1. Sample 1

Seventy-eight students (30 men and 48 women) participated in this study. Participants were selected based on a pre-selection questionnaire. Individuals who met any of the following criteria were excluded: presence of a cardiovascular or psychiatric disorder, drug use, physical activity of more than 10 h per week, and the use of medication that could alter cardiac activity. Once they had been selected, participants were contacted by telephone and asked to maintain their normal intake and sleep patterns, avoid alcohol consumption, and refrain from performing extreme physical activities during the 24 h prior to the experiment. After the experimental phase, one participant was eliminated due to irregularities in the acquisition of the electrophysiological record. Therefore, the final sample in the first study consisted of 77 participants (37 winners and 40 losers) who were 21.8 $\pm$ 3.32 years old (mean $\pm$ SD) and had a body mass index (BMI) of 22.6 $\pm$ 3.32.

2.1.2. Sample 2

In the second phase of this study, 36 male university students from different faculties at Miguel Hernández University in Elche were recruited. These participants met the same inclusion criteria and participated in an identical experimental procedure as in study 1. After the competition, 18 winners and 18 losers were obtained. The mean age was 21.2 $\pm$ 1.75, and BMI was 24.9 $\pm$ 3.57.

2.1.3. Sample 3

In the third phase, 40 female university students from different faculties at the University of Valencia were recruited. These participants met the same inclusion criteria and participated in the same experimental procedure as in study 1. After the competition, 20 winners and 20 losers were obtained. The mean age was 22.6 $\pm$ 2.65, and BMI was 21.68 $\pm$ 2.

2.2. Measures

2.2.1. Competitiveness

Interpersonal competitiveness (IC) was evaluated with the Competitiveness Questionnaire [27]. This scale refers to the desire to win, and it has a high internal consistency index (α =0.76). Participants expressed their degree of agreement on a Likert scale (from 1 to 5) with items such as: I have always wanted to be better than others.

2.2.2. Anxiety

Trait anxiety (TA) was evaluated with the State Trait Anxiety Inventory [28]. The trait scale refers to the tendency to perceive situations as more threatening. The internal consistency of this scale was α =0.90. Participants expressed their degree of agreement with the items on a Likert scale (from 1 to 5).

2.2.3. Motivation

Based on previous studies [26], we employed the following item: How important is it for you to win this competition? To evaluate the degree of motivation (M) oriented toward winning the competition. Participants answered this item on a Likert scale from 1 to 100.

2.2.4. Self-Efficacy

Self-efficacy (SE) was measured before the competitive task with the following item: How capable are you of successfully performing the competition task? Prior to the study, we conducted an inter-rater reliability test to find out if this item represented the self-efficacy construct described by Bandura [29]. The result was a kappa index = 1. The self-efficacy item was answered by the participants on a Likert scale from 1 to 100.

2.2.5. Heart Rate Reactivity

HR activity was recorded using a Polar RS800CX monitor (CIC polar, Kempele, Finland). This instrument is composed of a chest strap that detects cardiac activity and a clock that records cardiac information. Polar RE800CX devices have demonstrated exceptional reliability and validity for recording cardiovascular activity through changes in body position [30]. HR was calculated in two 5 min periods: one measurement at baseline and one during the competition. HR reactivity (HRR) was calculated with a simple subtraction of competition levels from baseline levels.

2.3. Competitive Task

The task employed in this study was a modification of the squares and letters test [31]. This is a paper-and-pencil test that consists of a sheet with different matrixes (4 * 4) containing 16 letters. The task consisted of finding the letter that is repeated in each matrix as quickly as possible. In order to involve the participants in a competition, the task was modified by introducing some elements: (a) The participants sat face-to-face at opposite ends

of the same table; (b) The researcher informed the participants that they would compete for an economic prize (5 EUR); and (c) The task was divided into 5 rounds (2.5 min each), after which the participants received feedback about their performance. The winner of the competition was determined by the real performance on the task: number of matrixes completed correctly minus the incorrect matrixes.

2.4. Procedure

The day before the experiment, participants were asked to maintain their regular habits and avoid drinking alcohol and strenuous physical activity. Two hours beforehand, they were instructed not to drink stimulants or smoke. All participants performed the same procedure.

The experimental sessions were carried out between 16:00 and 20:00 in order to control circadian rhythms in cardiovascular activity. Two people of the same sex participated in each experimental session. When participants arrived at the laboratory, they were each seated in a separate individual room where they received information about the experimental procedure and signed an informed consent form. Subsequently, the experimenter instructed participants to adjust the Polar monitor for the HR registration, and s/he asked the participants to remain seated and relaxed for the next 10 min. The last five minutes of this period were used as the basal measure of HR. Next, the researcher provided a series of trait questionnaires (competitiveness and trait anxiety) and sociodemographic information and instructed the participants to complete them. Once both participants had finished the questionnaires, they were moved to a common room where they sat face-to-face at the same table. At this time, the researcher communicated to the participants that they were going to compete for an economic prize; s/he explained the task and gave participants a small sample of the task so that they could become familiar with it. After this training and before the competition, the participants answered some questions about self-efficacy and motivation. Afterward, they carried out the competition, which lasted about 20 min (5 rounds of 2.5 min plus the correction time and feedback between the rounds). The central 5 min of the competition period was used to obtain the competition measurement of HR. At the end of the competition, the experimenter announced the winner and rewarded him/her with the prize. After announcing the winner, participants were instructed to return to their individual rooms and remove the Polar monitor (Figure 1).

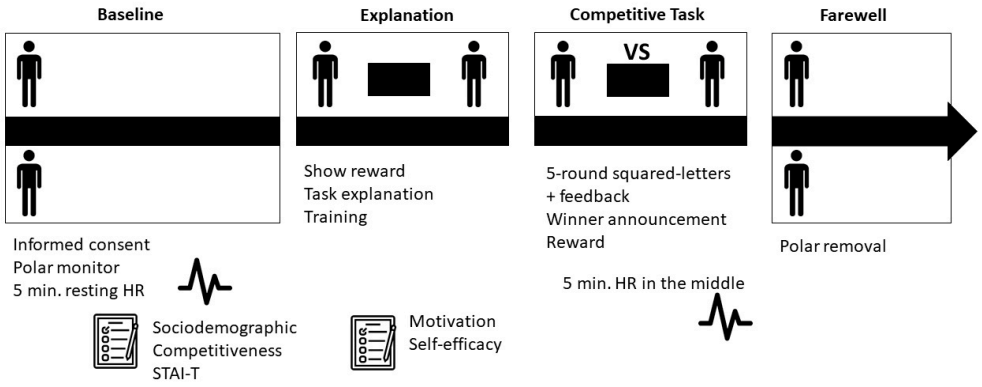

Figure 1. Study protocol.

2.5. Analyses and Data Reduction

Although it was not a main objective of this research, the first step in the analysis consisted of analyzing the effect of sex on the measured variables in order to control this effect in subsequent analyses. Through successive tests, we verified that there were differences in the means of heart rate reactivity (HRR) ($t_{[37.10]} = 2.591$; $p < 0.05$, $|d| = 0.662$), self-efficacy (SE) ($t_{[72]} = 2.161$; $p < 0.05$, $|d| = 0.813$) and motivation (M) ($t_{[72]} = 2.061$; $p < 0.05$, $|d| = 0.553$). Only HRR was a heteroscedastic variable ($Z_{[72]} = 8.765$; $p < 0.05$).

Nevertheless, in all three cases, the variables were distributed in a similar way, as we found after applying the Kolmogorov–Smirnov test for two independent samples.

These results led us to conclude that, despite the sex differences in the means, they did not affect the distribution of the variables, and, therefore, it was possible to minimize the effect of gender by transforming the direct scores into a scale of normalized or Z scores. The variables in which the sex had shown a significant effect were typified according to the men's and women's means and standard deviations. The other variables were typified according to the global means and standard deviations. When a case was detected that exceeded three standard deviations, it was considered an outlier and eliminated from the analysis. Hence, the final sample consisted of 66 valid cases. Finally, the typical scores were transformed into T scores, which verifies that their means have an approximate average of 50 and a standard deviation of 10. Table 1 shows the preprocessed and typified descriptive statistics of the variables included in the analyses.

Table 1. Descriptive statistics before the typification.

	Sample 1			Sample 2 (Men)	Sample 3 (Women)	Normality		
	Total (n = 66)	**Women (n = 33)**	**Men (n = 33)**	**Total (n = 28)**	**Total (n = 35)**	**Sample 1**	**Sample 2**	**Sample 3**
TA	20.879 (9.967)	21.049 (10.419)	20.6 (9.381)	19.143 (9.01)	19.225 (7.454)	0.621	0.569	0.697
SE	69.24 (16.107)	66.823 (16.947)	73.2 (14.059)	69.643 (15.271)	71.875 (14.662)	1.753 *	0.951	1.112
IC	22.742 (5.824)	23.08 (5.958)	22.537 (5.806)	22.857 (4.616)	22.450 (5.657)	0.405	0.534	0.447
M	50.773 (27.835)	54.878 (26.751)	44.04 (28.804)	57.857 (25.727)	60.750 (21.884)	1.088	0.671	0.425
HRR	8.328 (6.058)	10.152 (7.432)	7.214 (4.81)	6.88 (8.132)	4.793 (3.414)	1.083	0.538	0.138

* $p < 0.05$. TA (trait anxiety), SE (self-efficacy), IC (interpersonal competitiveness), M (motivation), HRR (heart rate reactivity).

Subsequently, we verified that the variables fulfilled the necessary statistical assumptions to carry out the discriminant analysis (DA) using sample 1. We included in the model trait anxiety (TA), self-efficacy (SE), interpersonal competitiveness (IC), motivation (M), and heart rate reactivity (HRR) as independent variables, to check the capacity of the model to predict outcome (win vs. lose). Multivariate normality was assumed when it was verified that the independent variables were all distributed according to the normal distribution; likewise, the equality of the variances–covariances matrixes was verified (M de Box = 23.715, $p = 0.116$). Once the DA had been performed, a confirmatory analysis was conducted with the second and third samples in order to show the validity of the predictions of the first sample. Given that the variables fulfilled the parametric assumptions, we checked their effect on the dependent variable by comparing their averages using the *t*-test for independent samples. Afterward, it was tested collinearity by means of the correlation matrix. Finally, discriminant analysis was performed using the block introduction method.

All the analyses were performed with the statistical package SPSS.

3. Results

3.1. Preliminary Results

In Table 2, we observed that IC and HRR were the only variables with significantly different averages between the groups and a medium-magnitude effect size. Although the SE, M, and TA measures were not significant, we decided to keep them in the discriminant model due to their importance in the literature presented in the introduction.

Table 2. Statistics descriptive of the predictors for each group of the dependent variable, correlations between the independent variables, and coefficients of the discriminant function.

	Descriptives (T Scores)					Correlation Matrix					Coefficients of the Discriminant Function	
	Total	**Loser**	**Winner**	**t**	$\|d\|$	**TA**	**SE**	**IC**	**M**	**HRR**	**Matrix of Structure**	**Standardized**
TA	49.795 (10.068)	49.402 (11.544)	50.187 (8.503)	0.175	0.077	1					0.112	−0.063
SE	50.039 (9.815)	49.203 (10.161)	50.876 (9.538)	1.154	0.170	−0.062	1				0.245	0.071
IC	50.234 (9.574)	47.932 (10.175)	52.537 (8.47)	2.233 *	0.492	0.054	0.231 *	1			0.711	0.771
M	49.804 (10.201)	48.853 (11.329)	50.755 (9.009)	0.970	0.186	0.209	0.284 *	0.421 **	1		0.269	−0.185
HRR	49.715 (9.13)	47.598 (9.737)	51.832 (8.079)	2 *	0.473	0.167	0.158	0.064	0.224	1	0.684	−0.718

* $p < 0.05$; ** $p < 0.01$. Winner' s centroid = 0.346; Loser' s centroid = −0.346. TA (trait anxiety), SE (self-efficacy), IC (interpersonal competitiveness), M (motivation), HRR (heart rate reactivity).

The analysis of the determinant of the correlation matrix between the predictors showed the existence of certain collinearity between the variables (det | A | = 0.681), and this was later confirmed in the matrix of correlations between the variables (Table 2). We found that M, SE, and IC were positively correlated. Despite this problem of collinearity among the predictors, we ruled out the possibility of combining them linearly to predict the outcome of the competition, in order to avoid a significant loss of variability as much as possible.

3.2. Discriminant Analyses

After verifying that our variables met the necessary conditions for the application of the DA, we constructed the model using the block introduction method. We obtained a single canonical discriminant function with a λ = 0.123 and a canonical correlation coefficient of 0.331. This coefficient, together with the value of the Lambda de Wilks obtained (λ = 0.890), led us to consider that our model has modest explanatory power (Table 2 also shows the coefficients of the discriminant function). In the model, we confirm that HRR, IC, and M are the best predictors of winning/losing the competition.

Despite the modest explanatory power of the model, we found that its predictive power was substantial. The set of variables considered made it possible to correctly classify 68.8% (n = 53) of the cases introduced. The model's predictive capacity of the winning vs. loser profiles is similar, without detecting a different performance in the classification based on the profile of the participant. The rate of correct classifications for the losing profile was 73% (n = 27), whereas for the winning profile, it was 65% (n = 26).

We also checked that our model's predictions were not an independent variable of the subject's outcome. Using an independence test, we verified that the two variables were related $\chi^2_{[1]} = 11.133$; $p < 0.001$ with a moderate magnitude (φ | 66 | = 0.380; $p < 0.001$).

3.3. Confirmatory Analyses

Given that our model had low explanatory power but an interesting predictive capacity, we wanted to find out whether this predictive capacity could be extended to another sample, or if it was a spurious effect due to the overfitting of the model. To determine this, we verified that the model constructed in the first study was able to predict the result of the same competition in another set of participants different from those used to estimate the coefficients of the discriminant function. That is, we set out to test its generalization capacity in another set of participants.

First, we examined whether the distribution of the scores in the independent variables of the model for the generalization sample was similar to the distribution observed in the first sample in which the coefficients of the discriminant function had been estimated. Table 3 shows that the averages and standard deviations of these variables in the generalization sample were similar to the descriptive statistics obtained previously in the first sample (see Tables 2 and 3). This similarity is verified by non-significant Levene contrasts for the variances of the groups and the t values for each pair of averages (Table 3 column 2).

Table 3. Descriptive statistics for the validation samples and contrast of means with the parameters of the estimation sample.

	Validation Sample 1		**Validation Sample 2**	
	Mean (sd)	**t +**	**Mean (sd)**	**t †**
TA	48.225 (9.326)	0.687	48.294 (7.154)	−0.875
SE	46.617 (11.127)	1.197	52.981 (8.652)	1.495
IC	54.014 (9.0644)	−1.574	48.943 (9.494)	−1.202
M	44.645 (8.899)	2.117 *	52.195 (8.181)	1.139
HRR	48.809 (7.542)	0.506	42.789 (4.593)	−4.793 **

* $p < 0.05$; ** $p < 0.01$. + The average is contrasted for each variable in the group of men in the sample for the estimation of the parameters of the discriminant function and among the averages in the validation sample. † The average is contrasted for each variable in the group of women in the sample for the estimation of the parameters of the discriminant function and among the averages in the validation sample. TA (trait anxiety), SE (self-efficacy), IC (interpersonal competitiveness), M (motivation), HRR (heart rate reactivity).

Next, to determine whether each subject belongs to the winner vs. loser group, each of his/her scores typified on the independent variables was weighted by the coefficients of the discriminant function (Table 3). The cut-off point that made it possible to assign subjects to the winning or losing group was obtained from the calculation of the average distance between the centroids of the winning group and the losing group. The rate of correct classifications in validation sample 1 (only men) was 60.71%, and this percentage was slightly lower than expected. The rate of correct classifications for the losing profile was 57.14%, whereas for the winning profile, it was 71.43%. In the same way, we repeated the procedure with a second validation sample (only women). The rate of correct classifications in validation sample 2 was 57.14%, with 56.52% for the losing profile and 58.33% for the winning profile.

4. Discussion

The aim of this study was to scrutinize the explanatory impact of psychophysiological variables on competition outcomes. The findings underscored the substantial predictive capability of the variable set in classifying participants as winners or losers based on these parameters. Notably, competitiveness and heart rate reactivity emerged as the most robust predictors of competition outcomes, followed by motivation and self-efficacy, with trait anxiety exhibiting the least influence. Consequently, our model accurately forecasted competition outcomes in 68.8% of cases, demonstrating consistent predictive efficacy for both winners (65%) and losers (73%). Furthermore, the results indicated the replicability of this model across diverse samples of both men and women. Although there was a slight decrease in predictive power in the validation samples, the outcome remained statistically significant.

Proximal situational factors (motivation, self-efficacy, and HR reactivity) turned out to be significant predictors of outcome. That is, winners would be characterized by high scores on motivation, self-efficacy, and HR reactivity. These results are consistent with what was expected and with the challenge appraisal hypothesis described in the CCM [3] and also with the theory of challenge and threat states in athletes [16], which proposed that, in competitive situations, high self-efficacy and motivation oriented toward approach goals would lead to appraising the competition as a challenge, characterized by an increase in HR and positive mood, thus increasing the chances of success. The opposite would lead to

a threat state associated with a lower cardiac response and negative mood, increasing the probability of defeat.

In addition, these results are in line with previous literature that showed higher self-efficacy in winners and a relationship between self-efficacy, approach achievement goals, and competition performance [18,32]. This might occur because confidence about performing the competitive task successfully would lead to facing the competition as a challenge, as long as the situation is important enough for the individual, and he/she is more focused on approach goals than on avoidance goals [16]. On the other hand, and in agreement with previous studies [21,26], our data reveal that high HR reactivity during competition would be a characteristic of winners. A high HR response could be a consequence of the challenge state produced by the situational appraisal. Thus, in a challenge state, a parasympathetic withdrawal/sympathetic activation, characterized by HR increases, would prepare the organism to actively cope with the competitive situation [3], thus increasing the chance of victory.

As demonstrated earlier, the outcome of a competition is influenced not only by situational factors but also by significant distal factors. In our investigation, we have substantiated the predictive potency of interpersonal competitiveness and anxiety, with competitiveness emerging as the most explicative distal variable. As anticipated, winners exhibited elevated scores in interpersonal competitiveness and lower scores in anxiety. It is plausible that this heightened competitiveness fosters a greater inclination toward enjoyment of competitive situations. Drawing on the motivation model of achievement, individuals with heightened interpersonal competitiveness may be motivated to assert their superiority over others [33]. Consequently, they may engage in task-approaching mechanisms, predisposing them to enhance the likelihood of winning.

In the context of competition, individual traits and the participants' contextual appraisals play crucial roles in predicting outcomes. This study's notable contribution lies in its proposition and substantiation of a psychophysiological profile distinguishing winners from losers. This complements prior research that has indicated a winner profile marked by elevated confidence levels and diminished anxiety [13,14]. The main implications are that training these variables could increase the probability of reaching victory. It is worth noting that all the variables introduced in the model are, in some way, sensitive to training. In the case of competitiveness, it has been pointed out that receiving feedback on one's performance during training would improve performance, in addition to increasing motivation and competitiveness [34]. Therefore, providing adequate feedback during training would be a key factor in increasing the probability of winning. Training trait anxiety directly may pose challenges, but interventions aimed at bolstering positive self-perception, enhancing individual capacities, and mitigating anxiety states have the potential to yield long-term reductions in trait anxiety. Additionally, efforts to enhance self-efficacy and motivation can be fruitful. In this context, training programs targeting the reinforcement of beliefs in personal control, outcome expectations, motivation, and effort have been suggested as effective avenues for improving self-efficacy [35,36]. Regarding baseline heart rate (HR), exploring training methodologies such as biofeedback or cardiac coherence could prove beneficial. Previous studies have demonstrated the efficacy of these techniques in enhancing an individual's control over their HR response in competitive and stressful scenarios [37–39]. This enhanced control holds the potential to foster improved emotional and cognitive self-regulation, subsequently influencing performance outcomes.

This research, while insightful, is not without its limitations. The sample size warrants consideration, as a larger cohort could bolster the robustness of the results. Similarly, the constrained sizes of the validation samples imply that the misclassification of a single case could exert a notable influence on predictive power. Furthermore, it is worth noting that the analyzed variables exhibited a degree of correlation, suggesting the potential for positive transfers between characteristics through synergistic effects with targeted training. For future studies, broadening the scope to include additional situational variables like mood, heart rate variability (HRV), or total peripheral vascular resistance could en-

hance the applicability of the findings. Lastly, acknowledging the controlled laboratory setting, it is advisable to validate the model in real-world competitive scenarios for a more comprehensive assessment of its effectiveness.

5. Conclusions

This study demonstrates that various proximal and distal factors associated with competition have predictive capabilities regarding the outcome. Competitiveness, anxiety, self-efficacy, motivation, and heart rate reactivity emerge as effective predictors of success or failure in a controlled laboratory competition. In summary, our findings unveil a notable accuracy in classification rates, suggesting potential implications and applicability in diverse contexts and with different participant samples.

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Impact of Met-Expectation of Athletic Justice on Athletic Satisfaction and Organizational Commitment via Leader–Member Exchange among Elite Saudi Arabian Athletes

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Abstract: Athletes' perceptions of fairness toward coaching behaviors and decisions can play a crucial role in the development and maintenance of a strong coach–athlete relationship. However, scholars have given limited attention to athletes' perceptions of fairness. Therefore, the current study aimed to explore the relationship between coaches and athletes by applying the concept of organizational justice based on met-expectation theory. The primary objective of the study was to empirically examine the direct and indirect relationships between the met-expectation of athletic justice and athletes' attitudinal outcomes, such as athletic satisfaction and organizational commitment, through leader–member exchange (LMX). Data were collected from 289 elite athletes (238 men and 51 women) in the Kingdom of Saudi Arabia using a mixed-mode approach (paper-and-pencil and online surveys). The results of Structural Equation Modeling indicated that when athletes perceive that their expectations of fair treatment are met, it positively affects their satisfaction. This relationship is partially influenced by the quality of their relationship with their leader. However, the findings also suggest that while the athletes' met-expectation of athletic justice has a positive effect on their satisfaction, it does not have a significant impact on their commitment to the team. The findings provide insight about important work-related outcomes by validating the coach–athlete relationship based on met-expectation of athletic justice. The findings can be utilized to improve athlete satisfaction and commitment, leading to positive team and individual outcomes.

Keywords: perception of fairness; coaching behaviors; athletes' attitudes; social exchange

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1. Introduction

Building a strong and trusting relationship between athletes and coaches is an essential component of developing a successful team [1,2]. A team led by a coach who fails to provide adequate support, direction, and motivation to their players may struggle to function cohesively, resulting in poor performance. In contrast, a team with a coach who fosters a positive and supportive relationship with their players can inspire them to work harder, communicate more effectively, and achieve their objectives. Thus, the quality of the athlete–coach relationship is likely to have a profound impact on a team's performance, either facilitating or hindering their success [3–5]. While there are several important factors (i.e., leadership, communication, and support) that contribute to a strong athlete–coach relationship, athletes' perceptions of fairness with respect to coaching behaviors can act as a crucial factor in building and maintaining that relationship [6–9]. However, the topic of athletes' perceptions of fairness has received limited attention in the literature. Therefore,

the current study explored the relationship between coaches and athletes by applying the concept of organizational justice, which refers to members' perceptions of fairness in an organization [10], to the context of sport. Based on the existing organizational justice literature, it was expected that athletes' perceptions of coaches' decisions and behaviors would play a crucial role in shaping athletes' satisfaction, commitment, effort, willingness to help, and team unity, all of which impact individual and team performance [6,7,11].

Met-Expectation

Two prominent concepts related to understanding employees' satisfaction and commitment are met-expectation and the psychological contract. Met-expectation relates to the extent to which an individual employee's expectations regarding their work environment and employment relationship (e.g., salary, benefits, and responsibilities; [12]) are met by the employer. Specifically, met-expectation refers to the "discrepancy between what a person encounters on [the] job in the way of positive and negative experiences and what he expected to encounter" [13] (p. 152). In contrast, psychological contract refers to the unwritten, informal and implicit expectations and obligations (e.g., job security, recognition, respect, and opportunity for development) based on a mutual agreement that arise from the employment relationship [14]. Although both met-expectation and the psychological contract are related to the fulfillment of expectations, which may influence job satisfaction in the workplace [15], the theories refer to different aspects of the employee–employer relationship. In the field of sport management, there have been a limited number of studies [15–18] that have adopted such concepts related to organization members' expectations.

Unlike previous studies [6–9] that simply examined the relationships between the perception of fairness toward coaching behaviors and athletes' attitudinal or behavioral outcomes, the current study employed a different approach by incorporating the concept of met-expectation as a way to measure athletes' perceptions of the alignment between their expectations (e.g., their role, playing time, and training within their team) and their experiences regarding coaches' behaviors. According to the met-expectation concept, when organization members' expectations are met, they are likely to have a higher level of satisfaction and commitment. For example, Kim et al. [15] applied the concept of met-expectation to examine the relationships between coaches' met-expectation of organizational justice and their job satisfaction and commitment in intercollegiate athletics in the United States. Therefore, this study provides evidence supporting the significance of athletes' met-expectations in relation to their role, playing time, and training within a team, as well as the influence of coaches' behaviors in these domains. By comprehending and addressing these factors, coaches can make equitable and met-expected decisions, thereby fostering athletes' overall satisfaction and commitment.

In the context of athlete–coach interactions, when athletes join a team, they tend to develop expectations of their roles, playing time, and performance on the team and compare those expectations with their actual experiences. Met-expectation theory suggests that when athletes' actual experiences on the team align with the expectations, they are more likely to feel satisfied and commit to their team, which is likely to help improve individual or team performance. However, when athletes perceive that their coaches are unfair or unjust in contrast with their expectations, they are more likely to have negative emotions (e.g., anger, frustration, and resentment), which may have a negative impact on performance [19].

2. Conceptual Framework

The met-expectation theory provides a useful means of understanding how organization members' perceptions of fairness in the workplace can impact their outcomes. In turn, a conceptual framework regarding the relationships between the met-expectation of athletic justice, leader–member exchange (LMX), and attitudinal outcomes (i.e., athletic satisfaction and team commitment) was developed, as shown in Figure 1. This framework describes how athletes' expectations of fairness about coaching behaviors can impact their

perceptions of the relationship with their coach (as measured by LMX), which in turn can affect their levels of satisfaction and commitment to their teams. Understanding these relationships yields valuable insights for coaches to improve their relationships with athletes and, ultimately, enhance team performance.

