






REVIEW ARTICLE



<https://doi.org/10.1057/s41599-023-02011-3>

OPEN

A systematic review of intention to use fitness apps (2020–2023)

Salvador Angosto ^{1,2}, Jerónimo García-Fernández ^{2,3}✉ & Moisés Grimaldi-Puyana ^{2,3}

Technology advances and digital transformation are constantly growing, resulting in an increase in the number of sports-related technologies and apps on the market, particularly during the COVID-19 pandemic. The aim of this study is to update a comprehensive evaluation of the literature published since 2020 on the desire to use and embrace fitness and physical activity-related apps. Using the PERSiST adapted from the PRISMA 2020 statement, a total of 29 articles that provide assessment models of sports consumers' desires to utilise fitness applications were discovered. Several major conclusions emerge from the findings: (1) the use of alternative models to the Technology Acceptance Model has increased in recent years with new theories not derived from that model now being associated with it; (2) studies in Europe are increasing as well as a specific interest in fitness apps; (3) the UTAUT and UTAUT2 model are more widely used within the sport sector and new models appear connected with behaviour intentions; and (4) the number of exogenous and endogenous variables that are linked to the main technology acceptance variables and their behavioral intentions is diverse within the academic literature. These findings could help technology managers to increase user communication, physical activity levels and participation in their fitness centres, as well as to modify the policies and services of sports organisations.

Introduction

In recent years, the number of smartphone users has steadily increased throughout the world, with nearly half of the population now owning a device (Newzoo, 2021). As a result, the smartphone is quickly becoming a vital instrument in the lives of the general public (Byun et al., 2018). This digital change can also be found in the sports and fitness industry, where the digital explosion in the usage of smartphones and wearables has allowed fitness apps to become one of the market's most important categories (Jones et al., 2020).

Fitness apps are swamping the mobile app market (Beldad and Hegner, 2018), with almost one in every five users downloading this type of app on their device (Fox and Duggan, 2021). Due to the lockdown placed on people and the requirement to stay at home, the demand for fitness apps has grown significantly since the onset of the COVID-19 pandemic (Clement, 2020;

¹Department of Physical Education and Sports, Faculty of Sports Sciences San Javier, University of Murcia, 30720 Santiago de la Ribera (Murcia), Spain.

²Department of Physical Education and Sports, Faculty of Educational Sciences, Universidad de Sevilla, 41013 Seville, Spain. ³These authors jointly supervised this work: Jerónimo García-Fernández, Moisés Grimaldi-Puyana. ✉email: jeronimo@us.es

Ting et al., 2020). A fitness app is a third-party programme for smartphones or wearables that may help consumers in recording physical activity data, guiding sports learning and leading a healthy lifestyle (Eshet and Bouwman, 2015). A recent study conducted a social comparison of fitness-related posts on social media platforms by fitness app users. Specifically, Kim (2022) found that when fitness comparison decreased there was a decrease in user self-efficacy towards physical activity, whereas if fitness comparison increased, self-efficacy towards physical activity increased. Consequently, Kim (2022) highlighted that self-efficacy is a key element for fitness app users' motivation and participation in physical activity, and they should be compared to high-performing individuals. In addition, gamification is another important element concerning fitness apps for user satisfaction, and a specific design adapted to the type of user is necessary given the number of existing elements in gamification, highlighting feedback and rewards (Yin et al., 2022).

The popularity of fitness apps has grown over the years, coinciding with a greater understanding of the value and advantages of physical activity and a healthy lifestyle (Lim and Noh, 2017). Fitness apps have become a trend in the worldwide fitness sector, resulting in new patterns of training behaviour (Hu et al., 2023; Kercher et al., 2022; Thompson, 2022). These new behaviour patterns are connected to physical activity monitoring, a shift in health-care perceptions, and changes in lifestyle habits (Lin et al., 2019). Middelweerd et al. (2014), for their part, emphasise that fitness apps employ many behaviour modification approaches such as goal planning, self-control, feedback, the use of contingent incentives and social support.