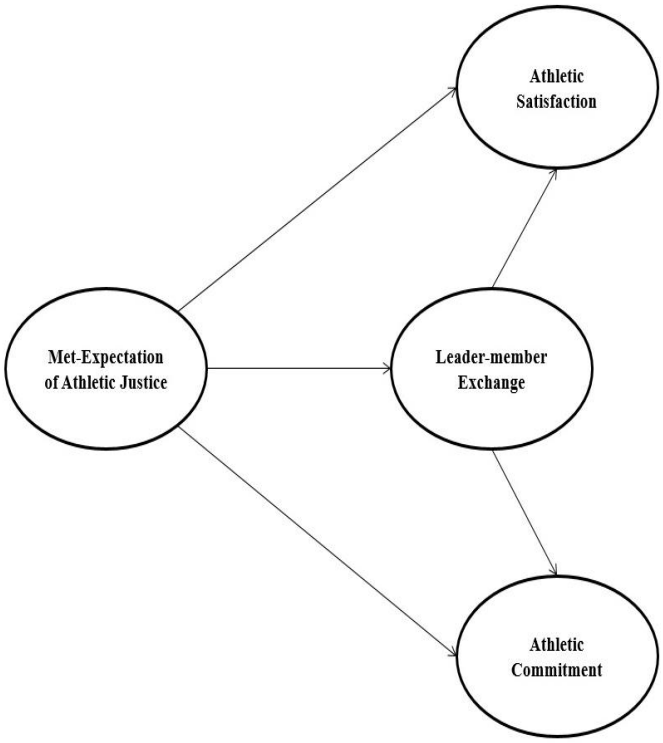

Figure 1. Conceptual framework.

2.1. Organizational Justice in Sport

The concept of organizational justice has received considerable attention since the 1980s in the field of organizational behavior due to its significant impact on members' attitudinal and behavioral outcomes [20]. Hums and Chelladurai [21] were the first to apply the concept of organizational justice to the context of sport when they examined stakeholders' perceptions of fairness regarding resource distribution in U.S. intercollegiate athletics. Since this pioneering work, many researchers [8,22–26] have continued to adopt the concept to investigate perceptions of fairness among different stakeholders and its impacts on organization members' attitudinal and behavioral outcomes in various settings, such as high school sports, university recreational departments, Olympic sports, and professional sport teams. Most studies on organizational justice in sports have focused on perceptions of fairness toward resource distribution (e.g., distribution of funds among sport teams in intercollegiate athletics) within sport and recreation organizations. However, the current study takes a novel approach by focusing on athletes' perceptions of fairness toward coaches' behaviors as target outcomes. In doing so, we term this type of organizational justice as "Athletic Justice" because coaches' decisions in evaluating athletes' abilities, assigning playing time, and allocating their roles and positions in the teams may serve a key role in influencing athletes' perceptions of fairness within a team.

Organizational justice is a multi-dimensional construct [27]. According to the four-type model [28], employees in the workplace develop perceptions of fairness based on the presence or absence of fairness in four dimensions: (a) distributive justice (e.g., salary and promotion), (b) procedural justice (e.g., procedures or rules used to make outcome decisions), (c) interpersonal justice (e.g., quality of interpersonal treatment of the management in progress), and (d) informational justice (e.g., justifications and explanations provided regarding the determined outcomes). In turn, we conceptualize athletic justice as

having the potential to be influenced by four aspects [29]: (a) distributive justice, where athletes perceive whether their coaches have been fair in evaluating their effort, ability, and contribution, allocating playing time, or assigning positions [30]; (b) procedural justice, where athletes perceive whether their coaches have used fair rules or processes in making outcome decisions [31]; (c) interpersonal justice, where athletes perceive whether coaches have been fair when communicating decisions, such as being respectful/disrespectful or sensitive/insensitive to athletes' feelings [32]; and (d) informational justice, where athletes may perceive whether coaches have provided adequate justifications or explanations for their decisions [33]. Overall, the four dimensions of athletic justice, encompassing distributive, procedural, interpersonal, and informational justice, provide a comprehensive framework for understanding athletes' perceptions of fairness within the team setting.

2.2. Outcomes of Organizational Justice

Based on the organizational justice literature, it is expected that there would be a positive relationship between the met-expectation of organizational justice and attitudinal or behavioral outcomes [15]. Athletes' perceptions of fairness, based on their subjective evaluations regarding rules, policies, and procedures within their teams, can have a significant impact on their satisfaction [7–9,34]. When athletes perceive their athletic experiences as fair, they are more likely to report higher levels of satisfaction. Therefore, it is important for coaches to be aware that creating a fair and just athletic environment requires fair outcome distribution, decision-making processes, clear and transparent justifications for their decisions, and the respectful and sincere treatment of athletes, as such an environment can positively foster athlete satisfaction and commitment.

2.2.1. Attitudinal Outcomes: Athlete Satisfaction and Team Commitment

Athlete satisfaction is defined as an athlete's feeling of pleasure or happiness regarding their athletic experience [35]. It is considered to be an important factor that can impact athletes' well-being and is linked to individual and team performance [35,36]. In fact, there is a substantial body of the literature that supports the positive role of athlete satisfaction on various outcomes, such as commitment and performance. Given the positive role of athlete satisfaction, personal factors (e.g., personality traits, self-esteem, and motivation) and environmental factors (e.g., coaching style, team cohesion, and organizational support) have been studied to understand how to develop a high level of athlete satisfaction. In the current study, we examined potential environmental factors, including met-expectations of organizational justice and leader–member exchange, that foster athlete satisfaction and ultimately lead to improved performance. Team commitment can be defined as the level of identification and attachment an athlete feels toward their team [37]. Numerous studies have found a positive relationship between employees' perceptions of fairness and level of commitment to their organization [20], which suggests that when athletes feel they are being treated fairly within their team, they are more likely to feel committed to the team.

2.2.2. Leader–Member Exchange as a Mediator

LMX, the quality of the relationship between a leader (e.g., coach) and their followers (e.g., athletes), can affect the attitudes of both the leaders and followers [38]. Coaches who demonstrate these qualities are more likely to develop high-quality LMX relationships with their athletes, leading to increased athlete satisfaction and team commitment [39]. Specifically, LMX involves, "(a) a system of components and their relationships, (b) involving both members of a dyad, (c) involving interdependent patterns of behavior, (d) sharing mutual outcome instrumentalities, and (e) producing conceptions of environments, cause maps, and values" [40] (p. 580).

The current study explored the impact of met-expectations, combined with organizational justice, on commitment. In other words, if athletes perceive that their expectations are being met in terms of fair treatment by their coach, they may be more likely to demonstrate commitment to the team. Numerous studies have found positive relationships

between organizational justice and LMX [41] and between LMX and job satisfaction and commitment [42,43] and also a mediating effect of LMX between organizational justice and attitudinal outcomes [42] based on social exchange theory [44]. For example, athletes who have high-quality LMX relationships with their coaches are more likely to report higher levels of satisfaction with their sport experience and commitment to their team. Therefore, athletes' perceptions of met-expectation are expected to positively influence LMX, which may have positive impacts on athletic satisfaction and commitment. Based on the existing literature, the following hypotheses were proposed regarding the constructs in the conceptual model.

Hypothesis 1: *LMX will mediate the relationship between the met-expectation of fairness perception toward coaching behaviors and athlete satisfaction.*

Hypothesis 2: *LMX will mediate the relationship between the met-expectation of fairness perception toward coaching behaviors and team commitment.*

3. Methods

3.1. Participants and Survey Procedure

The current study employed a cross-sectional research design. Data collection was undertaken through a mixed-mode approach combining traditional paper-and-pencil surveys with online surveys. Research Ethics Committee (REC) approval was obtained prior to data collection. Permission to collect data via offline or online surveys were acquired from each sport club before administering paper–pencil surveys or sending emails containing a survey link. The participants for this study were athletes based in the Kingdom of Saudi Arabia. A total of 356 responses were collected, out of which 289 were usable for the study, with the rest being excluded due to perceived insincerity or incomplete responses. The sample size aligns with the recommended criteria of Westland [45], who proposed a method for calculating the lower bound on sample size in CFA and SEM, which is expressed by Equation (1). Given the research design of the current study, comprising 22 observed variables and 4 latent variables, this calculation indicates that a sufficient sample size is 138. The final sample for the study comprised 238 men (82.3%) and 51 women (17.6%), with an average age of 27.5 years (SD = 9.05). Full demographic information, including the variety of sports played by the research participants, is provided in Table 1.

$$n \geq 50r^2 - 450r + 1100 \; where \; r = \frac{number\ of\ observed\ variables}{number\ of\ latent\ variables} \quad (1)$$

Table 1. Demographic statistics of participants.

		n	Percent (%)
Gender	Male	238	82.3
	Female	51	17.6
Sports	Football	61	21.1
	Athletics	38	13.1
	Tennis	25	8.7
	Basketball	18	6.2
	Volleyball	15	5.2
	Cycling	14	4.8
	Taekwondo	14	4.8
	Wrestling	13	4.5
	Gymnastics	10	3.5
	Fencing	8	2.8
	Jujitsu	8	2.8
	Weightlifting	8	2.8
	Rowing	7	2.4
	Others	50	17.3

3.2. Instrumentation

The present study consisted of four main variables: (a) met-expectation of fairness perception towards coaching behaviors, (b) LMX, (c) athlete satisfaction, and (d) team commitment. A set of questionnaires, comprising 35 items, was used to measure the data for these variables, as well as collect demographic information (e.g., age, gender, type of sport, and athletic career).

3.2.1. Met-Expectation

The current study developed a scale of met-expectation of athletic justice based on the authors' athletic justice scale [46]. While the original scale had 12 items across four dimensions (i.e., distributive, procedural, interpersonal, and informational justice), the current study adapted the scale to assess the met-expectation of athletic justice as a measure of overall justice. Sample items included "My coach addresses influence from administrators in a way I expect", "My coach provides team members with feedback about decisions and their implementation in a way I expect", and "My coach communicates their decisions in a way I expect". Responses were recorded on a 7-point Likert scale ranging (1) 'strongly disagree' to (7) 'strongly agree'.

3.2.2. Outcome Variables

The remaining constructs—LMX, athlete satisfaction, and team commitment—were measured using existing scales in the field of organizational behavior. These variables were carefully chosen, building upon the existing literature, to ensure comprehensive and robust outcomes. The scales have been frequently employed in sport studies with contextual modifications. First, LMX for elite athletes was assessed using the 7-item scale developed by Scandura and Graen [47]. Sample items included "I always know how satisfied my coach is with what I do", and "My coach certainly would be personally inclined to help solve problems". Athletic satisfaction was assessed using a 5-item scale of job satisfaction by Judge et al. [48]. Sample items were "I feel satisfied with my team" and "I consider my team and my sport rather unpleasant. (Reversed coded)". Finally, team commitment was measured by modifying the affective commitment component of Meyer and Allen's [49] organizational commitment. Sample items include, "I would be very happy to spend the rest of my athletic career with my team" and "I do not feel like 'part of the family' in my team. (Reversed)". In the context of sports, the reported reliabilities (α) of the scales were 0.94 for LMX [37], 0.82 for athlete satisfaction, and 0.82 for team commitment [36], respectively. All measurement items of the variables were adopted on a 7-point Likert scale, anchored from (1) 'strongly disagree' to (7) 'strongly agree'.

3.3. Data Analysis

To ensure the robustness of our measurements, we conducted validation and reliability assessments using statistical tests like Confirmatory Factor Analysis (CFA). Subsequently, we utilized Structural Equation Modeling (SEM) to empirically test our hypotheses. First, the investigators performed Confirmatory Factor Analysis (CFA) on the collected data to verify the measurement validity and reliability of the variables. This statistical procedure confirmed the factor structure of our observed variables and the factor loads of each item. Items with factor loading values lower than 0.6 were removed, ensuring a high level of construct validity and reliability. In general, there are serval goodness-of-fit indices that CFA requires for validation of a measurement scale. According to Hair et al., [50], the chi-squared value (CMIN), Standardized Root Mean Residual (SRMR), Root-Mean-Square Error of Approximation (RMSEA), Comparative Fit Index (CFI) and Tucker–Lewis Index (TLI) indices are used to determine model fit, with CMIN requiring a p-value of 0.05 or less, SRMR < 0.08, RMSEA < 0.01, CFI > 0.9, and TLI > 0.9. After removing inappropriate items and ensuring model fit, the final questionnaire included 9 items for met-expectation, 7 items for LMX, 3 items for athlete satisfaction, and 3 items for team commitment, respectively. Following the CFA, investigators performed SEM to verify research hypotheses. This

statistical procedure was chosen to uncover complex relationships between variables and to ascertain the strength and direction of these relationships. The SEM allowed for estimation of the direct, indirect, and total effects of the variables and testing of the proposed causal relationships between the met-expectation of athletic justice, LMX, athlete satisfaction, and team commitment.

4. Results

4.1. Measurement Validity and Reliability

The results of the study are organized into several sections that correspond to each stage of the data analysis. First, the CFA and associated model fit indices are reported, followed by tests of convergent and discriminant validity. Lastly, the Structural Equation Modeling (SEM) results are presented.

Table 2 presents descriptive statistics of the observed variables and the outcomes of the CFA. The model fit indices for the CFA demonstrated acceptable levels. Specifically, the chi-squared was $x^2 = 4594.612$, degrees of freedom (df) were 231, CFI was 0.919, TLI was 0.908, RMSEA was 0.078, and the SRMR was 0.053, all of which were within the acceptable range, thus providing evidence for construct validity.

Table 2. CFA Results.

Construct	Item	Mean	S.D.	Loadings	CR	AVE	A
Met-Expectation					0.924	0.578	0.923
	My coach addresses influence from administrators in a way I expect.	4.88	1.89	0.747			
	My coach handles influence from political factors in a way I expect.	4.97	1.85	0.643			
	My coach addresses influence from team members' parents in a way I expect.	5.16	1.66	0.739			
	My coach provides team members with feedback about decisions and their implementation in a way I expect.	4.93	1.98	0.688			
	My coach communicates their decisions in a way I expect.	4.76	1.97	0.785			
	My coach communicates with everyone on the team in a way I expect.	4.85	2.08	0.782			
	My coach meets my expectations by treating everyone on the team with respect.	5.72	1.69	0.795			
	My coach meets my expectations by treating everyone on the team in a polite manner.	5.57	1.77	0.829			
	My coach meets expectations by treating everyone on the team with dignity.	5.63	1.74	0.832			
Athlete Satisfaction					0.888	0.728	0.880
	Most days I am enthusiastic about my team and my sport.	6.08	1.44	0.759			
	I feel satisfied with my team.	5.56	1.67	0.912			
	I find real enjoyment in my team.	5.82	1.51	0.861			
Team Commitment					0.865	0.683	0.865
	I do not feel a strong sense of "belonging" to my team.	4.89	2.07	0.775			
	I do not feel "emotionally attached" to my team.	5.15	2.03	0.864			
	I do not feel like "part of the family" in my team.	5.18	2.11	0.839			

Table 2. *Cont.*

Construct	Item	Mean	S.D.	Loadings	CR	AVE	A
LMX					0.890	0.688	0.915
	I always know how satisfied my coach is with what I do.	5.23	1.87	0.728			
	My coach completely understands my problems and needs.	5.03	2.02	0.808			
	My coach fully recognizes my potential.	5.28	1.84	0.661			
	My coach certainly would be personally inclined to help solve problems	5.22	1.86	0.819			
	I certainly can count on my coach to "bail me out" at his/her expense when I really need it.	4.44	2.01	0.728			
	I have enough confidence in my coach that I certainly would defend and justify his/her decisions if he/she were not present to do so.	4.90	2.07	0.888			
	I would characterize my relationship with my coach as extremely effective.	5.22	1.84	0.814			
	x^2 = 4594.612, df = 231 $p < 0.001$, CFI = 0.919, TLI = 0.908, RMSEA = 0.078, SRMR = 0.053						

Next, we assessed the internal consistency of the constructs using Composite Reliability (CR). The CR values for met-expectation, athlete satisfaction, team commitment, and LMX were 0.924, 0.888, 0.865, and 0.890, respectively, exceeding the suggested threshold of 0.7 [44], which indicated the constructs have high internal consistency. We also considered the Average Variance Extracted (AVE), which were 0.578, 0.728, 0.683, and 0.688 for met-expectation, athlete satisfaction, team commitment, and LMX, respectively. As the AVE for each construct was above the recommended threshold of 0.5, this further affirmed the convergent validity of our measurement items [50]. The reliability of measurement items was verified using Cronbach's alpha, with values of 0.923, 0.880, 0.865, and 0.915 for met-expectation, athlete satisfaction, team commitment, and LMX, respectively. All alpha values exceeded the commonly accepted threshold of 0.7, indicating that the measures were reliable [51]. Discriminant validity was ascertained through comparing the square root of the AVE of each construct with the correlation coefficients of each pair of variables, as shown in Table 3. The square root of the AVE for each variable was larger than the correlations between that variable and every other variable, which confirms discriminant validity [50].

Table 3. Discriminant validity.

Variables	$\sqrt{AVE}$	ME	AS	AC	LMX
ME	0.760	1			
AS	0.853	0.459	1		
TC	0.826	0.182	0.389	1	
LMX	0.829	0.814	0.471	0.206	1

ME: met-expectation, AS: athlete satisfaction, TC: team commitment, LMX: leader–member exchange.

4.2. Results of SEM

Turning to the SEM results, presented in Table 4, the model yielded an acceptable goodness-of-fit (x^2 = 4594.621, df = 231, CFI = 0.919, TLI = 0.908, RMSEA = 0.078, SRMR = 0.053), which indicates the model fitted the data well (adopting the same criteria as CFA validation; [44]). Results from the SEMs revealed LMX partially mediated the relationship between met-expectation and athlete satisfaction, which supports hypothesis 1. The direct effect of ME on AS was estimated at 0.225, while the indirect effect via LMX was 0.234 (0.814 × 0.288). Thus, the total effect of met-expectation on athlete satisfaction was 0.459, suggesting LMX plays a significant mediating role. On the contrary, LMX was not found to mediate the relationship between met-expectation and team commitment, which

does not support hypothesis 2. No significant direct or indirect effects were observed. This suggests that the impact of met-expectation of athletic justice on team commitment does not rely on the level of LMX. In sum, our data support the conceptual model and hypotheses, with the exception of the hypothesized mediating role of LMX in the relationship between the met-expectation of athletic justice and team commitment.

Table 4. Results of SEM.

To	From	Std. B	Std.err	*p*
LMX	ME	0.814 *	0.071	<0.001
AS	ME	0.225 *	0.087	0.046
	LMX	0.288 *	0.091	0.011
TC	ME	0.043	0.142	0.733
	LMX	0.171	0.148	0.174
x^2 = 4594.621, df = 231 $p < 0.001$, CFI = 0.919, TLI = 0.908, RMSEA = 0.078, SRMR = 0.053				

ME: met-expectation, AS: athlete satisfaction, TC: team commitment, LMX: leader–member exchange. *: Significant at the 5% level.

5. Discussion

The current study was designed based on prior research and theories in the field of organizational behavior to propose two research hypotheses. Specifically, we hypothesized that LMX would mediate the relationship between the met-expectation of fairness perception toward coaching behaviors and athlete satisfaction (H1) and the relationship between the met-expectation of fairness perception toward coaching behaviors and team commitment (H2). The results of the current study have important academic contributions and practical implications for the field of sport management and coaching.

First, the results of descriptive statistics indicate that most elite athletes in Saudi Arabia generally perceive their coaches as treating them fairly and with respect and develop quality relationship with their coaches. Additionally, the athletes report high levels of athletic satisfaction, which may reflect their positive experiences. However, they rated team commitment slightly lower than the other variables, which indicates an area for further consideration and improvement. Thus, coaches in this context should work on strategies that could enhance team commitment, such as team-building exercises and promoting a sense of shared goals and purposes among athletes. Given the high levels of athletic satisfaction and relatively strong commitment among athletes in Saudi Arabia, coaches have an opportunity to enhance overall team performance and cultivate a more cohesive and supportive athletic environment.

This study assessed athletes' perception toward coaching styles and behaviors using the concept of organizational justice. Given the important influence of coaches on athletes' experience and performance in teams, while numerous studies [52,53] have examined the relationship between coaching behaviors and athlete satisfaction, the current study provides a more nuanced perspective by examining the role of perceived fairness toward coaches' decisions and behaviors on athletes' attitudes. In addition, this study incorporated the concept of met-expectation in measuring athletic justice and expanded the understanding of athlete satisfaction and team commitment. The results of SEM analysis indicate that met-expectation regarding athletic justice had both direct and indirect impacts on athletic satisfaction, providing further evidence for the role of the met-expectation of athletic justice in the relationship between coaches and athletes. The overall results support a number of previous studies [9,15] by confirming that the congruence between justice perceptions and expectations positively impacts job satisfaction.

The current study also reinforces the importance of LMX and the quality of athlete–coach relationships on athletes' attitudinal outcomes. The findings of the study supported a mediating role of LMX, showing that athletes' satisfaction with their sports is directly linked to both the congruence between the athletes' expectations and actual experiences regarding coaches' decisions and behaviors in their teams, and their perceived quality of the social

exchange relationships with their coaches. This highlights the importance of coaches' fair and just behaviors and decisions in enhancing athlete satisfaction, which may ultimately lead to better overall team performance [6–8]. In this way, the current study contributes to the organizational behavior in the sport literature by empirically confirming the mediation effects of LMX in the relationship between met-expectation and outcome variables.

The findings of this study indicate that compared to athlete satisfaction, the met-expectation of athletic justice and LMX did not have a significant impact on team commitment. These findings suggest that while LMX plays a crucial role in promoting athlete satisfaction, it may not be as significant in promoting team commitment, which has implications for athlete retention and overall team performance. In the literature, LMX and POS are considered important social exchange variables to influence organizational commitment [46,54]. However, the findings of this study revealed the insignificance of LMX on team commitment in the context of sport. The descriptive statistics revealed that the mean score of team commitment was lower than the mean score of athletic satisfaction in the athletic context in Saudi Arabia, which may have contributed to the study's insignificant findings regarding the roles of LMX and met-expectation on team commitment. These results also indicate other factors may be more important in promoting team commitment in sport. For example, athletes are often encouraged to adhere to a set of norms that stress the need to make sacrifices for the sake of the team [55,56]. In turn, athletes who are not satisfied may still have a high level of commitment to the team because of the expectation that they make sacrifices (including their own interests and satisfaction) for the betterment of the team. Overall, our study contributes to the growing body of research on organizational behavior in sports and provides a foundation for future research in this area.

The findings of the study provide several practical implications for coaches, athletes, and sport management professionals. First, this study reinforces the importance of coaches striving to create fair and just practices and team policies to enhance athlete satisfaction and performance. By understanding the importance of fair and just coaching practices in promoting athlete satisfaction, coaches can develop strategies to enhance athlete satisfaction and ultimately improve team performance. For athletes, this study emphasizes the importance of understanding the role of the met-expectation of athletic justice toward coaching behaviors in their satisfaction with their athletic experience. Athletes should be encouraged to communicate their expectations with their coach and provide feedback on their coaching experience. Additionally, athletes should be aware of the importance of their relationship with their coach in their overall satisfaction with their athletic experience. For sport management professionals, the study highlights the limitations of LMX in promoting team commitment. While LMX is an important factor in promoting athlete satisfaction, other factors, such as team cohesion, shared goals, and a sense of belonging, may be more important in promoting team commitment. Sport management professionals should consider these factors when developing strategies to promote team commitment and cohesion.

6. Limitations and Future Research

The current study contributes to our understanding of the effects of fair or unfair coaching behaviors on athletes' attitudinal outcomes among elite athletes in Saudi Arabia. However, there are several limitations that need to be addressed in future research on the topic. First, this focus of this study was on elite athletes in Saudi Arabia. As such, readers should use appropriate caution when extrapolating the data to other populations, and future studies could be conducted in other cultural contexts or across different levels of sports (e.g., intercollegiate or interscholastic sports) to increase the generalizability of the findings in the athlete–coaching relationship. Second, this study relied on self-reported data from athletes, which may introduce biases and social desirability effects. For example, athletes have been hesitant to address negative attitudes toward their coaches. Future studies may utilize a mixed-methods approach to help further explore these issues. Observations or interviews could provide a more comprehensive understanding of the relationships

between the met-expectation of athletic justice and outcomes. Furthermore, the study examined the effect of athletic justice on athletic satisfaction and team commitment through LMX. Future studies could incorporate other social exchange variables, such as perceived organizational support, and quality relationships between athletes and the team, to capture the full range of social exchange relationships between athletic justice and outcomes. Finally, a longitudinal design is recommended to examine the proposed relationships at multiple time points over an extended period to better understand the causal relationships between the met-expectation of athletic justice and attitudinal outcomes.

7. Conclusions

Coaches' decisions greatly influence athletes' satisfaction and commitment within the team. Therefore, this study advanced the knowledge of the relationships between coaches and athletes by examining athletes' perceptions of fairness based on organizational justice and met-expectation theories. The results yielded insight into the direct and indirect relationships between the met-expectation of athletic justice and athletes' attitudes through leader–member exchange based on social exchange theory. Specifically, leader–member exchange partially mediated the association between athletes' met-expectation of athletic justice and satisfaction. However, no mediation effect was observed for team commitment. These results emphasize the importance of coaching fairness in improving athlete satisfaction. By validating the coach–athlete relationship based on met-expectation of athletic justice, teams could improve athlete satisfaction and commitment, benefiting both individuals and teams. Further research is needed to explore additional factors influencing the coach–athlete relationship and its consequences.

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Data Availability Statement: The data presented in this study are not publicly available to maintain confidentiality and privacy of the people who participated in the study.

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Article

The Impact of Sustainable Exercise on Self-Efficacy and Life Satisfaction in Women before and after Menopause

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Abstract: The study aims at elucidating the association between sustainable exercise and its influence on self-efficacy and life satisfaction in women during their premenopausal and postmenopausal stages. A relational screening model was employed on a sample of 422 women, with 215 premenopausal and 207 postmenopausal participants, utilizing convenience sampling. Participants' regularity of exercise and its duration was taken into consideration. Evaluation tools included the General Self-Efficacy Scale (GSES) and the Satisfaction with Life Scale (SWLS). Data were analyzed using a statistical software package with significance set at 0.05. Sustainable exercise demonstrated no significant difference in SWLS or GSES subdimensions among premenopausal women. However, postmenopausal women engaging in regular exercise reported significantly higher scores in SWLS and all GSES subdimensions. Moreover, positive correlations between age and SWLS scores, as well as between age and certain GSES subdimensions, were found in both pre- and postmenopausal periods. While sustainable exercise does not evidently impact the life satisfaction and self-efficacy of premenopausal women, it significantly enhances these parameters in postmenopausal women. Additionally, age appears to influence life satisfaction and specific self-efficacy subdimensions across both phases.

Keywords: menopause; exercise; sustainable exercise; self-efficacy; life satisfaction

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1. Introduction

Menopause is a significant transitional phase in a woman's life, characterized by marked physiological and psychological alterations. The importance of regular physical activity during this period is emphasized by its potential to mitigate symptoms and foster a healthier lifestyle. Within this paradigm, sustainable exercise, defined as a long-term, individualized approach to physical activity, is of paramount importance. However, the intricate relationship between sustainable exercise, self-efficacy, and life satisfaction during pre- and postmenopausal stages remains under-researched. Sustainability, in a broader context, seeks to address the present generation's needs without compromising the future, encompassing environmental, social, and economic dimensions [1]. When applied to physical activity, sustainability prioritizes long-term health and psychological well-being over transient achievements or potential overexertion [2]. This approach is guided by principles such as individualization, progression, and prioritizing recovery, which collectively advocate a sustained active lifestyle with myriad health benefits [3,4].

The onset of menopause introduces pronounced hormonal variations in women, manifesting symptoms such as hot flashes, mood disturbances, and diminished bone density, which escalates osteoporosis risks [5]. The academic consensus underscores the imperative

of regular physical activity during menopause, especially weight-bearing aerobic and resistance training, to counteract these physiological shifts [6–8]. Given these benefits, healthcare professionals are increasingly recognizing the importance of directing menopausal women towards sustainable exercise routines tailored to their specific needs [9]. Such routines, which encompass aerobic, resistance, flexibility, and balance exercises, address both the physiological and psychological facets of menopause [10]. Central to this adoption is the role of perceived self-efficacy.

Rooted in Bandura's social cognitive theory, self-efficacy refers to one's confidence in executing specific tasks, influenced by past experiences, observations, and feedback [11,12]. High self-efficacy correlates with diverse positive psychological outcomes, including motivation and life satisfaction [13–16]. In the realm of menopause, where emotional and physiological upheavals are rife, the significance of self-efficacy in driving adherence to sustainable exercise is profound [17–20].

Life satisfaction, a broad metric reflecting overall well-being, encapsulates various life domains, from health to familial bonds. It is dynamic, influenced by life events and significant physiological milestones such as menopause [21]. As menopause poses physical and psychological challenges, physical activity's therapeutic role becomes even more vital [22,23]. Regular exercise not only ameliorates the physical repercussions of menopause but also enhances psychological well-being, making it pivotal for maintaining life satisfaction during this transition [24,25]. The nexus between self-efficacy, life satisfaction, and sustainable exercise in women during their menopausal transition is integral to holistic well-being [26]. Though past research has elucidated the myriad benefits of exercise during post-menopause [6,7], a comprehensive study integrating these elements remains scarce. The societal and clinical ramifications of this research are substantial. Menopause affects a significant fraction of the global female demographic, yet holistic interventions are relatively nascent. This study endeavors to bridge this gap by delineating the synergies between exercise, self-efficacy, and life satisfaction during menopause. By presenting an integrative approach, we aspire to enrich the toolkit of healthcare professionals, elevating the care quality for menopausal women and enriching our understanding of this critical life phase.

Research Question and Hypotheses

The primary aim of this study is to elucidate the relationship between self-efficacy, as measured by GSES subdimensions, and life satisfaction (as determined by SWLS scores) among pre- and postmenopausal women who engage in sustainable exercise. Specifically, we focus on understanding how the initiation, perseverance, and maintenance effort subdimensions of GSES correlate with SWLS scores across different exercise patterns and life stages.

Hypotheses:

H1: *Women who engage in sustainable exercise during both pre- and post-menopause will report higher SWLS scores compared to those who do not.*

H2: *Among women who perform sustainable exercise, mean scores on the initiation subdimension of the GSES will be higher than among those who do not, across both life stages.*

H3: *The perseverance subdimension of the GSES will show significant score differences between women who engage in sustainable exercise and those who do not, during both the premenopausal and postmenopausal periods.*

H4: *Sustainable exercise will correspond to higher scores in the maintenance effort subdimension of the GSES for women in both life stages compared to those who do not engage in such exercise.*

H5: *In premenopausal women, there will be discernible relationships among age, SWLS scores, GSES subdimensions, and sustainable exercise patterns.*

H6: *For postmenopausal women, age, SWLS scores, and GSES subdimension scores will interact in specific patterns based on their engagement in sustainable exercise.*

The sub-problems that emerged in line with the aim of the research are listed below:

1. Do women who engage in sustainable exercise have significantly higher scores from the SWLS as compared to women who do not engage in sustainable exercise, both pre- and post-menopause?
2. Do women performing sustainable exercise have significantly higher mean scores on the *initiation* subdimension of the GSES than women who do not participate in sustainable exercise, both pre- and post-menopause?
3. Are there significant differences in the mean scores on the *perseverance* subdimension of the GSES between women performing sustainable exercise and those who do not, in both premenopausal and postmenopausal periods?
4. Do women engaging in sustainable exercise score higher in the *maintenance effort* subdimension of the GSES than women engaging in no sustainable exercise, during both the premenopausal and postmenopausal periods?
5. How do age, life satisfaction scores, and GSES subdimensions (*initiation*, *perseverance*, and *maintenance effort*) relate to sustainable exercise in premenopausal women?
6. How do age, SWLS scores, and GSES subdimension scores interrelate in postmenopausal women according to their engagement in sustainable exercise?

2. Materials and Methods

2.1. Study Design

This research employed the relational screening model to probe the associations between multiple variables, eschewing the establishment of causal relationships [27].

2.2. Participants Selection and Demographics

2.2.1. Sampling Strategy

The convenience sampling method was adopted for this study, drawing participants based on their accessibility and readiness to contribute. This non-probability sampling technique, while efficient in terms of time and cost, might introduce bias, potentially affecting the generalizability of the results [28].

2.2.2. Power Analysis and Sample Size

To establish the required sample size, a power analysis was executed, aiming for an 80% power with an alpha level of 0.05 to discern an effect size of 0.5.

2.2.3. Participant Criteria

Eligible participants were females aged 40–60, free of chronic illnesses, and inhabitants of the designated metropolitan area.

2.3. Study Groups

2.3.1. Group Characteristics

The sample encompassed 215 premenopausal women, averaging an age of 45.53 ± 4.93 years. Among these, 110 engaged in regular exercise of a minimum 45 min duration at least thrice weekly, while 105 did not. An additional group of 207 postmenopausal women, with an average age of 55.97 ± 3.05 years, was also surveyed. Here, 104 women partook in consistent exercise, meeting the previously mentioned criteria, and 103 did not. The cumulative study sample was 422 women.

2.3.2. Exercise Recommendations

The World Health Organization (WHO) advocates adults undertake a minimum of 150 min of moderate-intensity aerobic activity or an equivalent of 75 min of vigorous activity weekly [29]. The recommendation of thrice-weekly, 45 min sessions aligns closely

with these guidelines, optimizing both health benefits and adherence, especially in the demography of pre- and postmenopausal women.

2.4. Instrument for Data Collection

2.4.1. Personal Information Form

Curated by the research team, this instrument solicits data on variables such as sustainable exercise habits and age.

2.4.2. General Self Efficacy Scale [GSES]

The 17-item GSES, formulated originally by Sherer et al. [30] and later adapted for Turkish culture by Yıldırım et al. [31], gauged participants' self-efficacy levels. Employing a five-point Likert scale, the tool offers scores from a minimum of 17 to a maximum of 85, with elevated scores signifying enhanced self-efficacy.

2.4.3. The Satisfaction with Life Scale

This instrument was wielded to gauge life satisfaction among participants [32]. Scores range from 1 to 35, and a higher tally is indicative of increased life contentment. Validity and reliability of the Turkish adaptation were affirmed by Köker [33] and Yetim [34], with a reported Cronbach's alpha value of 0.86 in the latter study.

2.5. Data Analysis Procedure

Data processing employed specialized statistical software. The steps encompassed the following: Computing the Cronbach's alpha coefficient for individual scales, ensuring internal consistency. Evaluating kurtosis and skewness metrics to validate the aptness of data for parametric tests. Utilizing *t*-tests for bilateral comparisons and reporting effect sizes via Cohen's d, where d values of 0.2, 0.5, and 0.8 signify small, medium, and large effects, respectively [35]. Leveraging Pearson correlation analysis to discern relationships between variables, the established criteria was used for interpretation of association strength [35,36]. The stipulated significance threshold was set at $p < 0.05$. Table 1 below provides summary information about the data collection tools used in the study.

Table 1. Summary of data collection tools used in the study.

Data Collection Tools	Description	Scale/Response Format	Score Range	Reference
Personal information form	Custom tool by researchers to gather data on sustainable exercise habits and age.	Open and closed questions	N/A	N/A
General Self-Efficacy Scale (GSES)	17-item scale assessing self-efficacy levels. Consists of three subdimensions: initiation, perseverance, and maintenance effort.	5-point Likert ("not at all" to "very good")	17–85	[28,29]
Satisfaction with Life Scale (SWLS)	5-item scale to measure life satisfaction.	7-point Likert ('strongly disagree' to 'strongly agree')	5–35	[30–32]

3. Results

The findings of this study are presented in a way that aligns with the specific problems identified and investigated within the research context.

No significant difference was found in the mean scores of SWLS between women who practiced sustainable exercise and those who did not during the premenopausal period ($p > 0.05$). However, SWLS scores differed significantly between postmenopausal

women who exercised regularly and those who did not—women doing regular exercise postmenopause had significantly higher SWLS scores ($p < 0.05$), as shown in Table 2.

Table 2. Comparison of mean SWLS scores of premenopausal and postmenopausal women engaging in sustainable exercise and non-exercisers.

Factor	Variable	N	M	SD	t	*p*
Premenopause	**Sustainable exercise**	110	4.81	0.98	0.529	0.590
	No sustainable exercise	105	4.43	0.73		
Postmenopause	**Sustainable exercise**	104	4.99	0.70	2.435	0.010 *
	No sustainable exercise	103	3.01	0.78		

* N = sample size; M = mean; SD = standard deviation; t = t-statistic; *p* = significance level.

The mean scores from the initiation subdimension of GSES showed no significant difference between women doing sustainable exercise and those who did not during the premenopausal period ($p > 0.05$), but these scores were significantly different in the postmenopausal period, with women doing exercise during the postmenopausal period scoring significantly higher in the initiation subdimension ($p < 0.05$), as shown in Table 3.

Table 3. Comparison of mean scores from the GSES *initiation* subdimension of premenopausal and postmenopausal women doing sustainable exercise and non-exercisers.

Factor	Variable	N	M	SD	t	*p*
Premenopause	**Sustainable exercise**	110	3.87	0.65	0.547	0.620
	No sustainable exercise	105	3.01	0.38		
Postmenopause	**Sustainable exercise**	104	4.87	0.29	2.309	0.010 *
	No sustainable exercise	03	3.26	0.61		

* N = sample size; M = mean; SD = standard deviation; t = t-statistic; *p* = significance level.

There was no significant difference in the mean scores of GSES *perseverance* subdimension between premenopausal women according to the sustainable exercise variable ($p > 0.05$). However, women engaging in sustainable physical activity postmenopause had significantly higher scores from *perseverance* subdimension of GSES ($p < 0.05$), as presented in Table 4.

Table 4. Comparison of mean scores from the GSES *perseverance* subdimension of women doing sustainable exercise and non-exercisers during premenopausal and postmenopausal periods.

Factor	Variable	N	M	SD	t	*p*
Premenopause	Sustainable exercise	110	3.74	0.67	0.555	0.660
	No sustainable exercise	105	3.12	0.51		
Postmenopause	Sustainable exercise	104	4.84	0.52	2.401	0.010 *
	No sustainable exercise	103	3.31	0.59		

* N = sample size; M = mean; SD = standard deviation; t = t-statistic; *p* = significance level.

There was no significant difference in the scores from the *maintenance effort* subdimension of GSES among women who exercised regularly and those who did not before premenopause ($p > 0.05$). In the postmenopausal period, however, the scores from this

subdimension differed significantly between these two groups, with women doing regular exercise in the postmenopausal period scoring significantly higher ($p < 0.05$) (Table 5).

Table 5. Comparison of mean scores from GSES *maintenance effort* subdimension of women doing sustainable exercise and non-exercisers during premenopausal and postmenopausal periods.

Factor	Variable	N	M	SD	t	*p*
Premenopause	**Sustainable Exercise**	110	3.65	0.60	0.420	0.720
	No Sustainable Exercise	105	3.39	0.51		
Postmenopause	**Sustainable Exercise**	104	4.87	0.59	2.489	0.010 *
	No Sustainable Exercise	103	3.40	0.46		

* N = sample size; M = mean; SD = standard deviation; t = t-statistic; *p* = significance level.

A significant and moderate positive correlation (r = 0.318; $p < 0.01$) was observed between the age variable and SWLS scores after premenopause. Similarly, a significant and low-level positive correlation (r = 0.267; $p < 0.01$) was identified between the age variable and the *initiation* subdimension scores. However, no significant correlation was found between the age variable, *perseverance* subdimension, or *maintenance effort*, as shown in Table 6.

Table 6. Correlation between age, SWLS, and GSES subdimension scores (*initiation*, *perseverance*, *maintenance effort*) of women engaging in sustainable exercise and non-exercisers during premenopausal period.

N = 215		SWLS	Initiation	Perseverance	Maintenance Effort
Age	**r**	0.318 **	0.267 **	0.040	0.090
	p	0.001	0.001	0.512	0.672

** Significant at $p < 0.01$.

A significant, positive and moderate relationship (r = 0,383; $p < 0,01$) was detected between the age variable and SWLS scores in the postmenopausal period. Another significant and low-level positive correlation (r = 0.291; $p < 0.01$) was observed between the age variable and the *initiation* subdimension. Besides, a significant and moderate positive correlation (r = 0.301; $p < 0.01$) was found between the age variable and the *perseverance* subdimension. Finally, a significant and low-level positive correlation (r = 0.139; $p < 0.05$) was identified between the age variable and the *maintenance effort* subdimension, as displayed in Table 7**.**

Table 7. Correlation between age, SWLS, and GSES subdimension scores (*initiation*, *perseverance*, *maintenance effort*) of women engaging in sustainable exercise and non-exercisers during postmenopausal period.

N = 207		SWLS	Initiation	Perseverance	Maintenance Effort
Age	**r**	0.383 **	0.291 **	0.301 **	0.139 *
	p	0.001	0.001	0.001	0.020

** Significant at $p < 0.01$, * significant at $p < 0.05$.

4. Discussion

This study aimed to compare self-efficacy perceptions and life satisfaction parameters. The purpose of this study was to illuminate the relationships between self-efficacy, life satisfaction, and physical exercise across different stages of a woman's life. The exploration of these interrelationships in both pre- and postmenopausal women, differentiated by

their exercise habits, contributes novel insights to the extant literature. While our study found no significant difference in life satisfaction scores between physically active and inactive premenopausal women, this finding underscores the complexity of factors influencing life satisfaction at this life stage. It is plausible that the multitude of responsibilities premenopausal women encounter—career, family, personal development—dilute the discernable impact of exercise on life satisfaction [37,38]. This diverges from the conventional understanding of the role of exercise in well-being, suggesting an intricate interplay of variables that future research must consider to optimize interventions.

In contrast, postmenopausal women who regularly exercised demonstrated significantly higher life satisfaction scores. This supports the broader literature base that corroborates the positive impact of exercise on life satisfaction during post-menopause [39,40]. Our findings reinforce the crucial role exercise plays in enhancing physical and psychological health at this stage, offering relief from conditions such as osteoporosis and heart disease, and from mental health challenges. Yet, it is noteworthy that not all studies align with our findings. Some research reports an insignificant influence of exercise on life satisfaction among postmenopausal women [41,42], implying that other factors, or variations in exercise type, intensity, and duration, could interfere. This discrepancy in findings indicates an ongoing debate, and an area ripe for further research.

Findings indicated no significant difference in the mean scores of the *initiation* subdimension on the General Self-Efficacy Scale (GSES) between premenopausal women according to their physical activity status. The *initiation* subdimension of the GSES measures an individual's confidence in starting new tasks or pursuing goals, reflecting their self-assurance and belief in their abilities. It is commonly believed that exercise has a positive influence on self-efficacy, as regular exercisers tend to exhibit higher self-efficacy scores due to the self-confidence and resilience fostered by physical activity. However, intriguingly, the study did not detect a significant disparity in the mean scores of the *initiation* subdimension among premenopausal women. This suggests that self-efficacy may be influenced not only by exercise but also by other aspects of life. Factors such as career achievements, familial relationships, social support, and educational attainment could play a role in shaping an individual's self-efficacy, potentially overshadowing the impact of exercise alone. These findings highlight the multi-faceted nature of self-efficacy and suggest that it is influenced by various domains beyond exercise. While exercise is often associated with enhanced self-efficacy, this particular study suggests that its impact may be less pronounced when compared to other life factors.

Self-efficacy, a crucial concept within Bandura's social cognitive theory, encompasses an individual's confidence, motivation, and perceived ability to achieve goals [11]. Therefore, in order to fully understand the impact of exercise on self-efficacy, it is imperative to consider factors beyond exercise in isolation. Recent research [43] has shed light on this matter by revealing that the influence of exercise on self-efficacy is intertwined with other elements, such as an individual's overall lifestyle and the level of social support they receive. This suggests that the effect of exercise on self-efficacy can be influenced by an individual's experiences and accomplishments in various aspects of life. By acknowledging the interconnectedness of these factors, we can gain a more comprehensive understanding of how exercise relates to self-efficacy.

Postmenopausal women who exercised regularly had higher self-efficacy scores from the *initiation* subdimension of the GSES, supporting the positive association between exercise and self-efficacy. Exercise is known to have the potential to enhance an individual's self-confidence and ability to achieve goals, which has a direct impact on their willingness to take on new challenges and tasks. Particularly during the postmenopausal phase, exercise can empower women to cope with various physiological and life changes. Previous research found that regular participation in an exercise program led to increased overall self-efficacy scores among postmenopausal women, observing increased confidence, particularly in achieving new goals, among women who exercised [44]. It is important to note, however, that not all studies confirm these findings. For example, the impact of regular exercise on

self-efficacy was reported to possibly depend on other factors such as age, health status, and lifestyle, so the influence of exercise on self-efficacy should be examined in conjunction with other factors, such as an individual's overall lifestyle and health status [45]. While most of the existing literature on the influence of exercise on self-efficacy in postmenopausal women suggests a positive effect, it is worth noting that some studies caution against assuming a uniformly beneficial influence across all domains of life. Studies examining the relationship between exercise, life satisfaction, and self-efficacy in older adults (both men and women aged 60–77) found no significant benefit of exercise [46]. However, it is important to recognize that such research included a broader age range of older adults and was not specifically focused on postmenopausal women.

The analysis of the study results revealed no significant difference in the mean scores of the *perseverance* subdimension of the GSES, as premenopausal women who exercised regularly and those who did not had similar scores. The absence of a significant difference in this subdimension may be attributed to several factors. First, it is possible that women generally have high levels of self-efficacy across multiple domains of life before menopause. This may explain why exercise did not lead to further improvements in such areas. For example, one study reported no significant difference in self-efficacy perceptions between pre- and postmenopausal women, suggesting that premenopausal women may inherently have high self-efficacy regardless of their level of physical activity [47]. Conversely, another study observed significant improvements in subdimensions of self-efficacy, such as perseverance, in women who exercised regularly after the premenopause [48]. This suggests that exercise may indeed affect women's self-efficacy, but the effects may not be consistent across individuals. The contradictory nature of these findings suggests that women's perceptions of self-efficacy may be shaped by multiple factors, including personal beliefs, past experiences, and possibly exercise. Overall, the lack of a significant difference in mean scores on the *perseverance* subdimension between premenopausal women who exercised and those who did not suggests that self-efficacy is influenced by multiple factors beyond exercise alone. Beyond physical activity, beliefs, experiences, and other life factors may contribute to self-efficacy.

Postmenopausal women who exercised regularly had significantly higher *perseverance* scores on the GSES as compared to those reporting no sustainable physical activity after menopause. This subdimension of the GSES measures an individual's ability to persist and remain determined in accomplishing tasks, even in the face of difficulties and obstacles [11]. The observed statistically significant difference in the mean scores of the *perseverance* subdimension among postmenopausal women who engaged in regular exercise highlights the impact of self-efficacy on physical activity and the broader life process. This finding is in line with some previous work that demonstrated that regular exercise had a positive influence on self-efficacy subdimensions such as *perseverance* among postmenopausal women [49]. Conversely, women who did not engage in regular exercise during the postmenopausal period exhibited lower mean scores on the *perseverance* subdimension. One possible explanation for this discrepancy is that hormonal changes occurring during the postmenopausal period may negatively affect overall life satisfaction and self-efficacy perceptions [50]. Regular exercise may serve as a mitigating factor, counteracting these adverse effects and enhancing individuals' levels of self-efficacy. In a related study, researchers found that menopausal women who engaged in higher levels of physical exercise, along with displaying greater interpersonal competence and emotional intelligence, reported lower levels of health anxiety [51]. Interpersonal competence, coupled with elevated emotional intelligence and reduced health anxiety, is directly linked to higher self-efficacy perceptions. This suggests that individuals' effective communication skills and empathic abilities may enhance their perceived competence in managing various situations. Furthermore, this study indicates that lower health anxiety positively influences overall life satisfaction and self-efficacy perceptions by alleviating negative thoughts and concerns related to health.

The mean scores from the *maintenance effort* subdimension of the GSES did not exhibit a significant difference among premenopausal women depending on their exercise status.

This subdimension of self-efficacy reflects an individual's ability to persist with a specific action or behavior [11], and is influenced by various factors, including available time, motivation, health status, and the ability to engage in exercise. As such, it is not surprising that premenopausal women would have similar scores on this subdimension, as they are all likely to have faced similar challenges regardless of their physical activity practices. For example, a woman who has been exercising regularly for a certain period may lack confidence in her ability to sustain this behavior in the future. On the other hand, a woman who does not currently exercise might believe that she could initiate and maintain a regular exercise routine if she has sufficient motivation and resources. Premenopausal women are often faced with a number of physical and emotional changes that can make it difficult to maintain a regular exercise routine. Hormonal changes, stress, and other life transitions during this phase can impact women's exercise habits and their perceptions of self-efficacy. However, these factors may not significantly influence the scores from the *maintenance effort* subdimension solely based on regular physical activity.

Data analyses revealed a noteworthy disparity in the mean scores from the *maintenance effort* subdimension within the GSES scale, comparing postmenopausal women engaging in sustainable exercise and those who did not. Specifically, women exercising regularly during menopause exhibited significantly higher scores in this subdimension. This discovery is consistent with plenty of research that generally supports the positive impact of exercise on self-efficacy. As described by Bandura, self-efficacy refers to an individual's belief in their capability to successfully accomplish a particular task [11], although there are certain reports suggesting that increased physical activity among postmenopausal women effectively could diminish self-efficacy, body perception, and depressive symptoms [37].

As for life satisfaction, a significant, positive, and moderate correlation was found between age and SWLS scores in the premenopausal group. Another significant, positive, and low-level correlation was observed between age and the *initiation* subdimension, which evaluates self-efficacy beliefs regarding task initiation. However, no significant correlation was detected between age and the other two subdimensions: *perseverance* and *maintenance effort*. These findings are consistent with some psychological theories that posit that life satisfaction increases with age due to improved emotion regulation strategies [52] However, other empirical studies have suggested a U-shaped relationship between life satisfaction and age, indicating that life satisfaction is highest in youth and old age and lowest in middle age [53]. The positive correlation between initiation self-efficacy and age implies that older individuals may develop more confidence in initiating tasks as a result of accumulated life experiences [15]. Nevertheless, the lack of a significant correlation between age and the other dimensions of self-efficacy indicates that these dimensions may not change substantially with age. This implies that individual differences and personality traits could primarily determine these dimensions of self-efficacy [54].

In the postmenopausal group, a significant, positive, and moderate correlation was detected between the age variable and SWLS scores. Analysis of participant age profiles and the *initiation* subdimension scores also revealed a significant, positive, and low-level relationship. There was a significant, positive, and moderate relationship with the *perseverance* subdimension, and a similar but low-level correlation with the *maintenance effort* subdimension. Our study's findings align with a trend generally observed in the literature. One previous study [55] suggests that life satisfaction typically increases with age. This capacity for age to augment life satisfaction may be associated with having a wider breadth of life experience and an improved understanding of life's complexity. The relationships observed between self-efficacy subdimensions and age are noteworthy. The current literature generally supports these findings—as individuals age, they accumulate more experiences, which may positively impact their perceptions of self-efficacy [11], which is noticeable in perceptions of self-efficacy related to the initiation and perseverance of tasks. Particularly concerning the *perseverance* subdimension, a high level of self-efficacy is frequently linked with the ability to persevere and complete tasks despite facing difficulties [56]. This finding provides further support for the proposition that older individuals may possess enhanced

skills to navigate difficulties and bolster their capacity to persist throughout this journey. Nonetheless, it is important to note that the associations between life satisfaction and self-efficacy perceptions are not universally fixed, as they can be influenced by a range of factors. Such factors may encompass an individual's overall physical well-being, distinctive personality attributes, socioeconomic standing, and the surrounding conditions in which they reside [57].

5. Conclusions

Our study reveals a substantial correlation between sustainable exercise and increased life satisfaction and self-efficacy in pre- and postmenopausal women.

This research fills a gap in behavioral and sport science literature by emphasizing the psychophysical responses of pre- and postmenopausal women to sustainable exercise. These insights have potential applications for mental health and fitness interventions tailored to this demographic, aiming to enhance their overall well-being. For future studies, our findings suggest the benefit of longitudinal designs, randomized controlled trials, and broader participant diversity to amplify the generalizability and real-world applicability of the results.

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Article

Active for Life after Cancer: Association of Physical Activity with Cancer Patients' Interpersonal Competence, Quality of Life, and Survival Beliefs

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Abstract: This study aimed to examine the relationship between physical activity and cancer patients' survival beliefs and constructed a mediation model involving the mediating effects of interpersonal competence and quality of life. We conducted 252 questionnaire surveys on multiple chat groups for cancer patients using the WeChat software, and assessed physical activity, survival beliefs, interpersonal competence, and quality of life using standard scales. Data were analyzed using SPSS and AMOS. There were positive correlations between physical activity and quality of life ($\beta = 0.393$, $p < 0.001$), physical activity and interpersonal competence ($\beta = 0.385$, $p < 0.001$), interpersonal competence and quality of life ($\beta = 0.455$, $p < 0.001$), and quality of life and survival beliefs ($\beta = 0.478$, $p < 0.001$). In addition, a significant mediating effect between physical activity and survival beliefs was observed between interpersonal competence and quality of life (standardized indirect effect = 0.384, $p < 0.001$). The study revealed that effective physical activity led to higher interpersonal competence, more excellent quality of life, and improved survival beliefs in cancer patients, and that the association of physical activity with improved survival beliefs was fully mediated through interpersonal competence and quality of life. The findings suggest that the relevant government should increase policy support and publicity to improve cancer patients' participation in physical activity.