In the fitness context, it is also important to address the importance that apps can have in the management of sports centres as a two-way communication tool between the organisation (managers or trainers) and users. In this way, Ferreira-Barbosa et al. (2021) consider that the use of notifications and communications through the fitness app costs less and produces a greater and better interaction with the client. Thus, the use of applications in fitness centres can enable more direct and dynamic communication with users, providing a better and more personalised service.

Despite this, while studies have begun to find the factors that lead to the desire of using technologies such as apps in numerous fields (Gao et al., 2012), a deeper knowledge of the intention to use using certain apps is required (Cho et al., 2020). As a result, there are several theoretical frameworks in the scientific literature that explain the acceptance of new technology by sports customers. This 'acceptance of technology' refers to an individual's readiness to adopt technology (Dillon, 2001).

The technology adoption model (TAM) developed by Davis (1989) and Davis et al. (1989) is the principal model utilised in most research to quantify consumer acceptance of new technologies. The TAM assumes an extension of Ajzen and Fishbein's (1980) Theory of Reasoned Action, in which the behavioural intention is decided by the attitude towards this conduct (Davis, 1989). According to this author, attitudes are developed around two beliefs: *perceived usefulness* (PU) and *perceived ease of use* (PEOU). PU is described as the individual's belief about the worth of a system, such as its performance or efficiency, in order to gain an advantage, while PEOU is defined as the degree to which the individual believes that the system requires no physical or mental effort and is easily accessible (Davis, 1989; Davis et al., 1989). PU and PEOU provide for the prediction of user intentions in relation to the adoption of both devices and mobile apps (Kim et al., 2016; Koenig-Lewis et al., 2015). The TAM has been employed in a variety of areas, including finance, tourism, gaming, health and sports (Rivera et al., 2015).

A number of TAM-based theories have been established, including the technology readiness and acceptance model

(TRAM), which is derived from the TAM and the "Technology Readiness" (TR) model. Parasuraman (2000) created the TR with the goal of reflecting consumers' views and dispositions to implement new technologies, linking their usage with the fulfilment of personal or work objectives. The TRAM has been used in a variety of apps, including social innovation (Rahman et al., 2017), branding (Jin, 2020) and sports technology (Kim and Chiu, 2019). Venkatesh and Davis (2000) introduced the TAM2 model, which integrates social influence and cognitive belief processes. Other models developed from the TAM are those proposed by Venkatesh et al. (2003), who suggested the Unified Theory of Acceptance and Use of Technology (UTAUT), its extension called UTAUT2 proposed by Venkatesh et al. (2012) and UTAUT3 proposed by Farooq et al. (2017). These theories are concerned with both customers and users (Ferreira et al., 2021). According to Venkatesh et al. (2003), the UTAUT model identifies four elements that influence 'intention to use': (i) *performance expectancy* (PE), or the degree to which individuals believe that using the system will allow them to improve their work performance; (ii) *effort expectancy* (EE), or the degree to which individuals believe that using the system will allow them to improve their work performance; (iii) *social influence* (SI), defined as the degree to which individuals believe that their social referents believe that they should use the system; and (iv) *facilitating conditions* (FC), identified as the degree to which the individual believes in the existence of a technical and organisational benefit.

In addition to the four factors derived from the UTAUT model, the UTAUT2 approach integrates three additional variables (Venkatesh et al., 2012): (i) *hedonic motivation* (HM), which reflects the individual's intrinsic motivations for accepting new technology; (ii) *price value* (PV) considered as acceptance of the cost involved in using new technology; and (iii) *habit* (HA) or the degree to which the individual tends to use the new technology automatically after a learning process. Regarding the UTAUT3 model, Farooq et al. (2017) introduce a new variable, Personal Innovativeness (PI). Dutta et al. (2015) indicate that personality traits, such as PI, play an essential role in Information Technology (IT) adoption. As a trait, PI is stable and situation-specific and has a high tendency to influence IT adoption and acceptance (Farooq et al., 2017; Thatcher and Perrewé, 2002). Thus, PI can be defined as the perceived predisposition or personal attitude of individuals that reflect their tendency to independently experience and adopt new developments in IT (Schillewaert et al., 2005). This means that PI can be conceptualised as the willingness to adopt the latest technological gadgets or be linked to trying out new IT features and developments (Farooq et al., 2017).

Figure 1 shows the conceptual model of the different theories discussed (TAM, UTAUT, UTAUT2, UTAUT3). The UTAUT and the UTAUT2 models were performed to investigate consumer acceptance and usage of new technologies (Beh et al., 2021), and have been used in a variety of research in the sports, fitness and wearable sectors (Beh et al., 2021; Dhiman et al., 2020; Yuan et al., 2015). However, the UTAUT3 model has not yet been used in the sport context, but it has been employed in other contexts such as tourism (Pinto et al., 2022), virtual communication (Gupta et al., 2022) and education (Gunasinghe et al., 2020).

In conclusion, despite the recent systematic review conducted by Angosto et al. (2020) on research that examined the intentions to use and implement apps in the fitness and health sector, or a recent meta-analysis of the Intention to use wearable devices in health and fitness (Gopinath et al., 2022), more research is needed. Regarding the need for a new review update, this is necessary for three reasons: (a) the previous review developed by Angosto et al. (2020) has some shortcomings that will be addressed in the

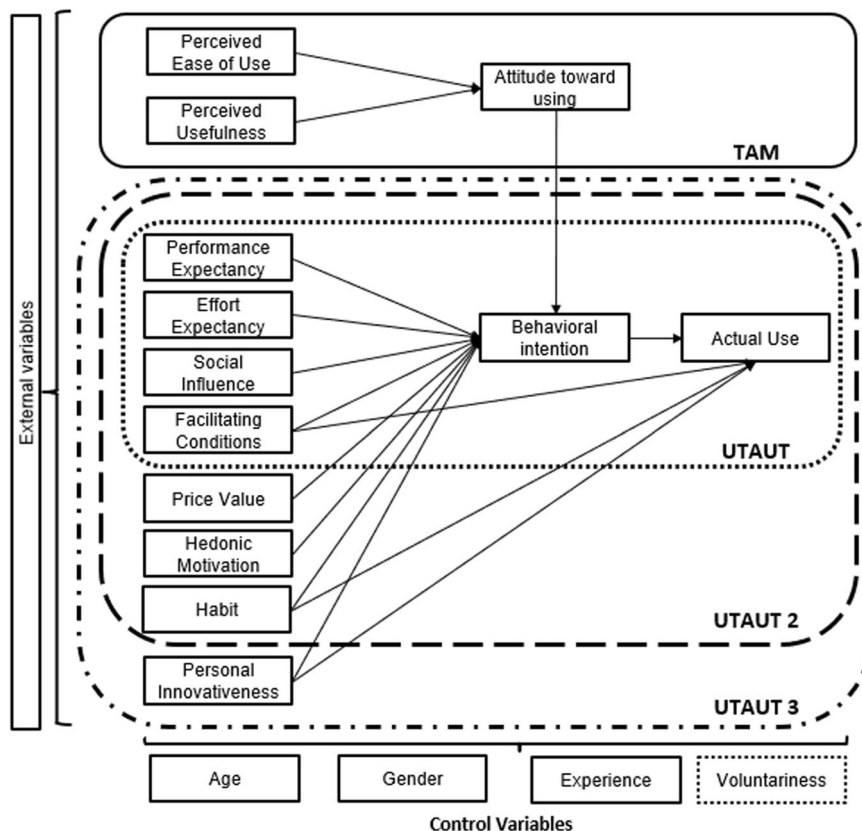


Fig. 1 Conceptual model of the different theories. TAM (Davis, 1989), UAUT (Venkatesh et al., 2003), UAUT2 (Venkatesh et al., 2012), UTAUT3 (Farooq et al., 2017). Source: Own elaboration.