Keywords: physical activity; interpersonal competence; quality of life; survival beliefs; interpersonal relations theory; cancer

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1. Introduction

Cancer has always been a significant threat to human health [1]. In recent decades, with breakthroughs in cancer research and advances in medical science and technology, cancer patients' recovery and survival rates have gradually increased [2,3]. However, medical advances have not necessarily been accompanied by changes in cancer patients' beliefs about survival. Cancer treatment is a painful process, and the effects of treatments can vary, depending on a patient's mood. Negative emotions, such as fear, anxiety, and depression, can accelerate the deterioration caused by the disease and adversely affect treatments [4,5]. These emotions also interfere with the treatment processes followed by medical staff [6]. Therefore, maintaining a positive and optimistic mood will help alleviate patients' fears [7]. Studies have shown that people with high survival beliefs are more active in receiving treatments [8], tend to be more self-motivated in the face of cancer stress, and face their future lives with optimism. In contrast, people with low survival beliefs tend to equate cancer with death. They are more inclined to adopt negative ways of yielding and avoiding it, thus allowing the disease to continue to develop. Therefore, we need to pay attention to the survival beliefs of cancer patients.

In contemporary medicine, previous studies have focused on the effects of treatments and medical drug interventions used on cancer, such as surgical treatments [9], radiotherapy [10], chemotherapy [11], immunotherapy [12,13], and hormone therapy [14]. However, cancer patients suffer from a decline in their physical functions and the double blow of impaired social and psychological processes. Therefore, it is not enough to evaluate the effects of treatment on a patient based on that patient's physical state. Studies have shown that the psychological trauma left after cancer treatment, resulting in depression, anxiety, and other psychological problems, may be one of the causes of the deterioration of cancer treatments and recovery rates [15]. Therefore, psychotherapy is essential for the treatment of cancer patients. Many scholars have focused on the intervening psychological factors in cancer patients such as depression and anxiety. They have also begun to pay attention to postoperative psychotherapy interventions such as cognitive behavioral therapy [16] and musical therapy [17].

Physical activity is a simple yet effective intervention that can yield numerous benefits for individuals, including improvements in physical health, mental health, social skills, well-being, and cognitive function. For instance, physical activity can serve as a unique group communication activity, allowing individuals to connect and communicate with each other. By engaging in physical activity, patients can alleviate pain, reduce loneliness, and develop a sense of social interaction. Research has shown that physical activity also promotes interpersonal communication. Moreover, being an activity rather than a therapeutic behavior, physical activity can alleviate the treatment burden and mental stress experienced by cancer patients, leading to greater participation and improved health benefits.

Unlike previous studies, this study focused on cancer patients' most relevant survival beliefs, as these beliefs directly impact cancer treatments. This study was also the first to focus on how physical activity could improve cancer patients' survival beliefs. This study filled the existing research gap by linking physiological activities with psychological activities and, for the first time, quantitatively demonstrating the relationships between physical activity, interpersonal competence, quality of life, and survival beliefs. The objectives of this study were as follows: (1) to understand the survival beliefs of cancer patients, (2) to explore the factors that affected cancer patients' survival beliefs, and (3) to report existing problems to the government and to hospitals and make appropriate suggestions.

This study used interpersonal relations theory to improve our ability to explain and predict survival beliefs. We used physical activity as an independent variable, and further examined how survival beliefs develop through the mediating roles of interpersonal competence and quality of life. The innovations of this model are as follows. Firstly, the existing research has made various innovations in the treatment and intervention methods used on cancer patients. While each treatment method has its advantages and disadvantages, it also has limitations. Cancer patients are complete living bodies, and their diseases may involve physiological and psychological factors. Often, a patient's treatment cannot be achieved by using a singular method, and may instead require a combination of various treatment concepts and techniques. This study focused on the co-promoting effect of physical activity on cancer patients' physical and psychological characteristics. For cancer patients, physical activity can decrease pain, relieve fatigue, improve physical performance, and reduce anxiety, stress, and depression. Secondly, previous research, which had emphasized survival, had been limited to treating cancer patients through surgery or psychological interventions, and had rarely involved lifestyle and other aspects. This study found that interpersonal competence has an important impact on the survival beliefs of cancer patients. The patients in the study talked to each other and communicated emotionally when interacting with others. This behavior can promote psychological satisfaction and enhance mutual belief support, which are conducive to remission and recovery from the disease.

2. Literature Interview and Hypothesis Development

2.1. Physical Activity, Interpersonal Competence, and Quality of Life

Physical activity refers to all physical movements that consume energy due to skeletal muscle contraction, including sports, entertainment, housework, and other activities [18]. Physical activity is a unique social activity with fitness, recreational, and social functions. Firstly, the essential function of sports is the strengthening of the body, and physical activities can improve human operation [19]. Secondly, physical activity has a positive regulatory effect on emotions [20]. Physical activity can produce rich emotional experiences; participation in sporting and other physical activities can enable people to digest and offset negative emotions through catharsis. Thirdly, physical activity promotes self-efficacy [21]. By completing activities or winning in sports, people experience success, enhance their self-efficacy, and develop a firm will and solid psychological endurance through continuous effort.

Interpersonal communication is one of the essential contents of people's social lives [22]. Self-development, psychological adjustment, information transmission, the communication of needs, and relationship coordination are all inseparable from interpersonal communication. Studies have shown that physical activity is an effective way of establishing harmonious interpersonal relationships [23]. Participation in sports activities can help people who have never met before get to know each other. It can also make patients more willing to socialize and make new friends and thus improve their interpersonal competence [24,25]. Good interpersonal competence can relieve a depressed mood, release pressure, help improve quality of life [25], and enhance anticancer enthusiasm in cancer patients.

Quality of life is a relatively broad concept that is mainly affected by the complex influences of an individual's physical health, mental state, degree of independence, social relations, and personal beliefs and prominent features of the environment [26]. Past research has shown that physical activity benefits cancer patients [27] by improving bodily functions and quality of life [28], during both cancer treatment and recovery [29,30]. In addition, some data suggest that exercise can improve sleep quality in patients [31]. Physical activity can also provide significant psychological and cognitive benefits [32,33]. As an effective means of relieving psychological pressures, physical activity can induce positive thinking and emotions and help a patient resist negative emotions such as anxiety and tension.

In summary, physical activity not only improves the body's overall function and enhances physical fitness but also promotes the development of an individual's mental health and improves their quality of life. At the same time, it provides opportunities for interpersonal communication, promotes mutual communication between individuals, and facilitates people's social adaptation, thereby indirectly improving their living conditions. Therefore, this study proposes the following three hypotheses:

Hypothesis 1 (H1): *Physical activity positively affects interpersonal competence.*

Hypothesis 2 (H2): *Physical activity positively affects quality of life.*

Hypothesis 3 (H3): *Interpersonal competence mediates the relationship between physical activity and quality of life.*

2.2. The Mediating Effect

Survival belief is the fundamental belief in the value of life. It is an important spiritual activity in human beings and a powerful driving force for people to firmly pursue the ideal of continued survival, especially when confronted by particular negative circumstances and unfavorable situations [34]. A belief in improvement guides people's practical lives and has instructive and normative significance [35]. Survival belief comprises three factors: a rational cognitive factor, an emotional aspect, and a deliberate element [36]. People, in their long-term life practices, gradually form survival beliefs. In addition to their subjective conditions, beliefs also include the long-term impacts of their social environments [34].

Positive survival beliefs often go hand in hand with healthy mindsets. Relevant studies have shown that individuals with higher survival beliefs are less likely to be at risk of depression, hopelessness, and suicide [37]. Individuals with solid survival beliefs will show optimism, high self-esteem, a strong faith in the meaning of life, gratitude, and other characteristics.

Good interpersonal relationships are essential parts of life. Through contact and communication, people can exchange information, broaden their horizons, enhance their emotions, maintain good attitudes, and realize the value of life. Interpersonal communication is accompanied by cognitive, emotional, and volitional factors that seem highly related to survival belief. Studies have shown that social practice activities, family support, and peer support can improve individuals' survival beliefs [38,39]. Quality of life is a multidimensional structure that includes mental, physical, economic, social, and spiritual health [40,41]. As a comprehensive health evaluation, quality of life reflects subjective conditions, the pros and cons of the social environment, and the personal ability to adapt to society. People with a high quality of life have suitable living environments, good tolerance, and relatively high survival beliefs [42].

Relevant studies have proven that physical activity promotes opportunities for individuals to communicate with each other. There are also significant relationships between physical activity, interpersonal competence, and quality of life. In addition, research has revealed a strong association between interpersonal competence, quality of life, and beliefs regarding survival. Does physical activity impact survival belief by mediating interpersonal competence and quality of life? Based on this question, this study proposes Hypothesis 4:

Hypothesis 4 (H4): *Interpersonal competence and quality of life mediate the relationship between physical activity and survival beliefs.*

The hypothesized model is shown in Figure 1.

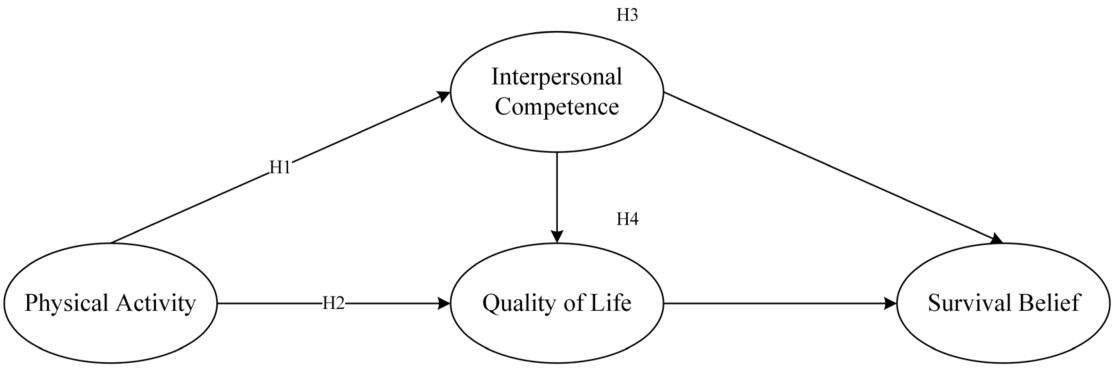

Figure 1. The hypothesized model.

3. Methods

3.1. Participants and Procedures

In this study, a snowball sampling method was used to sample cancer patients. Questionnaires were distributed to multiple chat groups for cancer patients through WeChat. Before completing the questionnaire, participants were told the following:

- Participation by filling out the questionnaire was voluntary;
- If they felt uncomfortable during the questionnaire filling process, they could refuse to continue at any time;
- The questionnaire was anonymous;
- The data analysis would be used only for academic research;
- Personal information and data would not be shared with anyone.

Questionnaire respondents were only allowed to fill in the formal questionnaire after reading and accepting the contents of the informed consent form. After completing the questionnaire, respondents could choose to receive electronic shopping vouchers as rewards for participation. Only one submission was allowed per person. Data were collected continuously from March to May 2022 after the Ethics Committee approved the study. In this survey, a total of 278 online questionnaires were collected and subsequently screened for answer regularity and short response time. After this screening process, 26 invalid questionnaires were excluded, resulting in a final sample size of 252 valid questionnaires. The effective questionnaire recovery rate, which represented the proportion of valid questionnaires retrieved out of the total number distributed, was calculated to be 90.6%. Considering the specific cultural background of China, the cancer patients were not asked to provide too much personal background information; otherwise, receiving a valid questionnaire would have been difficult. Table 1 shows the simple demographics of the patients. The sample consisted of 55% males and 45% females, aged 23 to 78 years, with a mean age of 57.

Table 1. Participant profile (N = 252).

Variables		N	%
Gender	Male	139	55.2
	Female	113	44.8
Age (years)	Mean: 57 Range: 23–78		
	<60	130	51.6
	≥60	122	48.4

3.2. Measures

In this study, measured responses belonged to one of four categories: physical activity, interpersonal competence, quality of life, and survival beliefs. In order to adapt to the research field and specific cultural background, remove any language barriers, and generate informed feedback, the researchers made certain adjustments to the items of the scale. The scale translation process was based on Brislin's translation model [43], which encompasses three key stages: translation, back-translation, and cultural adjustment. Firstly, two medical experts who were native Chinese speakers independently translated the scale. Next, a medical specialist was invited to review and refine the differences between the two translations to generate the first draft of the Chinese version of the scale. Secondly, a doctor of psychology with overseas study experience back-translated the first draft of the scale and compared the translated English version to the original English entries. This comparison helped identify and correct any linguistic inaccuracies in the translated text. Finally, an expert committee comprising members of the research group and the translation team compared and discussed the original scale, translated version, and back-translated version. The committee made adjustments and modifications to the translated version of the scale to ensure its accuracy, cultural relevance, and suitability for use in the Chinese population. This rigorous process culminated in the development of the final Chinese version of the test scale. In addition, a pilot test was conducted to verify the reliability of the adjusted test scale [44]. In the pilot test, 60 questionnaires were distributed using random sampling and a total of 55 valid questionnaires were returned. The Cronbach's alpha coefficients were all higher than 0.7, indicating that the measurement tools had good internal consistency [45].

3.2.1. Physical Activity

To measure the effectiveness of physical activity, this study extracted three items from the Physical Activity Scale developed by Andersen et al. [46]. An example item includes "In your leisure time, how often do you engage in light physical activity such as walking, light cleaning, raking lawn, or lightly strenuous exercise such as yoga, bowling or similar

activities?" Respondents answered using a five-point Likert scale (1 = "never", 5 = "very frequently"). The Cronbach's alpha coefficient for this scale was 0.791.

3.2.2. Interpersonal Competence

The measure of interpersonal competence was taken from the Interpersonal Competence Scale developed by Buhrmester et al. [47]. An example item from this scale is "Finding and suggesting things to do with new people whom you find interesting and attractive." Respondents rated how much they agreed with the statement using a five-point Likert scale (1 = "strongly disagree", 5 = "strongly agree"). The Cronbach's alpha coefficient for this scale was 0.799.

3.2.3. Quality of Life

The measure of quality of life was derived from the WHOQOL-BREF scale developed by the WHOQOL group [48]. An example item from this scale is "Do you have enough energy for everyday life?" Respondents rated how much they agreed with the statement using a five-point Likert scale (1 = "strongly disagree", 5 = "strongly agree"). The Cronbach's alpha coefficient for this scale was 0.831.

3.2.4. Survival Beliefs

Survival beliefs were measured by using four items from the Survival and Coping Beliefs scale developed by Linehan et al. [49]. An example item from this scale is "I have the courage to face life." Respondents rated how much they agreed with the statement using a five-point Likert scale (1 = "strongly disagree", 5 = "strongly agree"). The Cronbach's alpha coefficient for this scale was 0.910.

3.3. Data Analysis

In this study, a structural equation model (SEM) was constructed using AMOS v.26 and the model parameters were estimated using the maximum likelihood (ML) estimation method. SEM is often used to evaluate latent variables in measurement models and to test hypotheses between latent variables in structural models [50]. To evaluate both measurement and structural models, this study utilized a two-step modeling approach. [51]. First of all, we evaluated the reliability and validity of our model. Fornell and Larcker suggested that reliability analysis should be validated by using Cronbach's alpha coefficient and the CR coefficient of latent variables [45]. A high reliability coefficient indicates that the results of a test are more consistent, stable, and reliable. Hair et al. recommend that if both the Cronbach's alpha coefficient and CR coefficient are greater than 0.7, the test can be considered reliable [52]. Convergence effectiveness is usually measured by factor loading the coefficient and average variance extracted (AVE). Fornell and Larcker recommended that the ideal standard value of AVE must be greater than 0.5 [45]. We also evaluated discriminant ability, which requires that the square root of the AVE value of the variable be greater than the correlation coefficient between the variables. In addition, the fit and path coefficients of the hypothetical model were measured, and the existence of the mediation effect was tested. Hair et al. [52] proposed that the basic fitness of the entire model could not have a negative error or residual terms and that otherwise the test criteria would be violated. More importantly, this study followed the suggestion of Bollen and Stine [53] by using the bootstrap method to verify the existence of the mediating effect.

Considering that all data were generated by cancer patients' self-reports, common method variance (CMV) was deemed likely to exist. Harman's single factor test was first used to check the data. To determine the number of factors required to account for the variance of each variable, the unrotated factor solution was examined in a one-way test [54]. All the variables were incorporated into a factor analysis in SPSS, and the extraction factor was set to 1. The results showed that the cumulative variance was 44.01%, which was below the critical criterion of 50% [55]. This means that there was no common methodological bias in this study [45]. In accordance with Mossholder et al.'s [56] recommendations, this

study compared the degrees of freedom and chi-square values of model 1 and model 2 to assess the fit of the models. Model 1 had a chi-square value of 614.3 with 77 degrees of freedom and a *p*-value of less than 0.001, while model 2 had a chi-square value of 195.7 with 71 degrees of freedom and a *p*-value of less than 0.05. These results indicated that the fit of model 1 was proportional to that of model 2. As there was no evidence of univariate structure, the impact of common method variance (CMV) on the study was deemed to be small and negligible.

4. Results

4.1. Measurement Model

Non-external consistency describes the reliability of a structure. The reliability test results in Table 2 show that the Cronbach's alpha coefficient of each variable was between 0.791 and 0.910, which was higher than the recommended value of 0.7. The CR coefficients for each variable ranged from 0.795 to 0.914: much higher than the required value of 0.7. Therefore, these variables had good reliability. The further confirmation of convergent validity and discriminative validity is crucial for assessing the authenticity of scientific data. As shown in Table 2, the AVE of each variable was between 0.526 and 0.728, exceeding the recommended value of 0.5, and the factor loading coefficient of each measurement item was between 0.640 and 0.918. The research results in Table 3 all met the requirement of discriminant validity. The chosen variables all had good convergent validity and discriminative validity.

Table 2. Reliability and validity tests.

Items	Loadings	Cα	AVE	CR
Physical Activity (PA)		0.791	0.564	0.795
PA1	0.770			
PA2	0.756			
PA 3	0.726			
Interpersonal Competence (IC)		0.799	0.526	0.814
IC1	0.791			
IC2	0.640			
IC3	0.801			
IC4	0.653			
Quality of Life (QoL)		0.831	0.626	0.833
QoL1	0.780			
QoL2	0.847			
QoL3	0.742			
Survival Beliefs (SB)		0.910	0.728	0.914
SB1	0.869			
SB2	0.859			
SB3	0.918			
SB4	0.759			

All standardized loadings were significant at the 0.001 level.

Table 3. Discriminant validity test.

Construct	PA	IC	QoL	SB
PA	**(0.751)**			
IC	0.310 **	**(0.725)**		
QoL	0.473 **	0.499 **	**(0.791)**	
SB	0.368 **	0.520 **	0.590 **	**(0.853)**

The square root of the average variance extracted (AVE) is shown in diagonals (bold); the off-diagonals are Pearson's correlations of constructs. ** $p < 0.01$.

4.2. Structural Path Model

The error term and residual term of the structural equation model did not exhibit negative values. The structural model also showed a good fit to the data (χ^2/df = 1.336, GFI = 0.952, NFI = 0.950, CFI = 0.987, TLI = 0.983, RMSEA = 0.037). Table 2 lists the correlations between the variables. Significant positive correlations were found between independent variables, mediators, and dependent variables, providing preliminary support for the validation of the research hypothesis. The structural pathway model results are shown in Figure 2. The conceptual model suggests that physical activity positively affects survival beliefs through two mediating factors, namely interpersonal competence and quality of life.

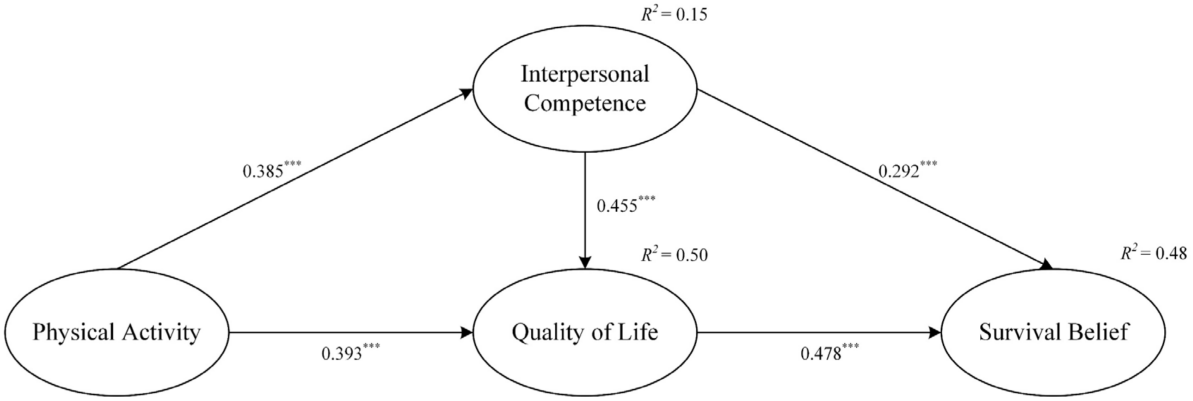

Figure 2. Structural path model. *** $p < 0.001$; standardized coefficients are reported.

The effect of physical activity on interpersonal competence was statistically significant ($\beta = 0.385$, $p < 0.001$), supporting H1. The results showed that physical activity had a statistically significant effect on quality of life ($\beta = 0.393$, $p < 0.001$), supporting H2. Table 4 presents the results for the 5000 bootstrapped samples, with 95% confidence intervals. All Z values in the table are greater than 1.96, and there are no zeros within the 95% confidence intervals. In addition, the study showed that there was a possible significant mediating effect between physical activity and quality of life through interpersonal competence (standardized indirect effect = 0.175, $p < 0.01$), providing support for H3. The study also showed that there was a possible significant mediating effect between physical activity and survival beliefs through interpersonal competence and quality of life (standardized indirect effect = 0.384, $p < 0.001$), providing support for H4. These findings imply that people with high physical activity, good relationships, and a high quality of life are more likely to have higher survival beliefs.

Table 4. Standardized indirect effects.

	Point Estimate	Product of Coefficients		Bootstrapping				Two-Tailed Significance
				Percentile 95% CI		Bias-Corrected 95% CI		
		SE	Z	Lower	Upper	Lower	Upper	
Indirect effects								
PA→ QoL	0.175	0.055	3.182	0.079	0.289	0.081	0.293	0.001(**)
PA → SB	0.384	0.066	5.818	0.259	0.520	0.259	0.518	0.000(***)
IC → SB	0.218	0.088	2.477	0.083	0.425	0.081	0.416	0.013(*)

Standardized estimation of 5000 bootstrap samples; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

5. Discussion

5.1. Contributions

This study represents the first attempt to utilize interpersonal relationship theory to elucidate the effects of physical activity on interpersonal competence, quality of life, and survival beliefs. This novel research perspective provides a valuable direction for understanding the mind–body connection in cancer patients. Moreover, the findings of this study have the potential to enrich the relevant viewpoints and research fields in interpersonal relationship theory.

Firstly, this study introduced a research model that illuminated the impact of physical activity on both interpersonal competence and quality of life, and found that physical activity significantly and positively impacted interpersonal competence and quality of life, consistent with previous research studies [24,57–59]. The effects of physical activity on improving human functions, improving sleep quality, reducing depression levels, and promoting interpersonal communication have been verified. Physical activity is a process in which individuals actively participate, and is not limited to sporting events. At the same time, participation provides methods for individuals to improve their ability to withstand stress in life, relieve interpersonal tension, and effectively improve their mental health [60,61]. Appropriate physical activity can also activate people's cognition and behavior, promote their psychological balance, and strengthen their self-awareness and positive emotions [62] to help them maintain a higher level of quality of life.

Secondly, the research model confirms that interpersonal competence serves as a mediator between physical activity and quality of life. According to the theory of interpersonal relations, the formation process of interpersonal relationships must go through four stages: recognition, confirmation, progression, and resolution [63]. Physical activities are always carried out in a particular social environment that requires interactions and connections between people. With changes in the contents of these activities, it may be necessary for people to assume different roles, becoming organizers, practitioners, and helpers. Therefore, in sports activities, one must correctly understand one's position and undertake the corresponding responsibilities and obligations to coordinate all aspects of their relationships; this is essential to improve interpersonal competence. Through cooperation and competition, people realize this communication and promote the establishment and harmonious development of interpersonal relationships [25]. In contrast, the lack of interpersonal competence will lead to interpersonal disorders, which are some of the causes of psychological problems. Mental health problems in interpersonal relationships can manifest as egotism, suspiciousness, shyness, withdrawal, inferiority complex, jealousy, and social fear. These psychological barriers will significantly affect people's quality of life. They can be contrasted with good interpersonal competence, which helps people maintain good attitudes while dealing with various complex social relations, better adapt to society, and improve their quality of life [64].

Finally, our model sheds light on the positive effects of physical activity on enhancing survival beliefs in cancer patients. Furthermore, our study investigated the specific mechanism underlying this effect by incorporating interpersonal competence and quality of life as mediator variables. The findings showed that the positive effect of physical activity on survival beliefs was fully mediated by interpersonal competence and quality of life. As shown in Figure 2, interpersonal competence and quality of life can explain 48% of the variation in survival beliefs, which is significantly higher than the general reference value. As a basic form of spiritual consciousness, survival belief is not fixed but will change with objective reality and can be constantly adjusted and improved. Interpersonal competence can help individuals cope with emergencies in life and work through family or peer support [65]. When cancer patients have high interpersonal competence, they can analyze the impact of crises on themselves and use interpersonal relationships to regulate their emotional states and behaviors [66]. As a result, they can put enough energy into their behavior, actively mobilize their ability to deal with problems, establish healthy lives, have more positive emotions, and maintain a good quality of life. At the same time, the higher

the quality of life of cancer patients is, the more they can reflect on their advantages in the living environment, and the higher their psychological, physiological, and spiritual health levels are, the more they can have a positive sense of their selves, love lives, and life in general, which will then enhance survival beliefs. These findings confirm the effectiveness of physical activity in improving one's physiological and psychological health, affecting interpersonal competence and quality of life and thereby indirectly affecting the survival beliefs of cancer patients and improving their survival.

5.2. Implications

This study demonstrates the positive impact of physical activity on survival beliefs in cancer patients and the mechanism of action during this effect. Interpersonal competence and quality of life can directly affect survival beliefs, while physical activity can directly affect interpersonal competence and quality of life. Therefore, simply by increasing their participation in physical activity, cancer patients can indirectly and positively impact their beliefs about survival. Physical activity is an essential avenue that people of all ages and abilities can partake in for cancer prevention, treatment, and control [67]. As an effective cancer treatment intervention, physical activity has the following advantages: it helps improve the quality of life of patients, is easy to implement, has no treatment costs, and does not need to target specific cancer patients.

Considering the positive impact of physical activity on interpersonal competence, quality of life, and survival beliefs, the government should increase policy support for sports activities, encourage the active participation of patients, and promote the formation of lifelong sports awareness. To increase physical activity, the government should increase the relevant financial investment. Such investment could support hospitals in sports training and organization management and could also be used to construct sports venues and diversified sports facilities in hospitals. In addition, hospitals should establish sports rehabilitation management departments and train professional sports instructors. Finally, relevant lectures on physical fitness should be held to publicize the importance of sports and physical activity to allow more patients to participate in sports interactions. Medical staff should customize an individualized physical activity plan for each patient willing to engage in physical activities. Then, the team should reasonably guide patients on the correct way to engage in, and content of, each physical activity. It can also be appropriate for the team to participate in activities with patients to improve the patients' goodwill towards medical staff.