discussion; (b) to analyse the evolution of TAM-derived models such as UTAUT, UTAUT2 or UTAUT3; and (c) the previous review was conducted just before the COVID-19 pandemic, a period in which digitalisation underwent a major evolution to respond to the needs of society. The pandemic has impacted the need to adopt modern technology to monitor, record and control physical activity for both people and sports groups (Núñez Sánchez et al., 2022; Ruth et al., 2022). As a result, the study’s aim is to perform a comprehensive systematic review that updates the number of studies that have investigated the intention to use or adopt fitness apps from 2020 to May 2023.

Methods

Review design and protocol. The Prisma in Exercise, Rehabilitation, Sports Medicine and Sports science (PERSiST) guidelines (Arderm et al., 2022) based on the sports science adaptation of the Prisma 2020 statements (Page et al., 2021) were followed for this systematic review. The systematic review was not registered on the PROSPERO platform because, not being in the field of health, it did not meet the requirements for registering the systematic review protocol. Therefore, a prior search protocol was not established and all aspects were marked directly in the methodology of this study.

Inclusion and exclusion criteria. This systematic review includes empirical research published in peer-reviewed journals. However, grey literature was excluded, as were assessment reports, periodic reports, dissertations, abstracts and other forms of publishing. The following criteria were used to include studies in the search: (i) peer-reviewed journal articles; (ii) usage of any form of sports and fitness app; (iii) assessment of the intentions using the app

Table 1 Database search strategy.	
Category	Search terms
App	(smartphone* OR "Smart phone*" OR "smart-phone*") ("mobile phone*" OR "mobile-phone" OR "mobile device") (App OR Application* OR "mobile App*")
Sport	("physical activit*" OR exercise*) (fit* OR Fitness OR "sport*" OR sport)
Use	("intention to use" or "App* usage" or "intent* to use" or usage) (Technology Acceptance Model OR TAM OR UTAUT OR UTAUT2)

through a survey and (iv) publications in English and Spanish. The following items were excluded: (i) books, book chapters, congress proceedings, or other forms of publications; (ii) qualitative approaches, theoretical research, or reviews; (iii) studies written in a language other than English or Spanish; (iv) no mobile apps were utilised in the sports environment; and (v) duplicate articles.

Search strategy. Table 1 shows the categories of terms that were utilised in the search across multiple databases. Six databases were chosen in an attempt to cover a wide variety of topics linked to this multidisciplinary study, such as sports science, health, psychology and marketing. The databases employed were Pubmed, Web of Science, PsycINFO, Scopus, ABI/Inform and SPORT-Discus. The search lasted from December 27, 2021, through May 26, 2023. The search included all years and there were no

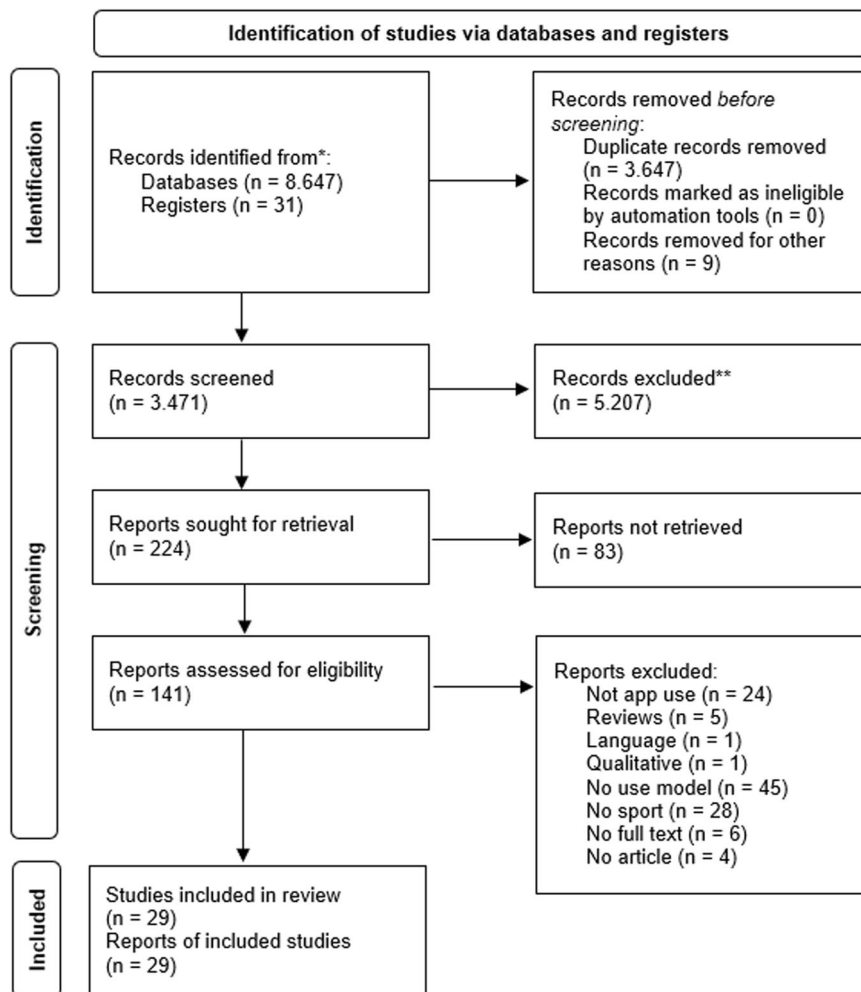


Fig. 2 PRISMA 2020 flow diagram. This conceptual diagram shows the protocol of the systematic review process (Page et al., 2021).

restrictions on document type or language from 2020 to the present, considering the previous work by Angosto et al. (2020).

Figure 2 illustrates the flow chart of all the points proposed by the PRISMA 2020 methodology for conducting systematic reviews (Page et al., 2021). The first database search found 8647 records, which were reduced to 3471 once duplicates were removed. A thorough scan of titles and abstracts was carried out by one reviewer, in addition to a full-text review of the selected studies after applying the inclusion and exclusion criteria. A second reviewer evaluated the abstracts of the publications that remained at the abstract level ($n = 12$) to check their eligibility, and there were no disagreements with the first reviewer.

Assessment of methodological quality. The methodological quality analysis was tested using a rating scale measure of 20 items developed by Angosto et al. (2020) in the sport consumer research type framework where there were no intervention methods on the themes of the CONSORT checklist (Schulz et al., 2010). Two reviewers independently assessed each study by examining the multiple elements that make up an investigation. Each element scored one point if the study met the criterion satisfactorily or zero if the research did not meet the criterion or if the element was not applicable to this study. When disagreement emerged, the reviewers resolved this by re-examining the study until an agreement was reached. Supplementary Table S2 (see the section “Data availability”) indicated the methodological quality evaluation results for each research.

Data extraction. For data extraction, an Excel form was created that includes the following characteristics: (a) publishing year; (b) *country of study*, country of the institution of the first author of the study; (c) *number of participants*, total of the sample used in the study; (d) *gender*, percentage of males and females in the sample; (e) *age of participants*, average age or age ranges of the study sample; (f) *type of Application evaluated*, fitness or sport apps and their combination with other types of apps such as health or diet apps.; (g) *theory used*, evaluation model used in the study; (h) *analyses performed*, types of analysis used in the results; and (i) *variables included*, assessed variables included in the model proposed in the study. Supplementary Table S3 (see the “Data availability” section) showed the individual data of each study.