5.3. Limitations of the Study

This study has certain limitations. First, the sampling procedure for this study was not pure randomization; this limits the generalizability of its findings. Future studies should overcome this limitation and use purely random sampling to make the results generalizable. Second, this study was cross-sectional and only considers a superficial level of data. Longitudinal studies should be considered for future research to make studies more in-depth and meaningful. Third, this study only performed a simple pooled analysis without distinguishing the characteristics of disease in the study samples. Future research may consider a classification analysis to examine differences between different conditions.

6. Conclusions

The study found three critical cores that stood out among the cancer patients. First, cancer patients with higher physical activity had higher survival beliefs. Second, interpersonal competence and quality of life were related to survival beliefs in cancer patients. Finally, physical activity affected survival beliefs by mediating interpersonal competence and quality of life. This study and similar studies suggest that if cancer patients with low survival beliefs can improve their survival beliefs and be willing to participate in physical activity, treatments to increase survival beliefs and prolong survival may be enhanced. Consequently, this study suggests that the government should improve the corresponding

policies, while hospitals should reinforce the promotion of lifelong sports awareness to heighten participation in physical activity among cancer patients.

Author Contributions: Y.L. (Ying Liu), H.W. and L.J. conceptualized the study. Y.L. (Ying Liu) analyzed and Y.L. (Yang Liu), H.W. and L.J. interpreted the data. Y.L. (Ying Liu), Y.L. (Yang Liu), H.W., L.J., T.Y. and J.Y. were all involved in drafting the manuscript. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of the School of Physical Education of Hunan University of Science and Technology (No. ECSPEHUST 2021/0047).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data used to support the findings of this study are available from the corresponding author upon request.

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Article

Physical Activity and Sedentary Behavior in Adults from Penafiel, Portugal: A Cross-Sectional Study

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Abstract: The aim of this study was to compare the physical activity (PA) and sedentary behavior (SB) levels of young and middle-aged adults living in and around the municipality of Penafiel and to determine whether they meet PA recommendations. The researchers used the "International Physical Activity Questionnaire" (IPAQ) to measure moderate to vigorous PA and time spent on sedentary behavior (high vs. low). A prospective observational cross-sectional sample of 1105 adults aged 18–63 years, living in the municipality of Penafiel and its surroundings (45% women, 55% men), was used. The results indicated that more than half of the population was inactive (53.8%) and sedentary (54.0%). Men were more likely to be sedentary (59.2%) and inactive (55.6%) than women (inactive: 51.7%, high SB: 47.7%). Regarding daily PA and SB levels, women had higher levels of walks (3.8 ± 2.3; $p = 0.034$) and vigorous PA (2.2 ± 1.8 min; $p = 0.005$) per days/week, as well as vigorous PA per minutes/week (75.4 ± 82.1 min; $p = 0.034$). The time spent on vigorous PA per day was also higher in women (26.2 ± 22.8 min; $p = 0.030$). However, men had higher values in walking minutes per day (26.3 ± 17.1 min; $p = 0.030$), SB for weekdays (429.2 ± 141.2 min; $p = 0.001$), SB for weekends (324.7 ± 163.7 min; $p = 0.033$) and time spent on SB per minutes/week (2795.6 ± 882.0 min; $p = 0.001$). The results also showed that the older the adults, the lower the frequency and total time of vigorous PA per week. Young adults (18–28 years) had higher levels of vigorous PA ($p = 0.005$) than the other age groups (29–39; 40–50 and 51–63 years). Finally, the study found no significant correlation between individual level factors, such as number of children, marital status and monthly income, and PA or SB. Conversely, a significant and negative correlation between SB and levels of PA was found, indicating that the higher the level of PA practice, the lower the SB level. The authors suggest that promoting new PA habits and healthy lifestyles is an important future challenge for sustainability and improving the quality of life in public health.

Keywords: epidemiology; physical inactivity; sedentary; IPAQ; exercise

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1. Introduction

A healthy lifestyle associated with regular physical activity (PA) can have psychological, social and life expectancy benefits according to the World Health Organization

(WHO) [1]. The practice of PA promotes an improvement in self-esteem, social acceptance and a sense of well-being [2]. In contrast, according to the American College of Sports Medicine (ACSM), sedentary lifestyle and physical inactivity are the main risk factors for the development of cardiovascular diseases, obesity, cancer and type 2 diabetes, among other diseases [3]. The evidence indicates that physical inactivity is also associated with all-cause mortality, depression, dementia, anxiety and mood swings [4], as well as a variety of other chronic diseases such as bone arthritis, osteoporosis, breast cancer and colon cancer [5].

Despite the encouragement of the importance of PA and physical exercise, the Portuguese population and world population continue to have low levels of PA. The objective, therefore, is to promote PA and physical exercise as methods of preventing cardiovascular disease and all-cause mortality [6,7]. In fact, despite the constant reinforcement of the benefits of PA by relevant organizations, physical inactivity continues to be part of the daily life of individuals and, as such, remains a significant factor of premature death [8]. It should be noted that physical inactivity and sedentary lifestyle are two different concepts. Physical inactivity refers to insufficiencies of PA and not meeting specific recommendations. Conversely, sedentary behavior is defined as any waking behavior characterized by the expenditure of 1.5 metabolic equivalent tasks (METs) or less of energy while in a sitting, reclining or lying posture [9].

Physical inactivity and sedentary lifestyle are strongly related to the incidence and severity of a vast number of chronic diseases [10], contributing to the decline in the general state of health. Considering the high prevalence rate of inactive and sedentary individuals in developed countries [11,12], several diseases are becoming increasingly prevalent in society. The advancement of new technologies is a preponderant and influential factor of low PA. The main sedentary behaviors are: watching television, playing video games and sitting too long [12]. Additionally, the low energy expenditure resulting from sedentary tasks associated with mental demands, especially those arising from work, leads to increased food consumption that results in a positive energy balance [13,14].

From the WHO to the European Union (EU), from the Portuguese Government to local authorities, there are several references, plans and recommendations to promote an active lifestyle, aiming the improve health and quality of life. As a form of intervention, the WHO recommends at least 150 min of moderate to vigorous PA per week, equivalent to 30 min per day. However, such recommendations are not fulfilled [12]. In Portugal, the municipality of Penafiel established a series of partnerships with local sports associations, with the aim of promoting and encouraging the practice of sports and the generalization of physical activities in the municipality. Other measures implemented by the municipality are the programs for the use of sports spaces, the programming of physical and sports activities aimed at the general population, as well as the carrying out of training and qualification actions for sports agents.

According to the National Institute of Statistics (INE), the municipality of Penafiel, located in the north of Portugal, in the district of Porto, has a population of around 72,000 inhabitants (338.4 inhabitants per km^2) and is made up of 28 parishes. Understanding the levels of PA and SB for this highly populated area is crucial to cross-check the overall data of European epidemiological reports (Eurobarometer, 2022). In this sense, the objective of this study was to know and compare the level of PA and sedentary behavior of young and middle-aged adults living in the municipality of Penafiel and its surroundings. Furthermore, it aimed to verify if the PA recommendations are performed.

2. Materials and Methods

2.1. Sample

A prospective observational cross-sectional analysis was conducted using a sample of 1105 adults, with a mean age of 28.7 ± 11.5 years, living in the municipality of Penafiel and its surroundings. Of the sample, 45% was formed by women and 55% by men, aged between 18 and 63 years. For inclusion, those who met the following inclusion criteria were considered: (i) aged 18 years old or older; (ii) provided informed consent to participate; and (iii) were physically active. We verified that the marital status of 64.7% of the sample was single, 31.9% married, 2.4% divorced and 1% widowed. In addition, 67.2% had no children, 15% had one child, 13.8% had two children and 3.8% had three or more children. Finally, the monthly income of 57.6% of the sample was less than EUR 700, 29.5% had an income between EUR 700 and 1200 and only 9.6% and 3.3% presented an income of EUR 1201 to 1700 and above EUR 1700, respectively. Thus, most of the participants in this study were single (64.7%), without children (67.2%) and with monthly income of less than EUR 700 (57.6%) [15].

In this study, we determined the required sample size using G*Power 3.4 (Institut für Experimentelle Psychologie, Düsseldorf, Germany). The parameters used were an anticipated effect size of f = 0.03, $\alpha = 0.05$ and statistical power of 0.95, which resulted in a minimum sample size of 253 participants per group. This sample size was met in the study.

2.2. Procedures

The data collection was performed through an online PA questionnaire: "International Physical Activity Questionnaire" (IPAQ)—short version, using the Google Forms online platform. The questions were preceded by a brief explanation of the procedures in order to clarify all possible doubts of the participants. The use of a small and simple questionnaire in an online format with all the necessary information and clarifications provides greater accessibility and consequently the possibility of a larger sample size. A previous study reported a high reliability for the IPAQ with a reliability test–retest (ICC) of 0.90 and concurrent validity (PC) of 0.917 to assess physical and sedentary behavior in European adults [16].

The IPAQ short version is composed of seven questions that evaluate physical activity across various areas such as leisure time, work-related activity and transport-related activity. The first two questions inquire about the number of days and duration of time spent engaging in moderate-intensity activities such as brisk walking or cycling at a relaxed pace, while the subsequent two questions assess the number of days and duration of time spent engaging in vigorous-intensity activities such as running, cycling at a fast pace or heavy lifting. Question five assesses the amount of time spent sitting during a typical weekday and question six assesses the amount of time spent sitting during a typical weekend day. The final question asks about the frequency of walking or cycling for transport-related purposes. Responses to these questions are used to determine the total amount of physical activity per week and the amount of time spent on moderate- and vigorous-intensity activities separately. The IPAQ is a reliable and valid tool for assessing physical activity levels among various populations and settings. This tool has become a popular choice for researchers, health professionals and educators alike. Its purpose is to gauge the volume and intensity of physical activity performed in various settings, including home, work, leisure and other activities within the general population [1,17]. The total sample was divided into four age groups: (1) 18–28 years, (2) 20–39 years, (3) 40–50 years and (4) 51–63 years. The questionnaire utilized in this study comprised five sections, namely personal data, walks, moderate activities, vigorous activities and no activities. Participants were grouped into four categories: (1) physically active, defined as engaging in vigorous PA for more than 75 min per week or moderate PA for more than 150 min per week; (2) physically inactive, defined as engaging in vigorous PA for 75 min or less per week or moderate PA for 150 min or less per week; (3) high sedentary behavior, defined as spending 8 or more hours

per day in a sitting, reclining or lying posture; and (4) low sedentary behavior, defined as spending less than 8 h per day in a sitting, reclining or lying posture [16].

2.3. Statistical Analysis

Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS 27.0, IBM Corp, Armonk, NY, USA). The significance level was set at 5%. Descriptive statistics were performed using the mean, standard deviation and median values. A Mann–Whitney test was applied in three different comparisons: number of days in the last week in which participants walked or carried out moderate PA and vigorous PA for at least 10 min; total time (in minutes) in which walks, moderate PA and vigorous PA were performed; time spent in a sitting, reclining or lying posture during a weekday and during a weekend day. Furthermore, we compared the same variables by four age groups through a Kruskal–Wallis test. Finally, the Spearman rank correlation (r) test was performed to perceive the existence and degree of correlation between the variables of SB, PA and personal data (number of children, marital status and monthly income). The correlation magnitude was classified as: trivial if $r \leq 0.1$, small if r = 0.1–0.3, moderate if r = 0.3–0.5, large if r = 0.5–0.7, very large if r = 0.7–0.9 and almost perfect if $r \geq 0.9$ [18].

3. Results

Table 1 presents the mean differences between men and women in levels of physical activity (PA) and sedentary behavior (SB), with statistically significant differences found for walks (p = 0.034 to 0.042), vigorous PA (p = 0.005 to 0.030) and time spent on SB (p = 0.001 to 0.033). Women reported higher frequency of walks (3.8 $\pm$ 2.3; p = 0.034) and vigorous PA (2.2 $\pm$ 1.8 min; p = 0.005) per days/week compared to men. While women spent more time on vigorous PA per day (26.2 $\pm$ 22.8 min; p = 0.030), men reported higher values for walking minutes per day (26.3 $\pm$ 17.1 min; p = 0.042), SB on weekdays (429.2 $\pm$ 141.2 min; p = 0.001) and SB on weekends (324.7 $\pm$ 163.7 min; p = 0.033). Additionally, women showed better levels of vigorous PA per minutes/week (75.4 $\pm$ 82.1 min; p = 0.034), whereas men spent more time on SB per minutes/week (2795.6 $\pm$ 882.0 min; p = 0.001).

Table 1. Mean differences among sexes in physical activity practice and sedentary behavior levels.

Variables		Men (n = 608)			Women (n = 497)			Total			Proof Value
		Mean	SD	Median	Mean	SD	Median	Mean	SD	Median	
Number of days/week	Walks	3.5	2.1	3.0	3.8	2.3	4.0	3.6	2.2	4.0	0.034 *
	Moderate PA	2.6	2.1	3.0	2.7	2.1	2.0	2.7	2.1	2.0	0.615
	Vigorous PA	2.0	2.1	2.0	2.2	1.8	2.00	2.1	2.0	2.0	0.005 *
Number of minutes/day	Walks	26.3	17.1	20.0	24.6	17.1	25.0	25.6	17.1	20.0	0.042 *
	Moderate PA	25.7	20.1	25.0	27.9	22.1	30.0	26.7	21.5	25.0	0.248
	Vigorous PA	24.2	25.3	20.0	26.2	22.8	20.0	25.1	24.2	20.0	0.030 *
	SB on weekday	429.2	141.2	480.0	395.9	151.9	480.0	414.2	147.0	480.0	0.001 *
	SB on weekend	324.7	163.7	333.0	303.8	155.2	300.0	315.3	160.2	300.0	0.033 *
Number minutes/week (number days * minutes/day)	Walks	97.0	79.6	90.0	102.8	88.9	80.0	99.6	83.9	80.0	0.495
	Moderate PA	86.8	88.9	60.0	97.5	104.5	60.0	91.6	96.3	60.0	0.287
	Vigorous PA	70.6	89.6	60.0	75.4	82.1	45.0	72.8	86.3	50.0	0.034 *
	SB during week	2795.6	882.0	3120.0	2587.0	943.1	3200.0	2701.8	915.4	3180.0	0.001

Notes: SD: standard deviation; Min: minimum value; Max: maximum value; PA: physical activity; SB: sedentary behavior; SB on weekday: time spent in a sitting, reclining or lying posture on a weekday; SB on weekend: time spent in a sitting, reclining or lying posture on a weekend day; * $p \leq 0.05$: significant differences.

Table 2 presents the frequency of PA and SB over the monitored period. More than half of the overall population was inactive (53.8%) and sedentary (54.0%). Men sampled tended to be more sedentary (59.2%) and inactive (55.6%) than women (inactive: 51.7%, SB: 47.7%).

Table 3 presents the levels of PA practice and SB by age groups: (1) 18–28 years; (2) 20–39 years; (3) 40–50 years and (4) 51–63 years. We observed significant differences only between group 1 (18–28 years) and the other groups in levels of vigorous PA: number of days/week (p = 0.001), number of minutes/day (p = 0.007) and number of minutes/week (p = 0.005). Group 1 presented higher levels of vigorous PA per days/week (2.2 $\pm$ 1.9 days; p = 0.001 to 0.021), per minutes/day (26.9 $\pm$ 21.2 min; p = 0.010 to 0.045) and per minutes/week (76.4 $\pm$ 84.3; p = 0.10 to 0.032) than groups 2, 3 and 4.

Table 2. Physical Activity and Sedentary Behavior Frequency.

Group	Moderate and/or Physical Activity (*n* (%))		Sedentary Behavior (*n* (%))	
	Active [1]	Inactive [2]	High [3]	Low [4]
Women	240 (48.3%)	257 (51.7%)	237 (47.7%)	260 (52.3%)
Men	270 (44.4%)	338 (55.6%)	360 (59.2%)	248 (40.8%)
Total	510 (46.2%)	595 (53.8%)	597 (54.0%)	508 (46.0%)

Notes: [1] Active: vigorous PA > 75 min/week or moderate PA > 150 min/week; [2] Inactive: vigorous PA $\leq$ 75 min/week or moderate PA $\leq$ 150 min/week. Sedentary behavior: [3] high sedentary behavior: number of hours in a sitting, reclining or lying posture $\geq$ 8 h/day; [4] low sedentary behavior: number of hours in a sitting, reclining or lying posture < 8 h/day.

According to Spearman rank correlation analysis, significant correlations were observed between PA or SB and the individual level factors: number of children ($p < 0.05$ to $p < 0.001$), marital status ($p < 0.05$ to $p < 0.001$) and monthly income ($p < 0.05$). Thus, these variables do not seem to be related to levels of PA and SB. On the other hand, significant and negative correlations between SB (time spent in a sitting, reclining or lying posture) and levels of PA per minutes/week were found for walks (r = -0.65; p = 0.001), moderate PA (r = -0.409; p = 0.001) and vigorous PA (r = -0.508; p = 0.001).

Table 3. Levels of physical activity practice and sedentary behavior by age groups.

Variables		18–28 Years (n = 656)			29–39 Years (n = 230)			40–50 Years (n = 158)			51–63 Years (n = 61)			Proof Value
		Mean	SD	Median	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median	
Number of days/week	Walks	3.7	2.1	4.0	3.4	2.3	3.0	3.5	2.2	3.0	3.3	2.4	3.0	0.146
	Moderate PA	2.7	2.0	3.0	2.6	2.2	2.0	2.7	2.2	2.0	2.7	2.3	2.0	0.775
	Vigorous PA	2.2	1.9	2.0	2.0	2.1	1.0	1.9	2.1	1.0	1.4	1.9	1.0	0.001 *
Number of minutes/day	Walks	25.2	16.6	20.0	26.0	18.7	25.0	26.6	17.0	25.0	25.1	16.9	25.0	0.854
	Moderate PA	26.9	21.2	25.0	27.6	22.9	30.0	26.1	21.8	30.0	22.5	18.4	20.0	0.449
	Vigorous PA	26.9	23.9	20.0	22.7	24.2	20.0	21.5	21.9	20.0	24.0	31.1	15.0	0.007 *
	SB on weekday	410.0	144.5	480.0	413.4	153.1	480.0	418.4	156.3	480.0	452.8	119.7	480.0	0.084
	SB on weekend	313.1	166.7	300.0	317.7	148.7	300.0	313.4	151.4	300.0	335.3	155.6	360.0	0.681
Number minutes/week (number days * minutes/day)	Walks	100.2	80.4	90.0	99.9	92.3	75.0	99.4	83.2	80.0	91.8	91.4	60.0	0.387
	Moderate PA	89.9	92.9	60.0	97.9	99.8	80.0	93.6	107.6	60.0	81.7	88.2	60.0	0.839
	Vigorous PA	76.4	84.3	60.0	71.1	94.1	45.0	65.0	81.2	30.0	60.3	89.0	15.0	0.005 *
	SB during week	2675.9	918.9	3180.0	2702.1	926.8	3180.0	2718.8	935.2	3180.0	2934.4	756.6	3240.0	0.567

Legend: SD: standard deviation; Min: minimum value; Max: maximum value; PA: physical activity; SB: sedentary behavior; SB on weekday: time spent in a sitting, reclining or lying posture on a weekday; SB on weekend: time spent in a sitting, reclining or lying posture on a weekend day; * $p \leq 0.05$: significant differences.

4. Discussion

The purpose of the current study was to investigate and compare the levels of physical activity (PA) and sedentary behavior (SB) of young and middle-aged adults residing in the municipality of Penafiel and surrounding areas, and to determine if they meet the recommended PA guidelines. The findings indicated that over half of the population did not meet the minimum recommended levels of PA (53.8%) and had high levels of sedentary behavior (54.0%), which confirms the high prevalence of physical inactivity and sedentary behavior reported in previous epidemiological studies [18,19]. In this sense, the study's subjects of research are at an increased risk for several chronic conditions, such as the development of several diseases (e.g., obesity, cancer, type 2 diabetes, cardiovascular diseases and depression), as well as lower cognitive development and mortality [3,19]. Evidence supports that PA is beneficial for the prevention of several types of cancer such as breast, colon, endometrium, kidney, bladder, esophagus and stomach. Furthermore, minimizing time spent in SB may also contribute to decreasing the risk of metabolic diseases endometrial, colon and lung cancer [20–22]. Thus, the results found in this study serve as an alert to promoters of PA and health in Penafiel, as they demonstrate a great risk to public health in the region. PA and physical exercise (PE) seem to be the best tools to combat this problem and government action is essential.

The results verified that the men sampled tended to be more sedentary and inactive than women. Juren et al. [22] evaluated the total daily sitting time for male and female undergraduate students and compared their daily sitting time between weekdays and weekends. The authors observed similar results (p = 0.169) for female undergraduates ($\overline{x}$ = 9.6 h/day) and male undergraduates ($\overline{x}$ = 9.5 h/day). Prince et al. [21] investigated the Canadian SB time statistics in 2019 and verified that Canadian adults aged 18–79 spent an average of 573 min/day on SB (men: 574 min/day and women: 572 min/day). The SB was analyzed by age group and the results showed that among youth, females were more sedentary than males in the earliest (2007–2009; 9.4 vs. 8.9 h/day, p = 0.009) and most recent cycles (2016–2017; 9.2 vs. 8.5 h/day, p = 0.003).

Among adults aged 35–49 years, women had significantly higher levels of SB than men from 2007–2009 (9.7 vs. 9.4 h/day, p = 0.037) and 2009–2011 (9.9 vs. 9.6 h/day, p = 0.030), but not in subsequent cycles. Furthermore, no significant gender differences were found in adults aged 18–34 years, 50–64 years or $\geq$65 years. According to this study, young men (12–17 and 18–34 years) spend significantly more leisure time playing video games than young women. Another factor analyzed is related to the use of a car as a means of transport. The authors indicate that women drive less and are more likely to be passengers in vehicles or use public transit. Another study compared the sitting time between males and females [22]. The authors stated that men and women with same occupation may perform different work tasks, which will result in different patterns of sitting time and PA at work. Thus, this study concluded that men spend on average 72% and women 67% of their worktime sitting. About 50% of the men and 34% of the women spent more than 75% of their time at work sitting, predominantly in uninterrupted bouts longer than 30 min, which is also consistent with findings by Hadgraft et al. [23].

A systematic review suggests that SB and time spent on various sedentary activities differ by gender in adults (18–64 years). Women are negatively associated with total sitting, television and screen entertainment and passive travel when compared to men [24]. On the other hand, Edwards and Sackett [25] conducted a study to review psychosocial influences on women's participation in PA because they believed that women have a lower level of PA compared to men. Self-efficacy, social support and motivation are empirically substantiated factors that explain the lower rates of participation in PA of women than men. According to several authors [19,26,27], prolonged durations of daily sitting time (more than 6 h daily) have a negative impact on health-related quality of life because they are associated with higher rates of chronic diseases and premature death, especially among working adults. Furthermore, the lack of physical activity is the fourth leading cause of death in the world [28].

In the PA analysis, the outcomes were divided by age group: (1) 18–28 years; (2) 20–39 years; (3) 40–50 years and (4) 51–63 years. We verified that group 1 presented higher levels of vigorous PA than groups 2, 3 and 4. Thus, the results showed that the greater the age, the lower the frequency and total time of vigorous PA per week. Unlike our results, a study of Finnish adults which was carried out from 1972–2002 showed that PA tended to increase with age [29]. The young adults (18–29 years) were the only group to present adequate mean values of vigorous PA per week (76.4 $\pm$ 84.3 min/week), according to specific WHO recommendations (vigorous PA > 75 min/week). However, no group obtained, on average, adequate moderate PA within the recommended values (moderate PA > 150 min/week). The best result of moderate PA was achieved by group 3 (40–50 years), with 93.6 $\pm$ 107.6 min/week. On the other hand, the worst results of moderate and vigorous PA were observed in group 4 (51–63 years) with 81.7 $\pm$ 88.2 min/week and 60.3 $\pm$ 89.0 min/week, respectively. Dagmar et al. [27] performed a study to describe the changes in PA, SB and BMI of the inhabitants in the Liberec region (Czech Republic) from the years 2002–2009 and compared the results of women and men. Regardless of the year of monitoring and gender, there were no significant differences in PA among age groups (age brackets 25–35, 36–45 and 46–60 years). Furthermore, men show more PA in total than women, which can be explained mainly by the differences in vigorous PA [30–32].

In the last analysis, no significant correlations were observed between PA or SB and the individual level factors: number of children, marital status and monthly income. Therefore, variables do not seem to be related to levels of PA and SB. On the other hand, O'Donoghue et al. [24] verified a significant correlation between SB and individual level factors (body mass index, socio-economic status and mood). The authors observed that the married or cohabiting participants had a trend towards increased amounts of leisure screen time while having children resulted in less total sitting time. We also found significant and negative correlations between SB and levels of PA. Therefore, the results suggest that the higher the PA level, the lower the SB level. Furthermore, there were significant and positive correlations between PA practice and environmental characteristics (including proximity of green space, neighborhood walkability, safety and weather), thus emphasizing the important role of the environment in the practice of PA. In this sense, efforts are needed to promote public health through spatial planning and policy interventions. Thus, a well-designed built environment that promotes PA would help reduce levels of physical inactivity and promote public health in a low-cost and effective way [33].

According to the Eurobarometer of Sport and Physical Activity (published by the European Commission in 2018 and 2022), there was an increase in the prevalence of physical inactivity in Portugal [30]. The Eurobarometer of 2022 showed that Portugal is the country of the European Union with the most respondents that say they never exercise or play sport (73%). Furthermore, the study verified a higher proportion of inactive people in Portugal compared to the Eurobarometer of 2018 [31,32]. Specifically in Penafiel, the scenario does not seem to be different, considering the results presented in this study. Therefore, in addition to plans and programs of action, it is essential to perform a regular and repeated monitoring of PA at national and regional levels. The reversing of this trend is a national challenge that requires a multisectoral strategy, with government support and support for the implementation of concrete actions, especially in a Portuguese context.

There are several limitations to consider in this study. Firstly, the data collected are based on self-reported responses, which may be subject to recall bias and may not accurately reflect participants' actual levels of physical activity and sedentary behavior. Additionally, the cross-sectional design of the study only allows for the observation of associations between variables and does not establish causality. Socio-economic variables were not analyzed, which may have an impact on physical activity and sedentary behavior and may limit the generalizability of the findings to other populations. Lastly, another limitation of this study is that body mass index was not assessed, which could provide a more comprehensive understanding of the relationship between physical activity levels

and risk factors for chronic diseases. Future research should consider incorporating BMI measurements to further explore the impact of physical activity on health outcomes.

5. Conclusions

The study revealed that a significant proportion of young and middle-aged adults residing in the Penafiel municipality fall short of meeting the recommended minimum levels of physical activity (53.8%) and have a high prevalence of sedentary behavior (54.0%). Thus, despite numerous national and international recommendations, society is still not active enough, probably as consequence of the current pace of people's lives and all the transformations brought about by technology. Urgent action is required from the city council and relevant organizations to create and promote public health interventions aimed at increasing physical activity and promoting healthy lifestyles. It is crucial to prevent the negative health outcomes associated with physical inactivity and sedentary behavior. Encouraging the population to adopt healthier habits and behaviors is vital for ensuring sustainability and enhancing overall quality of life. Although this study did not analyze SES variables, it is important to acknowledge the potential influence of SES on PA and SB behaviors, and further investigation is needed in this area.

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Institutional Review Board Statement: The study was conducted in accordance with the guidelines of the Declaration of Helsinki and approved by the institutional Ethical Committee of the Scientific Board of the Higher Institute of Educational Sciences of the Douro (no: 2.576).

Informed Consent Statement: An informed consent statement was obtained from all parents and/or legal guardians of the subjects involved in the current investigation.

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Article

Blinded by Attachment: Examining the Overconfidence Bias of Sports Fans' Intertemporal Ticket Purchase Decisions

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Abstract: Optimally deciding on the best deal for sport event tickets requires the ability to evaluate risk and make informed decisions in uncertain environments. This study examines how individual trait factors, such as experience, expertise, and involvement, influence consumers' decision-making process when purchasing tickets online for sporting events. To examine and test the study hypotheses, 640 respondents from a Qualtrics survey panel were recruited from geographically confined subjects of New York City sports fans over a ten-day data collection period. The research subjects were surveyed to assess their perception of the expected likelihood of obtaining event tickets at a lower rate (ELR) and the expected likelihood that tickets would remain available (ETA) as the event day approached. MANOVA showed that there was a significant effect of the time period on the participants' ETA and ELR risk assessments [$\Lambda = 0.954$, F (18, 1262) = 1.653, $p < 0.05$]. The ETA was highest ten days before the event and lowest the day before the event, with a similar pattern observed for the ELR. The mediation path analysis showed that fan involvement had a strong positive correlation with confidence ($B = 0.496$, $p < 0.001$). Confidence, in turn, was a significant predictor of the ELR ($B = 5.729$, $p < 0.05$) but not for the ETA ($B = 1.516$, $p = 0.504$). The positive mediation of confidence between fan involvement and the ELR indicates that consumers with higher fan involvement tend to have overconfidence in their ability to evaluate the uncertain purchase environment, which ultimately impacts their risk perception and decision-making. The study highlights the importance of considering both temporal and psychological factors when assessing the likelihood of ticket purchases and provides behavioral insights for sports marketers and ticket distributors.

Keywords: sport; involvement; overconfidence bias; inter-temporal choice; risk; uncertainty

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1. Introduction

The act of searching for the most favorable deal while buying tickets for sporting events over a period of time is fundamentally comparable to a behavior observed in behavioral ecology known as foraging and patch exploitation [1,2]. Optimization models have been utilized by behavioral ecologists to examine how animals seek out natural food resources at regular intervals while considering uncertain time and environmental constraints [3]. Similarly, consumers engage in information foraging and search to make predictions and decisions on when to purchase tickets based on various indicators and evaluations of uncertainty in the pre-sale ticketing environment [4].

Research in the field of sports has highlighted the significant level of uncertainty associated with pre-sale ticketing, which makes it inherently difficult to predict demand and prices for sports events [5]. This uncertainty is influenced not only by factors related to time and environmental variables (such as temperature, precipitation forecast, time of the event, part of season, weekday/weekend, days before event, etc.) [6], but also by dynamic team and individual performance factors (such as star player injuries, home and team winning percentage, season rankings, playoff contention, etc.) [7,8], which has been found

to have a significant impact on game attendance and ticket prices. Sports fans value the unpredictability of the product, which can change rapidly and frequently throughout the season, and this ultimately affects their perception of the product's usefulness [9,10].

Thus, in the context of pre-sale ticketing, the value of a sport ticket changes constantly, making it challenging for consumers to accurately determine the optimal time to purchase tickets for a sporting event [8]. In a perfect market with complete information, consumers would have access to all the relevant information necessary to make informed decisions about when to purchase sports event tickets [11]. Nevertheless, due to time and resource constraints, as well as inherent cognitive limitations, consumers often rely on quick and automatic decision-making rules that are influenced by decision heuristics based on intuition [12]. For example, experienced consumers in the pre-sale ticketing market may use decision heuristics, relying on past experiences and recognition-primed strategies [13,14].

Additionally, the different consumers of sports products are further divided into various segments of sports enthusiasts who possess a comprehensive understanding of the product elements and exhibit a significant psychological and emotional connection to it [15]. Passionate sports fans closely track daily game statistics, player salaries, and injury reports and have a profound emotional attachment to their team and players [16]. This creates a fanatic culture in which die-hard sports fans consistently follow and discuss the latest updates and real-time information through dedicated sports media channels and social media platforms online [17,18].

The considerable level of uncertainty in sports events creates anxiety and suspense among sports fans, which can lead to irrational and superstitious behavior [19,20]. This uncertainty also produces a wide range of opportunities for gambling and the legitimization of derivative markets, such as fantasy football [21,22]. Despite this uncertainty surrounding the sports environment, highly involved sports fans are convinced that they can better predict the outcome of sports events to some extent [23]. They tend to believe that they have more control over sporting events than they actually do and often believe they can influence the outcome [24].

The goal of this study is to explore how individual trait factors, such as experience, expertise, and fan involvement, affect the subjective accuracy of sports consumers' intertemporal purchase decisions. Understanding how these factors interact and influence decision-making under uncertainty can lead to a better understanding of consumer behavior in the advance ticket sales market.

2. Theoretical Background

2.1. Decision-Making under Uncertainty

Decision-making under uncertainty is a complex process that has been studied in various fields of behavioral science [2,14,25]. From the perspective of normative economics, it involves individuals making choices with incomplete information about the chances of potential outcomes [14]. Essentially, making decisions under uncertainty requires evaluating risks to quantify the level of uncertainty [12]. Effective decision-making requires more than just familiarity with factual information, concepts, and relationships. It also requires metaknowledge, which is an awareness of the limits of our knowledge [26].

Unfortunately, humans have a tendency to be overly confident in their beliefs and judgments, which can make decision-making under uncertainty more challenging [27]. Because meta-knowledge is not recognized or rewarded in practice (it is difficult for consumers to evaluate whether their purchase decision is relatively accurate), overconfidence has remained a hidden flaw in decision-making [28]. Bounded rationality is a theory that explains why consumers may struggle to make optimal decisions under uncertainty, as it suggests that individuals make decisions based on their cognitive abilities and the information available to them [29].

Consequently, decision-makers are frequently swayed by biases and heuristics that result in suboptimal decisions. For instance, when purchasing pre-sale tickets, consumers may adopt a straightforward dominant decision-making rule where one factor dominates

their thought process. This could involve prioritizing the risk of the tickets selling out over finding the best deal on the price or vice versa [20]. Alternatively naturalistic decision-making suggests that experts use recognition-primed strategies to make decisions under uncertain circumstances by recognizing situations as prototypes stored in their long-term memory [13]. In the advance sales ticket market, experienced buyers should roughly know what to expect, leading to heuristic decision-making where consumers rely on past experiences to guide their current decisions [30]. This approach is particularly relevant in complex and dynamic environments, such as the pre-sale ticketing market for sports events, where there is a high degree of uncertainty and rapid changes in demand and prices [31].

2.2. Fan Involvement and Risk Perceptions

Any time customers consider purchasing a new product or service, they face a set of uncertainties about the product or service, which is collectively referred to as perceived risk [32,33]. Perceived risk consequentially determines whether the purchase is worth making or not [34]. In the context of sports, this includes general risks associated with attending games, such as the risk of injury, violence, or other negative events [35]. Studies on sport risk management indicate that the degree of fan involvement with their preferred sports team can impact their risk perceptions [34–36]. Research has found that high levels of fan involvement generally led to lower risk perceptions and higher levels of risk-taking behavior [37]. This is frequently attributed to the emotional attachment that fans have with their teams, which may cause them to perceive the risks associated with attending games as lower than they actually are [25]. In addition to emotional attachment, the level of control that fans perceive they have over the situation can also influence their risk perceptions [24]. This is due to the "illusion of control" bias, where individuals tend to overestimate their control over events that are actually determined by chance [38].

In the context of purchasing sports event tickets online, Dwyer et al. introduced the generic advanced decision model, which posits that the purchase decision is primarily influenced by two types of perceived risks: expected ticket availability (ETA) and expected likelihood of finding a lower rate (ELR) [39]. Those with higher a ETA are more inclined to book their tickets early, while those with a lower ELR are less likely to book their tickets right away. The authors' empirical research also revealed that, on average, avid sports fans showed significantly lower expected ticket availability and a higher expected lower rate than the average group of consumers [39].

The degree of risk that fans associate with attending sporting events can be influenced by their level of involvement with their favorite team [34]. Fans who are emotionally invested may perceive the risks of missing out on their favorite event to be higher than the average consumer [25]. This perception can also be shaped by the amount of control that fans feel they have over the situation. Fans who believe they have more control over the ticket purchase process may underestimate the risks of sellout. Furthermore, fans who are confident in their ability to find the best deals may delay their purchase and continue searching for better deals in the future. However, these boundary conditions have yet to be examined in the sport literature.

Accordingly, the following hypotheses were developed and tested in this study:

Hypothesis 1 (H1). *Individuals' level of fan involvement will have a positive effect on their expected ticket availability (ETA).*

Hypothesis 2 (H2). *Individuals' level of fan involvement will have a positive effect on their expected likelihood of fining a lower rate (ELR).*

2.3. Illusion of Control and Sports

The illusion of control is a cognitive bias that refers to the tendency of individuals to overestimate their ability to control events that are actually determined by chance or other external factors [40]. This phenomenon has been extensively studied in the context

of gambling, where players often believe that their actions can influence the outcome of a game of chance, such as rolling a dice or spinning a roulette wheel [38,41]. Empirical research has provided support for the existence of the illusion of control across a variety of domains, including sports [42], health [43], and business [44]. Studies have also shown that the illusion of control can have both positive and negative consequences. On the one hand, it can lead to increased motivation and persistence in pursuing goals [45,46]. On the other hand, it can lead to overconfidence and poor decision-making, especially in situations where chance plays a significant role [47,48].

One area where the illusion of control has been studied in sports is in relation to superstitious behaviors [49]. Superstitions are irrational beliefs or practices that are believed to bring about a desired outcome. For example, athletes may wear lucky socks or engage in specific rituals before a game [50]. Research has shown that athletes who engage in superstitious behaviors tend to have a greater sense of control over their performance, even though the behavior itself is not directly related to their performance [19]. In other words, athletes who engage in superstitious behaviors may believe that they have more control over the outcome of the game than they actually do [51].

The illusion of control has also been shown to influence the decision-making of athletes. Due to the overestimation of their control over events, athletes may make choices that involve greater risk or rely on incomplete information to make decisions. This can lead to negative outcomes since they may not have the level of control they believed they had. Studies conducted on this topic have shown that athletes may choose to engage in riskier behaviors or make decisions based on incomplete information because they believe they have more control over the outcome than they do [52].

Studies have also examined the illusion of control in relation to the perception of fairness in officiating in sports. It has been found that both athletes and fans tend to believe that they have more control over the outcome of the game when the officiating is perceived to be fair [53]. This belief can lead to a greater sense of control over the outcome of the game, even though the actual outcome is determined by the performance of the athletes [54]. Research in this area highlights how the illusion of control can impact the perception of fairness and influence the decision-making processes of athletes and fans.

2.4. Fan Involvement and Overconfidence

As previously mentioned, the illusion of control can significantly affect individuals' behavior and decision-making in sports, particularly through the overconfidence bias of sports fans [23,24]. Fan involvement is a term used to describe the extent of emotional attachment and identification an individual has with a sports team or event [55]. The greater the emotional investment, the more likely the individual is to perceive a lower risk associated with attending games, despite the actual risks present.

This emotional attachment may cause fans to be blinded to the real risks, leading to overconfidence in their decision-making. Fans who have a strong attachment to a particular team or sport tend to believe they have superior knowledge and understanding of the game compared to others. This overconfidence among avid sports fans can result in various actions, such as overly optimistic predictions about game outcomes, underestimating the abilities of rival teams or players, and overestimating their capacity to affect the result of a game [56,57].

Accordingly, the following hypothesis was developed to test for the mediation effect of overconfidence:

Hypothesis 3 (H3). *The relationship between involvement and risk perceptions (ETA and ELR) will be moderated by the individual's level of confidence, acting as a mediator.*

The conceptual model in Figure 1 depicts the hypothesized mediation model relationships between the independent and dependent variables of the study:

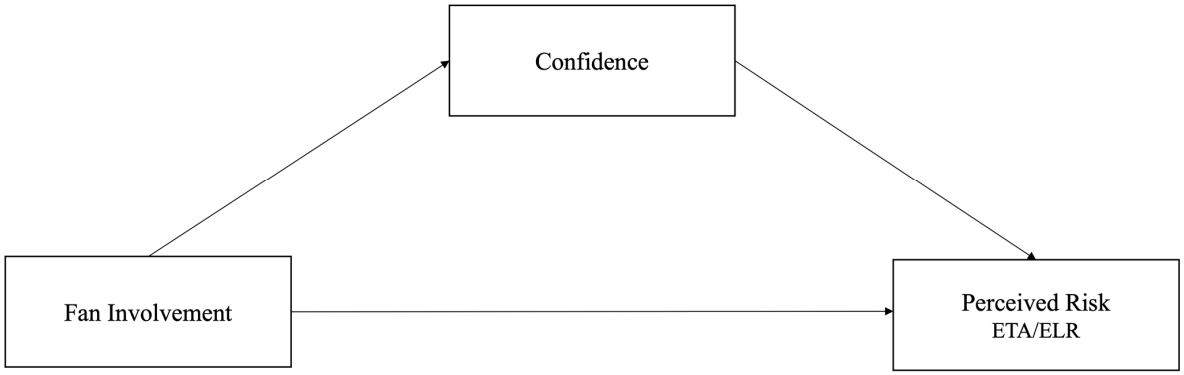

Figure 1. Hypothesized mediation model of fan involvement and confidence on risk perceptions.

To sum up, decision-making under uncertainty is a multifaceted and intricate process that is affected by various factors, such as risk probability calculations, past experiences, and cognitive heuristics. Understanding the mechanisms that shape consumer decision-making can provide valuable insights for sports marketers and ticket distributors looking to impact consumer behavior in the sports industry. This study focuses on understanding how the decisional factors (fan involvement, confidence, experience, and expertise) impact fans' booking behavior in the advance ticket sales environment. This understanding can also aid managers in developing effective strategies for ticket sales and marketing, as well as identifying potential areas of improvement in their sales process. Ultimately, a deeper understanding of fan behavior in the advance ticket sales environment can help sports organizations improve fan satisfaction and loyalty and ultimately drive revenue growth.

3. Methods and Measurements

3.1. Study Sample Demographics

To examine and test the effects of fan involvement and risk estimates of the advanced ticket sales environment, 640 respondents from Qualtrics were recruited to participate in the study. Ethical review and approval were not required for the study on human participants in accordance with the local legislation and institutional requirements. Through Qualtrics, the online survey was distributed to geographically confined subjects of New York City residents over a 10-day period from 7 December to 17 December 2017. Within each email, a brief message and link were provided to ask the respondents to participate in filling out an online questionnaire. Table 1 provides key demographic information for the sample.

Table 1. Key demographics of the sample.

Age	33.674, Mean 11.792, St. Dev	Ethnicity	76.3%, Caucasian 12.3%, Hispanic
Gender	69.1%, Male 30.9%, Female		6.1%, Asian 5.3%, Other
Household Income	12.5%, Less than USD 20 K 20.7%, USD 20 K–USD 40 K 22.9%, USD 40 K–USD 60 K 24.7%, USD 60 K–USD 80 K 15.0%, USD 100 K–USD 200 K 3.4%, More than USD 200 K	Education	21.5%, High school 4.1%, Bachelor's degree 18.0%, Graduate degree 16.5%, Professional degree 7.7%, Other 9.0%, Did not specify

The study adapted ELR and ETA measurements from the studies of Chen and Schwarz and Dwyer, and Drayer, and Shapiro's quasi-experimental design on examining the booking behavior for sporting events [39,58]. The research subjects who agreed to participate in the study were given a vignette scenario, where a group of friends decides to watch a NY Giants home NFL game against the Philadelphia Eagles (view Figure 2).

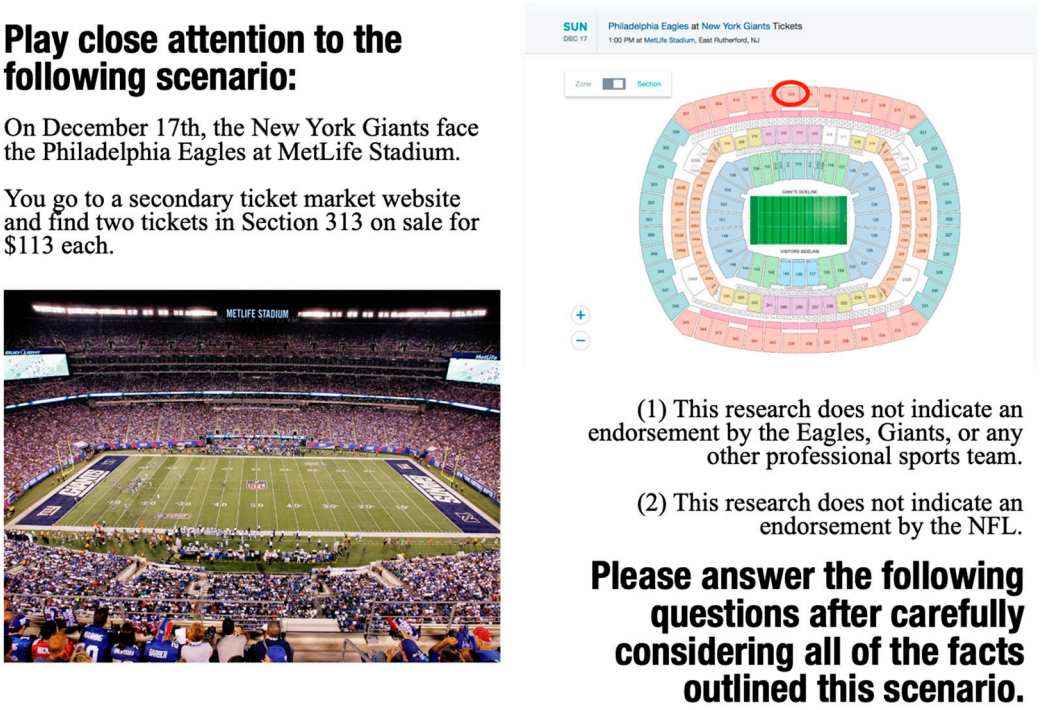

Figure 2. Vignette of the ticket purchase scenario.

3.2. Study Design and Procedures

The participants were told that they had been asked by their group of friends to book game tickets for the entire group. They searched the Internet to find available tickets to attend the future game. The described experimental task controlled for extraneous variables including the opponent for the game, the seat location, the date of stay, and the quoted price. After reading through the purchase scenario, the participants were asked two questions regarding estimating the likelihood of future events (the likelihood of sellout and the likelihood of finding a better priced deal later). The survey also collected the participants' demographic information, followed by questions regarding their ticket purchase behavior, knowledge of sport ticket markets, and fan involvement.

The measurement methods used to operationalize the illusion of control have varied in the literature on consumer behavior and sports management [23,24]. Studies have used different measures, such as discrepancy scores between expected and actual performance, self-rated perceived control, and self-rated confidence. Presson and Benassi found that studies which measured participants' perceived ability to predict outcomes had larger effect sizes than those that measured the perceived ability to control outcomes [59]. As such, this study will utilize self-rated perceptions of the likelihood of expected ticket availability (ETA) and the expected likelihood of finding a lower rate (ELR). The study also used single-item measures to directly assess the participants' perceived probability of sellout risk and the likelihood of finding a better deal, adapted from Dwyer, Drayer, and Shapiro's study on secondary ticket markets [39]. Demographic information, ticket purchase behavior, knowledge of sport ticket markets, and fan involvement will also be measured and collected.

3.3. Dependent Variables

A summary of all of the variables and survey measurement items are included in Table 2.

Table 2. Summary of the measurement items.

Variables of Study	Survey Items
Dependent Variable	
ETA	I believe the chance the same or very similar price tickets will be available between tomorrow and today is _____ %
ELR	I believe the chance I can find the same or very similar price ticket deals between tomorrow and today is _____ %
Independent Variable	
Involvement	Total number of years as a spectator or participant in the NFL Total number of hours spent watching or following their favorite NFL players or teams per week Total amount of money spent on NFL merchandise per year
Mediator Variable	
Confidence	I am confident in using both primary and secondary ticket market knowledge compared to the average sport fan I am confident in searching for the best deal available compared to the average sport fan Generally, I am confident in my purchase decisions for sports games
Control Variables	
Expertise	I am knowledgeable about sport ticket markets compared to the average sports fan I have a better ability to comprehend necessary sport ticket market information compared to the average sports fan
Experience	How often do you purchase tickets online on a monthly basis? Number of days since you last purchased a ticket online for the NFL
Time	Number of days before the game of event (dummy coded)

The two dependent variables for this study were the ETA, the subjects' assessment of the expected ticket availability, and the ELR, their assessment of the likelihood of finding a similar or lower price ticket any time before the scenario date and the game.

3.3.1. Expected Ticket Availability (ETA)

I believe the chance the same or very similar tickets will be available between tomorrow (DATE) and today (DATE) is _____%. (Please indicate a number between 0 and 100).

3.3.2. Expected Likelihood of Finding a Better Rate (ELR)

I believe the chance that I could find the same or very similar tickets somewhere else at a price lower than USD (PRICE) each between tomorrow (DATE) and today (DATE) is _____%. (Please indicate a number between 0 and 100).

3.4. Independent Variable

Fan Involvement (Behavioral Involvement)

The following items were included to measure fan involvement: (1) the total number of years as a spectator and participant in the NFL; (2) the total number of hours spent watching and following their favorite NFL players and teams on a weekly basis; and (3) the amount of money they spend on NFL merchandise on a weekly basis. A weighted composite score of involvement was created through exploratory factor analysis (EFA).

3.5. Mediator Variable

Perceived Confidence

Three items were used to measure the participants' perceived confidence (attitude) about their ticket purchase ("I am confident in using both primary and secondary ticket market knowledge compared to the average sport fan", "I am confident in searching for the

best deal available compared to the average sport fan", and "Generally, I am confident in my purchase decision for sport games"). A seven-point Likert scale (1 = strongly disagree; 7 = strongly agree) was used to measure the variability among the three items.

3.6. Control Variables

To better examine the hypothesized relationships and the proposed mediation model, two potential covariates were introduced to the statistical control variance between the main and indirect effects of the proposed structural model.

3.6.1. Ticket Purchase Experience

Two items were used to measure an individual's past ticket purchase behavior. The first item asked how often the participants purchase tickets online, monthly, on a five-point scale (1 = never; 2 = rarely; 3 = sometimes; 4 = frequently; 5 = every month). The second item asked the participants to identify the number of days since they had last purchased a ticket online for a sports game. The measurement was reverse coded and deducted from a total value of 365 days to ensure the directional strength of measurement; 365 indicates that the consumer purchased a ticket today and 1 indicates that the most recent day when the consumer purchased a ticket is 1 year ago.

3.6.2. Perceived Expertise of the Sports Ticket Market

Two items were adapted from Kwak et al. [24] to measure the participants' perceived knowledge about sport ticket markets: "I am knowledgeable about sport ticket markets compared to the average sport fan", "I have better ability to comprehend necessary sport information compared to the average sport fan", and "I have better ability to comprehend sport ticket market information compared with the average sport fan". The measures utilized a seven-point Likert scale (1 = strongly disagree; 7 = strongly agree).

4. Analysis

All statistical analyses were performed in R 3.6.2 and SPSS 27. Table 3 shows the number of observations that correspond to the 10-time level treatments as well as the averages and standard deviations for each of the two dependent variables (ELR and ETA). Perceived ticket availability was highest 10 days before the event (at 53.72%) and lowest the day before the event (at 37.89%). The same pattern was observed for the ELR. The ELR was highest at 48.92% 10 days before the event and dropped significantly to 35.88% just a day before the event. In general, as the time grew closer to the event, the respondents' perceived probability of both ticket availability and the likelihood of finding a lower priced ticket dropped significantly.

Table 3. Estimates of the ETA and the ELR by days leading up to the event.

		Expected Ticket Availability		Expected Lower Rate	
Days before the Game	**Number of Observations**	**Average (%)**	**SD**	**Average (%)**	**SD**
10	40	53.72	28.88	48.92	29.19
9	80	52.13	24.09	48.13	23.57
8	54	50.33	25.85	46.22 *	28.49
7	48	46.22 *	28.47	44.93	28.83
6	71	47.36 **	28.95	42.53 *	24.32
5	80	50.08	29.97	43.98	27.65
4	56	48.73	29.81	44.94	28.42
3	60	40.33 *	22.68	44.31 *	24.18
2	76	40.81 ***	27.98	38.63 ***	29.21
1	76	37.89 ***	28.15	35.88 **	29.75

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Using Wilks' statistic, our MANOVA results show that there was a significant effect of the time period on the participants' ETA and ELR risk assessments [$\Lambda = 0.954$, $F(18, 1262) = 1.653$, $p < 0.05$]. The descriptive statistics for the different dependent variables are reported in Table 4. The effect size measured using partial eta-squared values η^2 was 0.023. Because the participants responded over 10 different time slots for the experiment, time also needed to be included as a control variable for the global mediation model. Therefore, a time dummy variable was generated based on when the respondent took the survey prior to the days leading to the game event scenario.

Table 4. Regression estimates of unstandardized coefficients.

	Confidence		**Expected Ticket Availability**		**Expected Lower Rate**	
	Estimate	**SE**	**Estimate**	**SE**	**Estimate**	**SE**
Involvement	0.496 ***	0.069				
Involvement			4.448 **	1.639	3.926 *	1.655
Confidence			1.516	2.269	5.729 *	2.25
D1			19.881 ***	5.695	18.067 **	5.503
D2			16.273 ***	4.308	16.041 ***	4.503
D3			12.389 *	4.925	10.419 *	5.254
D4			8.371	5.169	9.530	5.192
D5			9.075	4.717	6.130	4.438
D6			13.925 **	4.709	9.202 *	4.591
D7			11.489 *	4.986	9.702	5.022
D8			3.180	4.345	8.305	4.611
D9			8.279	4.832	10.130 *	4.948
Expertise			0.625	2.207	−2.488	2.316
Experience			2.264	1.669	2.877	1.715

Total R^2 = 6.3% (ETA), 9.4% (ELR), $N = 641$. * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$.

Before conducting regressions for hypotheses testing, weighted sum scores for involvement, confidence, expertise, and experience were created through a series of exploratory factor analyses [60]. Next, a series of ordinary least squares (OLS) regression models were conducted to test the study's hypotheses regarding the effects of the consumers' level of involvement on their risk perception through the level of overconfidence. To isolate the effect of the independent variable and mediator, past experience, expertise was included as a control variable in the mediation model. Involvement and confidence predicted ETA, $R^2 = 0.063$ and ELR, $R^2 = 0.94$. Detailed regression estimates of the coefficients are presented in Table 4.

5. Results

H1 was supported as fan involvement was a significant predictor of the level of confidence ($B = 0.496$, $p < 0.001$). Confidence was a significant predictor of the ELR ($B = 5.729$, $p < 0.05$). However, confidence was not significantly associated with the ETA ($B = 1.516$, $p = 0.504$). To examine the mediated relationship of the illusion of control (involvement, overconfidence, and probability judgments of risk perception), the study generated confidence intervals through bootstrapping methods [61]. The indirect effect of involvement on the ELR through overconfidence was found to retain 95% confidence intervals (CIs) that did not include zero (indirect effect = 2.840, CI = [0.716, 5.455]). However, the indirect effect of involvement on the ETA through overconfidence was not statistically significant as the 95% confidence interval includes zero (indirect effect = 0.751, CI = [−1.433, 3.129]). Thus, H3 was partially confirmed (only for the ELR and not significant for the ETA). Figures 3 and 4 display the hypothesized path model results including the unstandardized regression coefficients and confidence intervals through bootstrapping methods.

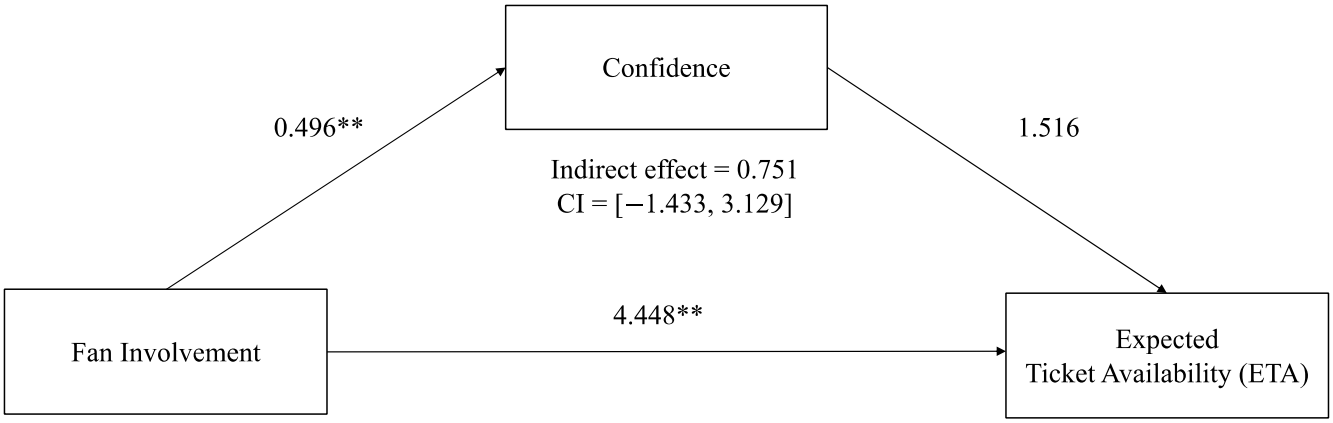

Figure 3. Unstandardized regression coefficients for the relationship between involvement and expected ticket availability (ETA) mediated by perceived confidence, ** $p < 0.01$.

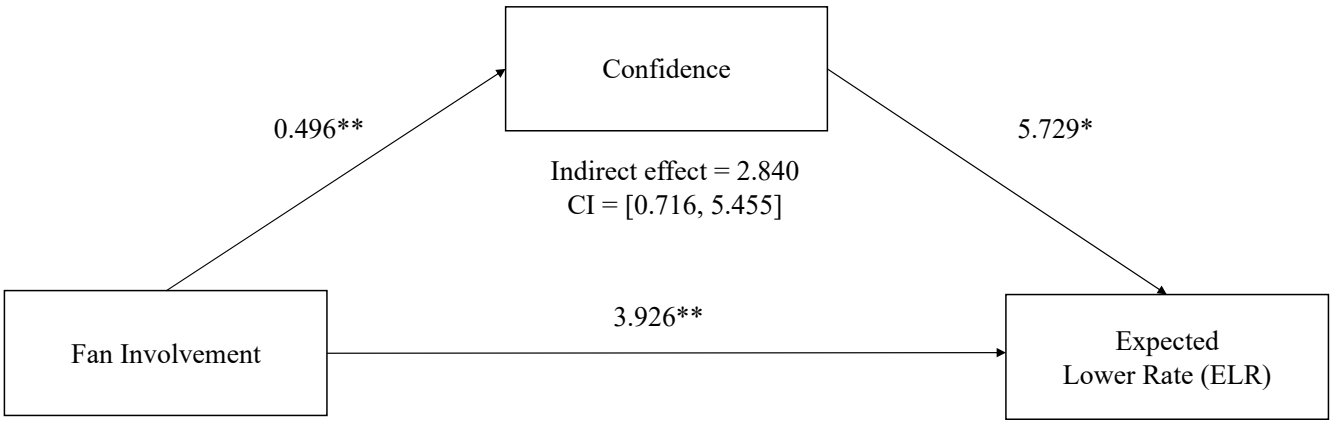

Figure 4. Unstandardized regression coefficients for the relationship between involvement and expected lower rate (ELR) mediated by perceived confidence, * $p < 0.05$, ** $p < 0.01$.

6. Discussion

The aim of this research was to investigate how individual trait factors, such as experience, expertise, and fan involvement, impact the subjective accuracy of sports consumers' intertemporal purchase decisions. The study hypothesized that fan involvement would lead to overconfidence bias in risk perceptions for sport fans in the presale ticketing environment, based on the illusion of control theory. The findings revealed that high involvement did, in fact, result in an overestimation of risk perceptions (ETA and ELR) in the presale ticketing environment, and this relationship was partly mediated by consumers' overconfidence.

6.1. Theoretical Implications

Dwyer, Drayer, and Shapiro first found that provided with the same environmental ticket market scenario, the average ETA (47.7% > 40.7%) and ELR (44.8% > 36.6%) predictions were higher for high involvement fans than low involvement fan groups [39]. These results indicate that the general prediction for availability and the perceived likelihood of finding a better deal were generally higher for highly identified sports fans [39]. Although this significant difference across fan groups has been an intriguing empirical finding, there has not been any research on the root cause of and procedural decision-making explaining this effect.

One key factor that this study considers as a root cause is the overconfidence that is created by consumer involvement in their product [36]. This study focuses on the concept of overconfidence that arises due to consumers' emotional involvement with the product. It uses the illusion of control theoretical framework to investigate why highly involved

sports fans can be blinded by overconfidence in their decision-making, leading to biases in future probability judgments and inter-temporal choices. The study tests whether varying levels of fandom affect the risk perception of future ticket availability and the likelihood of finding a better deal in the same environmental ticket market purchase conditions.

One explanation for the relationship between fan involvement and the ETA is that highly involved fans may be more likely to engage in selective attention and biased processing of information related to their team or sport [62]. This can lead to a confirmation bias, where fans selectively attend to and interpret information that supports their pre-existing beliefs and ignore information that contradicts them [63]. For example, a fan who is highly involved with a particular team may only pay attention to statistics or news stories that support their belief that their team will be likely to sell out, while ignoring or dismissing information that suggests otherwise [53].

Alternatively, another possible explanation for the relationship between fan involvement and the ELR is that highly involved fans may feel a greater sense of control over the outcome of a game [64]. This sense of control can lead to an illusion of control, where fans overestimate their ability to influence the outcome of a game through their own actions or support of their team. For example, a highly involved fan may believe that wearing a particular jersey or performing a certain ritual before a game will increase their team's chances of winning [49].

Overall, we theorized that customers may be blinded by their attachment, which clouds there judgement and risk perception judgment towards the uncertain purchase environment. In addition, this overconfidence would in fact be exhibited through overestimation of their ability to control events and, relatedly, the overestimation of their task skill ability to secure lower priced deals for a given ticket. The mediation analysis in our study was run as a confirmatory assessment of the overall theory of illusion of control being posited in this empirical study. The apparent mediation effect of overconfidence between involvement and the ELR in subjective risk probability in this study hopes to further strengthen the idea that given the same environmental scenario of uncertainty, consumers do not evaluate the information cues equally and objectively.

6.2. Practical Implications

The results of this study have several important implications for sports marketing and management, as they can help managers better understand how fans perceive and engage with their teams and events. For example, if managers can identify the factors that influence fans' booking behavior, they can tailor their marketing strategies to better meet the needs and preferences of their target audience [62].

First, the findings suggest that fan involvement is a crucial factor to consider when predicting consumer behavior in the sports industry [15]. Fans who are more involved with a particular sport or team are more likely to believe that they will be able to obtain tickets for a game and are also more likely to believe that they will be able to find a better deal on those tickets. This finding suggests that sports marketers should focus on building strong relationships with fans and creating a sense of community around their teams in order to increase fan involvement and engagement.

Second, the results of this study suggest that sports marketers should pay attention to the timing of ticket sales. Specifically, the study found that fans are more likely to believe that tickets will be available and that they will be able to find a better deal on those tickets as the event date approaches. This empirical finding suggests that sports marketers should consider implementing dynamic pricing strategies that take into account the expected demand for tickets as the event date approaches, as well as promotional strategies that incentivize fans to purchase tickets earlier rather than later.

Third, the study suggests that sports managers and marketers should focus on building consumer confidence in the ticket purchasing process. The study found that fan confidence is positively associated with expectations of ticket availability, which in turn influences purchase decisions. Although overconfidence might distort the prediction accuracy of

agents in decision-making, it can still serve a purpose during the decision implementation process (i.e., higher confidence in the decision can lead to higher satisfaction when decisional efficiency cannot be attained). This finding suggests that sports marketers should implement strategies that build consumer confidence in the ticket purchasing process, such as offering clear and transparent pricing information and providing easy-to-use online ticket purchasing platforms.

Overall, the findings of this study provide valuable insights into the factors that influence consumer behavior in the sports industry. By understanding how fans perceive risks and make decisions, managers can optimize the pricing and availability of tickets to maximize revenues while still providing a positive experience for fans. Ultimately, a deeper understanding of the factors that influence decision-making in sports can help managers improve their business operations and enhance the overall fan experience.

6.3. Limitations and Future Research

Although this study might offer interesting implications towards practice, several limitations should be noted. Firstly, the study was conducted using an online survey that used self-reported measures, which may be subject to response bias and not capture the full range of responses and behaviors that may occur in a real-life ticket purchase scenario [65]. Secondly, a particular team brand (the NY Giants and the Philadelphia Eagles) was used to control for the potential effects of brand strength. Although Gierl et al. [66] did not find any significant difference between a famous brand and fictitious generic brands in their quasi-experimental study, the potential moderating effects of brands might be worth examining in this area of research. Thirdly, the study focused only on the impact of fan involvement and perceived risk on ticket purchase decisions, and other factors such as price sensitivity and social influence were not explored [67]. Lastly, the study did not find a significant mediating effect between the relationship of involvement and ticket availability. We posit alternative cognitive biases to better explain why fan involvement may influence scarcity perceptions [68].

Despite these limitations, the study provides valuable insights into the inter-temporal decision-making process of sports fans when purchasing tickets for sporting events. Future research can expand on these findings by exploring additional factors that influence ticket purchase decisions and by examining other contexts such as on-site ticket purchases and secondary ticket markets. Additionally, future research can investigate the impact of these factors on other consumer behaviors, such as concession sales and merchandise purchases, in the sports industry.

7. Conclusions

In conclusion, decision-making in the context of purchasing tickets for sporting events is a complex and multifaceted process influenced by several factors, including the perception of risk, fan involvement, confidence, experience, and expertise. The advance ticket sales market for sporting events presents a challenging environment for consumers to make accurate purchase decisions due to the significant level of uncertainty surrounding the sports product. Fans' decision-making processes can be distorted by cognitive biases and heuristics, leading to suboptimal choices. The study has replicated the illusion of control and revealed that overconfidence bias exists in the pre-sale ticketing environment. Understanding the factors that influence fans' decision-making processes can help sports marketers and ticket distributors better understand how fans engage with their teams and events, and ultimately improve their sales and marketing strategies. Further research is needed to explore these relationships in more depth and to develop interventions to help fans make more informed decisions.

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Article

"10,000 Available" or "10% Remaining": The Impact of Scarcity Framing on Ticket Availability Perceptions in the Secondary Ticket Market

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Abstract: The aim of this study was to investigate the effect of numeracy framing and demand on participants' perceived ticket availability and likelihood of finding a lower-priced deal in the secondary ticket market for National Football League (NFL) games. A total of 640 participants were recruited via Qualtrics where participants were solicited electronically via 10 date-specific email blasts prior to a New York Giants Sunday Night Football home game. Participants were randomly assigned to one of five treatment conditions (control, percentage frame × low demand, percentage frame × high demand, frequency frame × low demand, frequency frame × high demand) to complete an online survey. Multivariate analysis of variance (MANOVA) was performed to discern overall differences in the mean likelihood scores of the dependent variable between groups. The results showed that participants presented with the "percentage" frame perceived tickets as less available than those presented with the "frequency scarcity" frame, and the effect was greater for high-demand games. Additionally, game demand moderated the effect of scarcity framing on participants' perceived ticket availability and expected lower rate. Several manipulation checks were applied to ensure the study's validity. The findings of this study have practical implications for ticket marketers in the sport industry to effectively frame scarcity information and facilitate transactions for online buyers and sellers.

Keywords: pricing; scarcity messages; framing; numeracy; secondary ticket market

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1. Introduction

The secondary ticket market for sport, music, and entertainment (i.e., the ticket resale marketplace) mushroomed into a USD 15 billion industry in 2021 and is expected to balloon to USD 68 billion by 2025 [1,2]. Roughly 1500 ticket service companies, including ticket resale platforms, were conducting business as of 2015 [3]. Mergers and acquisitions have increased industry concentration. StubHub is the largest player in this space and was initially acquired by eBay in 2007 for USD 310 million. The platform was later sold to Swiss ticket vender Viagogo for a whopping USD 405 billion [4]. The secondary ticket market has grown considerably with the emergence of Internet-based platforms that enable buyers and sellers to engage in transactions worldwide [5]. As the global mobile apps market expands, many service providers are developing mobile applications to offer consumers simple access. The virtual ticket marketplace has hence become fiercely competitive: vendors are vying to provide the ultimate user interface (UI) design. The goal of UI design is to create an interface through which users can easily, efficiently, and enjoyably interact with a product. StubHub's early success and subsequent rise to the top of the secondary market has been attributed to the site's simple yet informative UI. In recent years, there has been increased competition in the secondary ticket market in the sport industry. To make transactions more appealing for online buyers and sellers, ticket marketers are focusing on

standout user interface design on ticket distribution platforms. They are experimenting with ways to effectively frame scarcity information, incite urgency among buyers, and facilitate transactions.

Consumers' penchant to visit the secondary marketplace to buy tickets, coupled with high competition among providers, has compelled ticket platforms to conduct a/b testing. Companies have also experimented with marketing techniques in the digital space to distinguish themselves and make their platforms more appealing to buyers and sellers alike [6,7]. Nonetheless, research to date has merely empirically assessed the effectiveness of emerging practices in the virtual secondary ticket market; the practices themselves have yet to be tested (Brett Goldberg, CEO and co-founder of TickPick, personal communication, September 2017). As a late follower and startup founded in 2011, TickPick was built on a business model focusing on buyers' disdain for hidden fees. The platform instead quotes all-inclusive single prices that are guaranteed to be less at the purchase stage. This approach directly contradicts the market leader StubHub's business model where a low price is quoted in an initial search, but taxes and commission fee surcharges are added to the final price. StubHub believes that consumers will only remember the price anchor (i.e., the first piece of information) and forget the total price paid. Thanks to a standout UI and effective marketing strategies, TickPick was ranked the fourth largest secondary market in 2021 [1]. This platform, along with RazorGator, SeatGeek, TicketIQ, and Vivid Seats, has found success in this competitive industry. Meanwhile, many other players have perished. Determining what does and does not work (e.g., via a/b testing) seems essential to thriving in this space—as does being able to understand sport fans and buyers' decision-making processes in the ticket market.

Sport fans who book tickets in a dual market of primary and secondary providers must grapple with many decisions. Popp et al. identified seven salient attributes when booking sport event tickets online: (1) ticket purchase timing, (2) seat availability, (3) price fluctuations, (4) fee transparency, (5) number of price points, (6) fraud risk, and (7) price valuation assessment [8]. Official partnerships have recently been stressed to counter fraud risk [5]. Won and Shapiro examined the impacts of fee transparency, price fluctuations, and the number of price points by exploring the role of price bundling on consumers' attitudes and behavior [9]. The current work focuses on two other major factors—ticket purchase timing and seating availability—to further examine how these aspects influence consumers' likelihood of booking through the secondary ticket market.

Ticket marketplace distributors primarily display visuals and graphics on their websites to convey information on seat availability (see Figure 1). The premise behind this type of information disclosure is to signal scarcity and create a sense of urgency among buyers, thereby encouraging purchases [10]. This priority on scarcity has been augmented through creative fear of missing out (FOMO) marketing initiatives. Specifically, marketers strive to craft messages that appeal to consumers' desire to seize an opportunity before it slips through their fingers [11].

Typically, when purchasing event tickets online, consumers are exposed to information on product scarcity based on raw numbers (e.g., the total number of tickets available for certain seat sections). The way in which information is presented or framed affects individuals' purchase-related evaluations and choices [12]. For example, Levin demonstrated more favorable associations for a purchase of ground beef when the beef was described as "80% lean" rather than "20% fat" [13]. In the medical field, symptom evaluation, patient compliance, treatment, and doctor selection have all been shown to feature framing effects [14]. Patients presented with risk information about a medication's side effects in a percentage format (i.e., 10% of patients experience a blistering rash) perceived medication as less risky than when given risk information in frequency format (10 out of 100 people experience a blistering rash). Frequency formats appear to increase risk perceptions over percentage formats for less numerate participants. The present study tests whether consumers' scarcity perceptions vary when information about seat availability is presented using different numerical frames (i.e., as frequencies or a percentage).

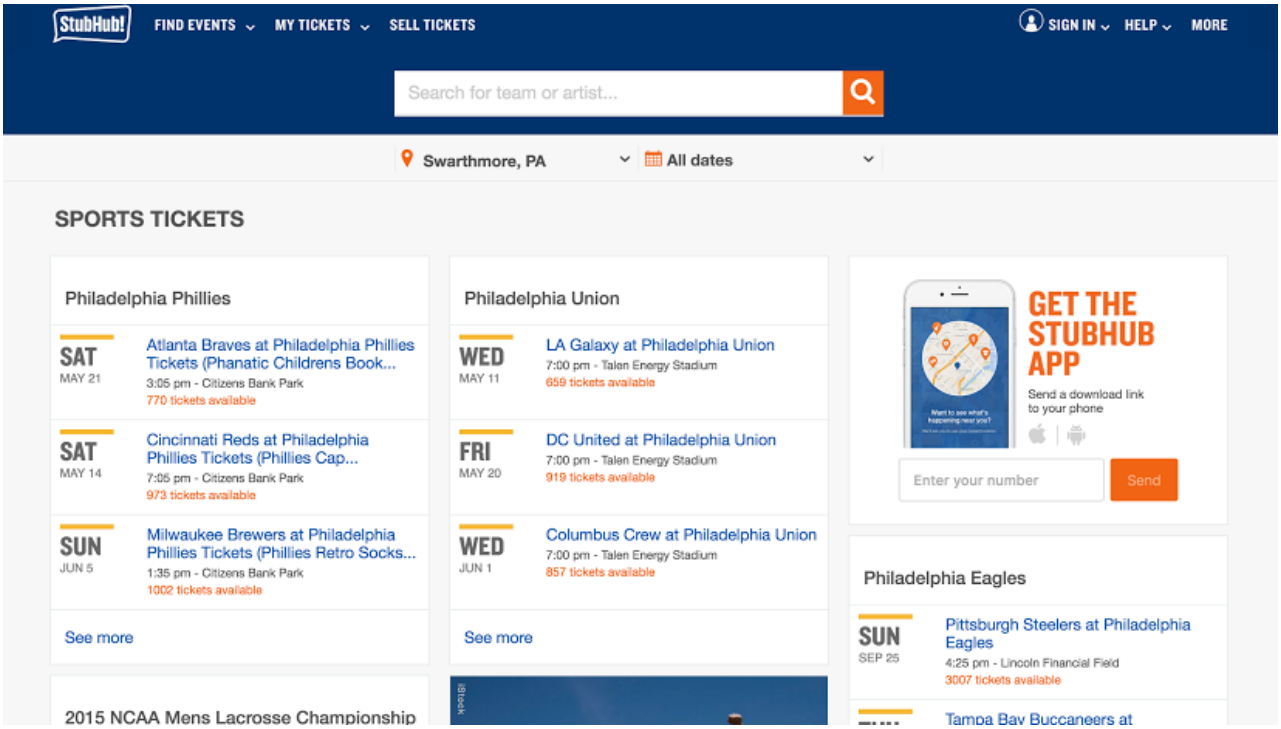

Figure 1. Example of Scarcity Through Frequency Numeracy Framing. Source: StubHub.

Marketers can struggle when sellers overestimate demand or when seeking to liquidate low-demand game tickets. Broker data showing tickets selling for pennies on the dollar (or not at all) in the secondary market highlight the need for improved marketing and serious consideration of scarcity framing. For instance, when using different numerical cues to gauge scarcity, are consumers even measuring the same phenomenon? If a stadium's full capacity is 40,000 seats, will a buyer's risk perception vary when the information is presented as "400 seats available" compared to "Less than 1% remaining"? Contrarily, when there is relatively low demand for a sport event, does a percentage generate more urgency (e.g., "56%" vs. "22,400 seats remaining")? Is any numeracy format in fact more effective than another when conveying scarcity? From a marketing perspective, it would be ideal to implement whichever frame signals greater scarcity and evokes a sense of urgency for consumers to book/purchase in an uncertain scenario. As such, this study explores which frame is more useful in signaling higher scarcity perceptions and amplifying consumers' propensity to book early.

Several research questions guide this work:

RQ_1: Do consumers' expectations of ticket availability with respect to an upcoming professional sport event differ over time?

RQ_2: Do consumers' expectations of finding lower-priced tickets with respect to an upcoming professional sport event differ over time?

RQ_3: Which numeracy frame (frequency vs. percentage) of seat availability more effectively signals scarcity with respect to high- and low-demand sport events?

2. Theoretical Background

2.1. Generic Advanced Decision-Making Model and Sport Ticket Booking Behavior

To address the above research questions, the theoretical framework of Dwyer, Drayer, and Shapiro's generic advanced decision-making model (view Figure 2) was adapted in this study [15]. This model consists of two constructs reflecting risk perceptions that dictate consumers' advance-purchase decisions in relation to sport tickets: expected ticket availability (ETA) and expected lower rate (ELR). Risk perceptions refer to people's subjective judgments about the characteristics and severity of a risk [16]. Using a 19-day advance-

purchase timeframe, Dwyer et al. found that ETA (an indirect measure of sellout risk) and ELR both decreased for a generic sport ticket product category when nearing the day of the event [15]. Consumers' lower ETA and ELR risk perceptions should ultimately increase the probability of purchasing event tickets.

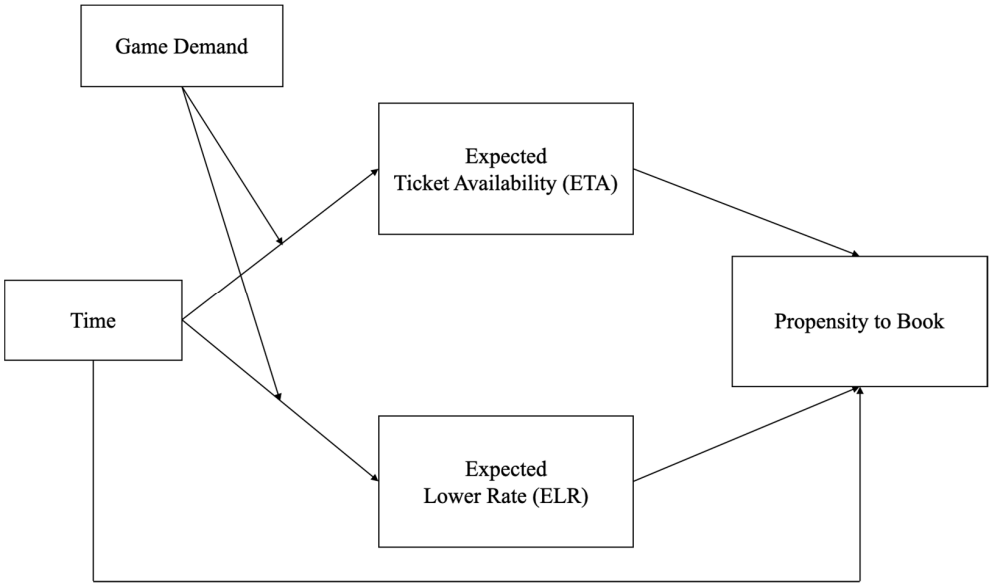

Figure 2. Generic Advanced Decision-Making Model.

The fluctuating ETA and ELR patterns revealed in Dwyer et al.'s work underline the need to develop strategies that capture how consumers deal with uncertain information cues in the advance ticket sales market [15]. Risk perceptions are distinct from actual risks, as the former are shaped by a range of affective, cognitive, contextual, and personal factors [17]. This study addresses context by investigating how consumers' subjective risk assessments (i.e., ETA and ELR) can be further distorted by information presented in the purchase environment. More precisely, under the generic advanced decision-making model, this study tested which numerical frame (frequency vs. percentage) generated greater urgency (i.e., ETA and ELR risk perceptions) that inspired consumers to either book immediately or wait. This research thus aimed to identify when the scarcity problem was most likely to manifest for buyers and to provide guidance on the optimal framing of seat availability messages.

Accordingly, the following hypotheses were empirically tested:

H1. *Based on the generic advanced decision-making model, we predict that there will be a significant relationship between purchase timing and participants' ETA and ELR. Specifically, as purchase timing increases, we expect ETA and ELR to decrease and vice versa.*

H2. *After controlling for the effects of purchase timing, we hypothesize that higher game demand will result in lower ETA and ELR, while lower game demand will lead to higher ETA and ELR.*

2.2. Framing Effect

A frame refers to a mental model of a decision problem [18]. People use this frame to solve the problem; it includes details about the elements of the problem (i.e., information) as well as the context. The framing literature suggests that decision makers will use information in the context of the frame that is presented to them without attempting to reframe it [19,20]. Although information about a particular problem might remain the same, it can be perceived, organized, and interpreted differently. The problem can also be resolved in varied contexts, by certain people, or at different times. Behavioral researchers have collectively referred to these distinct ways of looking at the same problem as a "different frame" [21,22]. The "framing effect" essentially involves the same problem being presented

using different information representations. People have been found to heavily modify, or even reverse, their decisions based on this effect [22].

Tversky and Kahneman's introduction of the Asia Disease Problem was among the earliest examples of how valence affects one's willingness to take a risk and, consequently, the malleability of human decision making. Imagine that the United States is preparing for an outbreak of an unusual Asian disease that is expected to kill 600 people, and two programs have been proposed to combat it. Scientific estimates of the consequences of each program are known. The positive frame is as follows: if Program A is adopted, 200 people will be saved; if Program B is adopted, there is a 1/3 probability that all 600 people will be saved and a 2/3 probability that no one will be saved. Under the negative frame, if Program C is adopted, 400 people will die; if Program D is adopted, there is a 1/3 probability that no one will die and a 2/3 probability that all people will die. Because Programs A and C and Programs B and D are logically equivalent, people's preferences should be identical. Their preferences also should not shift from risk seeking to risk avoidance simply because of how the problem is described. However, Tversky and Kahneman reported that 71% of participants would choose Program A rather than B in the positive frame, while 72% of participants would choose Program D rather than C in the negative frame [22].

A considerable body of work subsequently demonstrated that the framing effect is a robust phenomenon that applies to various decision-making problems [23,24]. Pertinent domains include the economy [25], lifesaving [26], resource allocation [27], and management [28]. Framing effects have also been documented in medical and clinical settings (e.g., decisions made by health care providers and patients), perceptual judgments, consumer choices, responses to social dilemmas, bargaining behavior, auditing evaluations, and many other decision types.

Kamoen et al. explored whether sports speakers' and writers' adjustments to their frame choices in athlete-related messaging affected sport fans' perceptions of athletes' performance [29]. In asking participants to rate a tennis player's previous performance, some participants were informed that the player had won 8 out of the last 10 games (positive frame), whereas others were told that she had lost 2 out of the last 10 games (negative frame). Risk was not an issue in either case, yet participants who were told success rates rather than failure rates rated the player's performance significantly [29]. These positive and negative descriptions may be truth-conditionally equivalent. Even so, research continues to indicate that the frame choice affects people's evaluations of the described entity.

2.3. Scarcity Framing and Numeracy

Scarcity is an intriguing concept to study with respect to decisions made in certain conditions. According to the scarcity principle, opportunities seem more valuable when they appear more limited [30]. Scarcity techniques predominantly fall into two categories: suppliers can either restrict the number of products/deals available (e.g., "Only 500 tickets available") or offer promotions for a limited time (e.g., "Only available for 15 days"). The fundamental principles of these messages differ. Under the quantity condition, suppliers restrict products to a limited number of available units; under the limited-time condition, suppliers encourage consumers to purchase as soon as possible to generate maximum revenue during the promotional period. The former approach creates a sense of urgency in that consumers feel as though they are competing with other buyers because the number of available products declines as others purchase [10].

Numeracy is defined as "how facile people are with basic probability and mathematical concepts" and is an important consideration in framing [31]. Individuals' perceptions of numbers, ratios, and percentages can be explored using numeracy tests, such as the Berlin Numeracy Test [32]. Other assessments emphasize statistical numeracy. Numeracy tests are especially applicable to judgment and decision-making tasks [33]. Black, Woloshin, and Welch discovered that numeracy was strongly related to understanding the benefits of mammography, which has implications for the framing of numbers [34]. In another

study in medicine, Peters, Sol Hart, and Fraenkel found that numeracy influences risk perceptions when different information frames and number formats are used to present medication risks [35].

This study attempts to replicate framing effects in the context of consumers' risk perceptions and booking behavior in the secondary sport ticket market. The researchers took the same information and presented it differently to two groups of participants and then compared participants' decisions. In some cases, the framing manipulation had no effect; when an effect was observed, the typical pattern involved either a choice reversal or a choice shift in the direction of lower willingness to take a risk when choices were framed positively than when choices were framed negatively. The authors theorized that participants' perceptions of scarcity would be influenced by the frame of the number of seats available. When framed differently under high (negative) or low demand (positive), a choice reversal was expected to occur [12].

Accordingly, the following hypotheses were empirically tested:

H3. *After controlling for the effects of purchase timing, we anticipate that seat availability framed through percentages will signal greater scarcity compared to frequency framing. Hence, we predict that participants presented with seat availability framed through percentages will have lower ETA and ELR than those presented with frequency framing.*

H4. *We further hypothesize that game demand will moderate the effect of numeracy framing. Specifically, we expect a choice reversal between high- and low-demand games. For high-demand games, we predict that frequency framing will result in lower ETA and ELR than percentage framing, while for low-demand games, we predict that percentage framing will result in lower ETA and ELR than frequency framing.*

3. Methods and Measurements

3.1. Sample and Procedures

A total of 640 participants were recruited via Qualtrics, a consumer insight panel, to complete an online survey. Participants were solicited electronically via 10 date-specific email blasts and recruited prior to a New York Giants home game on Sunday Night 17 December 2017. Participants were asked to complete two screening questions to verify that they met eligibility criteria (i.e., New York- and Philadelphia-area fans). Participants who agreed to take part in the study were next randomly assigned to a vignette ticket purchase scenario. The main study used a 2 (demand: high vs. low) $\times$ 2 (numeracy framing: frequency vs. percentage) factorial between-group design; participants were randomly assigned into five groups, including a control-group scenario. The hypothetical scenario controlled extraneous factors of seat location, time, and event date (see Figure 3). According to the scenario, participants were instructed to buy two tickets prior to the event. They were asked a pair of questions that estimated the likelihood of future events (i.e., anticipated ticket availability and the expected likelihood of finding a lower-priced deal later). These questions were followed by several demographic items addressing participants' attitudes and behavior, including their ticket purchase experience, knowledge, and fan involvement.

A between-subject design was adopted because participants were only exposed to one condition. This approach enabled the authors to ensure that participants' scores were not influenced by factors such as sensitization or realization of what was being measured, thereby increasing the possibility of eliciting sound tendencies. Participants also did not experience order effects, such as the carryover of perceived status. Systematic differences between groups were therefore minimized or eliminated in order to achieve group equivalence.

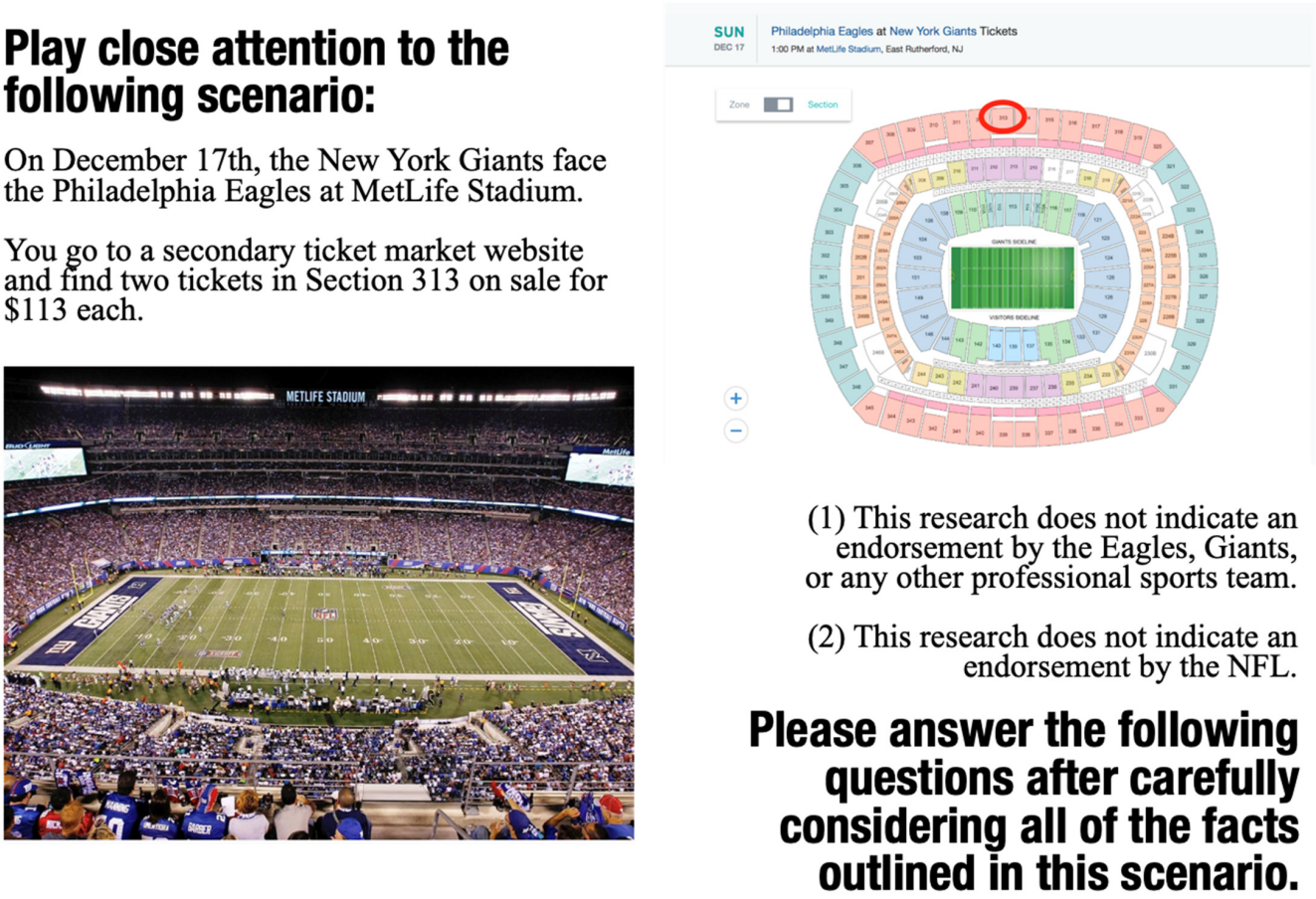

Figure 3. Vignette of Ticket Purchase Scenario.

3.2. Manipulation Check

Challenges to online survey data collection include self-misrepresentation, inattention to survey responses, and high attrition rates [36]. Several manipulation checks and screening questions were applied to uphold this study's validity. The first screening question addressed self-misrepresentation by verifying whether the participant was an actual fan of the team. Along with the geographical screening code, it was imperative to confine the sample to Giants home fans for the purpose of this study. The screening question contained a photo and asked participants to identify an all-pro wide receiver on the New York Giants. A memory recall attention check question appeared immediately after participants read the scenario description: they were asked to recall the exact price quoted in the purchase scenario and were not given the option to return to that page. Participants who responded incorrectly were directed out of the study. Attention check questions were also included in Likert-scale matrices throughout the survey. To check whether participants were paying attention as they completed the study, they were sporadically asked to either click "strongly agree" or "strongly disagree." Participants who completed the survey excessively quickly (i.e., in less than 5 min) or whose surveys were incomplete were also eliminated from data analysis.

3.3. Dependent Variable

The two dependent variables for this study were ETA (i.e., participants' assessment of expected ticket availability) and ELR (i.e., participants' perceived likelihood of finding a similar or lower-price ticket any time before the scenario date and the actual game [15]). The prompts accompanying each of these variables were as follows:

Expected ticket availability (ETA)

I believe the chance the same or very similar tickets will be available between tomorrow (DATE) and today (DATE) is _____%.

(Please indicate a number between 0 and 100)

Expected likelihood of finding a better deal (ELR)

I believe the chance that I could find the same or very similar tickets somewhere else at a price lower than $(PRICE) each between tomorrow (DATE) and today (DATE) is _____%. (Please indicate a number between 0 and 100)

3.4. Independent Variable

The independent variables were directly manipulated through vignette descriptions. Content analysis was conducted to determine the level of high demand and low demand for National Football League (NFL) games. The highest NY Giants attendance figure for the NFL season was in Week 7 (78,527 fans), while the lowest was in Week 10 (73,210 fans). The total capacity of seats at MetLife stadium is 82,500. Therefore, the high-demand condition was demonstrated through either the message "825 tickets remaining" (frequency) or "1% remaining" (percentage). Information in the low-demand condition was represented through either "16,500 seats remaining" (frequency) or "20% remaining" (percentage).

3.5. Statistical Analysis

All statistical analyses were performed in R 3.6.2 and SPSS 27. A total of 640 New York area sports fans responded to the email solicitation. Table 1 lists demographic information for the sample. Table 2 displays the number of observations corresponding to the 10 time-level treatments as well as the averages and standard deviations for each dependent variable (ETA and ELR). Perceived ticket availability was highest 10 days prior to the event (53.72%) and lowest the day before the event (37.89%). The same pattern was observed for ELR: it was highest (48.92%) 10 days prior to the event and dropped significantly to 35.88% a day before the event. In general, as the event date drew closer, participants' perceived probability of ticket availability and the likelihood of finding a lower-priced ticket declined significantly (view Figure 4).

Table 1. Sample Demographics.

Age	33.674, Mean	**Ethnicity**	76.3%, Caucasian
	11.792, St. Dev		12.3%, Hispanic
Gender	69.1%, Male		6.1%, Asian
	30.9%, Female		5.3%, Other
Household Income	12.5%, Less than USD 20 K	**Education**	21.5%, High school
	20.7%, USD 20 K–USD 40 K		4.1%, Bachelor's degree
	22.9%, USD 40 K–USD 60 K		18.0%, Graduate degree
	24.7%, USD 60 K–USD 80 K		16.5%, Professional degree
	15.0%, USD 100 K–USD 200 K		7.7%, Other
	3.4%, More than USD 200 K		9.0%, Did not specify

Multivariate analysis of variance (MANOVA) was performed to discern overall differences in the mean likelihood scores of the dependent variable between groups. MANOVA is appropriate when multiple dependent variables are moderately correlated [37]. Two 2×2 factorial analyses of variance (ANOVAs) were carried out to identify differences in the mean assessments for each treatment. The main effect results were then analyzed to determine whether the structural framing of numeracy scarcity and price anchoring affected participants' probability estimations of uncertainty (i.e., ETA and ELR). Tukey's post hoc tests were further conducted to detect which combined treatment level generated significant differences compared with other groups. Additionally, because the same dependent variables were used in two separate procedures, a Bonferroni adjustment was made. The significance value was set at 0.025 to account for all main effects.

Table 2. Estimates of ETA and ELR by Days Leading up to the Event.

		Expected Ticket Availability		Expected Lower Rate	
Days Before the Game	**Number of Observations**	**Average (%)**	***SD***	**Average (%)**	***SD***
10	40	53.72	28.88	48.92	29.19
9	80	52.13	24.09	48.13	23.57
8	54	50.33	25.85	46.22	28.49
7	48	46.22	28.47	44.93	28.83
6	71	47.36	28.95	42.53	24.32
5	80	50.08	29.97	43.98	27.65
4	56	48.73	29.81	44.94	28.42
3	60	40.33	22.68	44.31	24.18
2	76	40.81	27.98	38.63	29.21
1	76	37.89	28.15	35.88	29.75

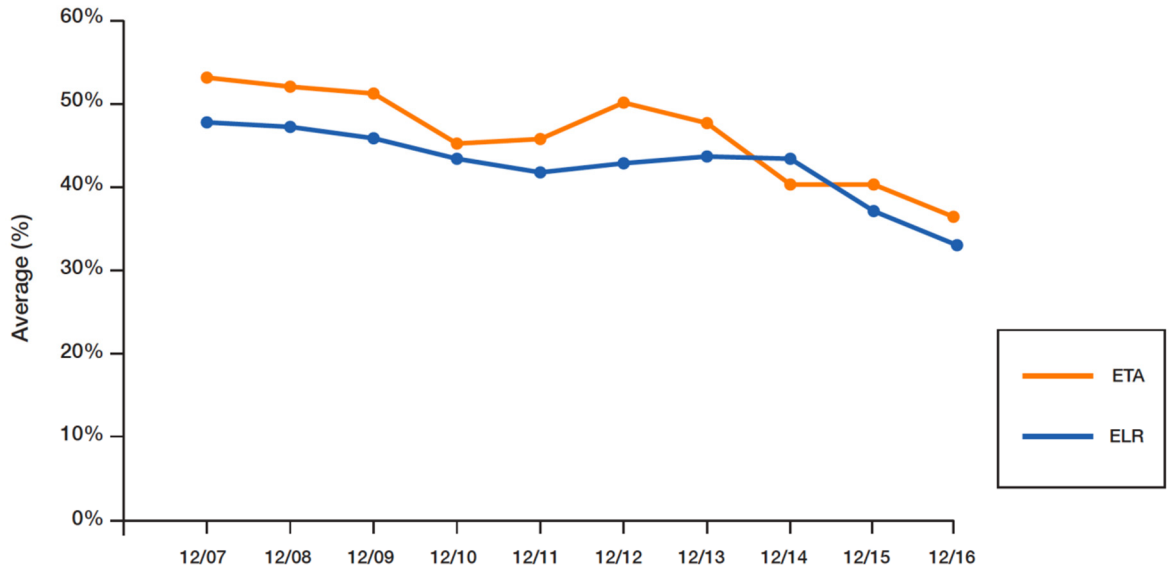

Figure 4. Graphical Trends in ETA and ELR Estimates by Days Leading up to the Event.

4. Results

Based on Wilks' statistic, the MANOVA revealed a significant effect of time period on participants' ETA and ELR assessments ($\Lambda = 0.954$, $F(18, 1262) = 1.653$, $p < 0.05$). The descriptive statistics for the dependent variables are reported in Table 2. The effect size, measured using partial η^2, was 0.023.

Table 3 provides the main effect results for game demand and scarcity framing. The main effects of scarcity framing on ETA and ELR (per a factorial ANOVA) showed statistically significant differences (ETA: $F(1420) = 19.040$, $p < 0.001$; ELR: $F(1420) = 21.418$, $p < 0.001$). The proportion of participants provided with the "raw numbers" frame (52.13%, $n = 213$) who felt that the same or similar tickets would be available between the scenario date and the game day exceeded the proportion of participants provided with the "percentage" frame (40.63%, $n = 208$). Meanwhile, more participants given the "frequency" frame (50.38%, $n = 213$) expected to find a similar or lower-priced deal versus participants in the "percentage" condition (38.33%, $n = 208$).

A factorial ANOVA of the main effects of game demand on ETA and ELR again unveiled significant differences (ETA: $F(1420) = 5.359$, $p < 0.05$; ELR: $F(1420) = 2.672$, $p < 0.1$). On average, the proportion of participants shown the "low" game demand scenario (51.24%, $n = 203$) who perceived the same probability that identical or similar tickets would be available between the scenario date and the game day exceeded that of participants shown the "high" game demand scenario (42.08%, $n = 218$). Participants in the "low" game demand

scenario (46.61%, n = 203) expected the probability of finding a similar or lower-priced deal to be higher than those in the "percentage" condition (37.14%, n = 218).

Table 3. Estimates of ETA/ELR by Game Demand and Scarcity Framing.

		Expected Ticket Availability		Expected Lower Rate	
Scarcity Framing	**Number of Observations**	**Average (%) [a]**	***SD***	**Average (%) [b]**	***SD***
Raw Numbers	208	52.13	26.46	50.38	27.23
Percentages	213	40.63	27.57	38.33	25.87
		Expected Ticket Availability		**Expected Lower Rate**	
Game Demand	**Number of Observations**	**Average (%) [c]**	***SD***	**Average (%) [d]**	***SD***
Low	203	49.50	30.32	46.52	29.24
High	218	43.35	25.58	42.21	25.50

[a] Main effects result, $p < 0.001$. [b] Main effects result, $p < 0.001$. [c] Main effects result, $p < 0.05$. [d] Main effects result, $p < 0.10$.

The interaction effect was statistically significant in terms of the moderating impacts of game demand and scarcity framing on participants' ETA and ELR (ETA: $F(1420) = 0.142$, $p < 0.01$; ELR: $F(1420) = 0.036$, $p < 0.01$). In the high-demand scenario, the frequency frame was associated with lower ETA (37.89%; ELR: 35.64%, n = 106) than the percentage frame (ETA: 49.03%; ELR: 49%, n = 112). The opposite effect applied in the low-demand scenario, where the percentage frame led to lower ETA (43.65%; ELR: 41.26%, n = 101) compared with the frequency frame (ETA: 55.40%; ELR: 51.84%, n = 102).

5. Discussion

This study investigated the impacts of purchase timing and the framing effects of scarcity in the advanced-booking setting of a professional sport event. Event game demand was taken as a potential moderator between scarcity framing and consumers' estimations of ticket availability and finding lower-priced deals. Results suggest that, as the amount of time before the event decreased, participants' estimations regarding ticket availability and finding a lower price declined significantly. In addition, participants who were presented with a high-demand game scenario had lower estimations of ticket availability and the likelihood of finding a lower price overall than those given the low-demand scenario. Participants in the latter condition who were presented with the percentage frame also had lower ETA and ELR risk estimations than participants given the frequency frame. Contrarily, respondents in the high-demand game scenario who were exposed to the frequency frame displayed lower risk estimations for ETA and ELR.

5.1. Theoretical Implications

With respect to theoretically extending the generic advanced decision-making model, Dwyer et al. called for future sport marketing research to include data from multiple time points to determine why consumers' perceptions of ticket prices and availability change [15]. This study directly responded to this recommendation by collecting data across a 10-day time frame and testing the influence of purchase timing on consumers' perceived risk in an advance ticket purchase environment. In addition, the distinct impacts of scarcity framing and observed choice reversal on consumers' perceptions of price and availability offer novel empirical insight to the advance ticket purchase literature. Numeracy framing effects have been replicated in multiple disciplines. However, these consequences have received thin coverage in the sport context. This study revealed statistically significant differences in participants' estimations via seat availability framing.

Several possible explanations exist for this choice reversal phenomenon via numeracy framing. Perhaps sport fans generally do not prioritize numeracy and thus opt not to closely consider total seat capacity when forming scarcity perceptions about high-demand

games. Alternatively, when game demand and risk are both low, seat availability provided as a percentage may simply serve as more information to guide fans' decisions. Choice reversal could also be a function of the number-size framing effect; for example, people are more sensitive to the change from 1 to 2 than to the change from 101 to 102. Although the size of this change is the same (i.e., an increase of one), larger numerical percentages framed on a scale from 0 to 100 may elicit more sensitivity than frequencies expressed from 0 to 100,000. These conjectures are beyond the scope of this work and require further study. It is nevertheless important to note that the order of risk perceptions was reversed based on expected game demand. Are these results unique to the contexts of sport tickets and the secondary ticket market? Replication with different product types and industry domains is strongly suggested to answer this question.

5.2. Practical Implications

Practically speaking, the results related to time and consumers' advance purchases in the secondary ticket market can offer an auction type simulation that may be useful for teams implementing dynamic ticket pricing in the primary market. Drayer found that primary market ticket prices gradually increased as the game drew closer; in the secondary ticket market, prices rose initially (approximately a month before the game) and dropped considerably leading up to game time [7]. Sport organizations might apply these tactics to protect the integrity of their ticket prices and encourage advance sales. At the same time, this strategy effectively ignores consumers' expected valuation of the ticket market over time as seen in the present study. The sport industry is moving toward customer-focused pricing rather than previously popular markup pricing to cover organizational costs [7]. Sport marketers must continue to balance traditional ticket sales strategies with an understanding of consumers' responses to ticket-purchase stimuli in the digital box office environment.

Moreover, sport marketers should vary and optimize seat availability messages (e.g., based on high vs. low demand) to amplify buyers' sense of urgency and capitalize on FOMO marketing opportunities in digital environments. As mentioned in the introduction, sport ticket purchases have shifted to mobile settings. UI has thus become a prime factor in businesses' success. Companies such as Gametime have oriented themselves nearly entirely around mobile-based ticketing for millennials. For many teams, leagues, and ticket sellers, the millennial audience represents from one-quarter to one-third of their overall revenue base. According to Ticketmaster's study on "Ticket Buying Among Millennials" (constituting Ticketmaster's largest customer segment and one-third of its event database), these consumers are 40% more likely to turn to another website for tickets [38]. They are also 26% more likely than other consumer groups to use the secondary market. Individuals are irrational decision makers, including when deliberating on sport ticket purchases: consumers do not have infinite time to search for the best deal and compare prices. Many systemized decisional biases exist beyond framing effects as well. These biases concern price anchoring [39] and reference pricing [40] along with time pressure and asymmetric dominance [41]. Secondary ticket market platforms can further test and strategically implement these options in their marketplaces as appropriate.

5.3. Limitations and Future Research

Although this study offers several practical implications, limitations should be noted. First, the experiments featured a Sunday Night game with a 7 PM ET kickoff time and a competitive NFC East divisional rivalry (NY Giants vs. Philadelphia Eagles). To demonstrate framing effects, it was essential to tightly control the potential impacts of extraneous variables to best focus on the proposed relationships. Yet, multiple questions remain. To what extent might these game attributes affect the experimental results? For example, would findings have differed for a single-header Monday, Thursday, or Sunday Night Football game? What if the teams were less popular? Gierl, Plantsch, and Schweidler did not find significant variation between famous brands and fictitious generic brands in their

quasi-experimental study [42]. However, researchers should explore how seat location, featured primetime scheduling, and consumers' brand attachment to a specific team may moderate the levels of risk perceptions on ticket availability and lower prices.

Another potential limitation of this study entailed the NFL context. Fans have the opportunity to attend a set number of games per season: each team hosts 10 home games for 17 weeks. Compared with the National Basketball Association (41 home games for 19 weeks) or Major League Baseball (81 home games for 26.5 weeks), the baseline scarcity for each NFL home game is higher. Game attendance tends to be high for NFL games, hence why ETA and ELR measures are higher than for other sport events. Scholars should compare the impact of time on ticket purchase risk perceptions across professional sport leagues to identify contextual differences.

Lastly, the study sample consisted solely of New York and Philadelphia area sport fans to understand their decision-making processes and booking behavior. As avid devotees to their home team, fans are primarily motivated by FOMO around being able to support their favorite team and players. Controlled sampling (e.g., by eliminating non-fan consumer segments) clarifies the role of context on the variables under examination but tempers results' generalizability. Actively engaged players also exist in the secondary market, chiefly casual sales prospects (i.e., people who and who are not avid fans but instead see a ticket purchase as a profit-earning opportunity). Decision agents driven by disparate objectives will likely evaluate risk (ETA and ELR) uniquely in the advance-purchase environment. Subsequent work should analyze how the generic advanced decision-making model may fit with these contrasting consumer segments.

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Conflicts of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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