Results

Analysis of the assessment of methodological quality. To assess methodological quality, the analysis of the 29 research papers reviewed in the study (Supplementary Table S2) found that 16 studies had the best rating of 15 points or more out of a possible 20. There have been 12 studies with an average score between 10 and 15 points, and one research had a score of <10 points (Jeong and Chung, 2022). It should be noted that none of the studies reviewed estimated the sample needed for the generalisability of the results, which could be attributed to the fact that all the studies selected their samples by convenience within a certain group. Furthermore, none of the research defined

inclusion criteria for the sample selection. Three studies revealed which author performed each phase of the study (García-Fernández et al., 2020; Vinnikova et al., 2020; Yu et al., 2021), and nine studies indicated whether or not they received funding.

Summary of reported intervention outcomes. Supplementary Table S3 shows the descriptive data taken from each research. According to the findings, this issue of assessing the intention to use applications in the sports marketing industry has garnered considerable attention in recent years. A total of 29 research works were chosen, based on the studies published following the systematic review conducted by Angosto et al. (2020) that focused on the quantitative evaluation of the intention to use sports applications, using either paper-based or online surveys. The results showed that 2022 was the year with the highest number of publications ($n = 12$), while nine articles were published in 2021, there were five articles published in 2020 and three articles in 2023. The location of the research revealed that 64% of the total articles published were from Asia ($n = 18$), ~32% were from Europe ($n = 9$) and 4% were from America ($n = 1$). Among the countries with the highest number of publications, the following should be highlighted China which had the most papers, with six, followed by Spain with four articles, and Hong Kong, Taiwan, and Germany, each with three articles.

A total of 22,942 respondents were examined in the sample of studies, with a range of total size between 200 and 8840 participants, and an average of 791.1 participants per research work. With respect to the type of the sample, the vast majority considered fitness users or community members, with ten and nine articles respectively. To a limited extent, the authors used students ($n = 6$) or the general population ($n = 2$). The socio-demographic data of the sample revealed that the majority of the studies had a greater proportion of females than males ($n = 18$), with an average of 46.1% males and 53.1% females. Seven articles indicated the average age of the participants, with an average age for all 30 years old. A total of 19 articles indicated age by range, with 10 articles having a higher proportion of young people under 30 years, eight articles having a higher population between 30 and 50 years, and one article with a majority of participants over 50 years. Two articles did not indicate age in any of the above ways. Regarding the type of apps used within the sports context, they were fitness apps used in sports centres ($n = 18$), followed by sports apps ($n = 6$), four used apps that also had a health aspect and one included diet-related aspects.

Analysing the theoretical background on which the authors have based their studies, the use of the TAM model still stands out ($n = 12$), and there was an increase in the number of articles that used the UTAUT or its derivatives (UAUT = 4; UTAUT2 = 6). In addition, three studies were based on another TAM-derived model, TRAM, while one article relied on the expectation-confirmation model (ECM), or the theory of normative social behavior (TNSB), and another study encompassed several models such as the theory of consumption values (TCV) and the theory of perceived risk (TPR). When examining the link between the various constructs studied, 25 studies used structural equation analysis (SEM), while one used regression analysis and another used correlation analysis. The SEM analysis was carried out using the PLS and AMOS statistical tools.

One issue to take into account in the variables used is that intention to use (ITU) is a common variable as it is a criterion for inclusion. Although the intention to use is referred to in many different ways, the concept is the same. The results show that more than 40 variables have been directly or indirectly associated with UTI in the different articles published. The most analysed variables are those that form the basis of the TAM. PU or PE was

another of the most important factors analysed together with UTI, appearing in 26 articles, followed by PEOU or EE, which was evaluated in a total of 23 articles. Among the most frequently used variables associated with the different models were Perceived Enjoyment (PEN) in eight articles, Satisfaction (SA) in five articles, Innovativeness (INN) in four studies, and Health Consciousness (HC), Optimism (OP) and Subjective Norms (SN) with three articles each.

The constructs associated with the UTAUT or UTAUT2 models have also been studied in almost all the articles that have considered these models. Among them, the use of SI stands out in eight articles, while other factors such as HA, HM, or FC have been analysed in five studies and PV in four studies. Other variables associated with the UTAUT or UTAUT2 models include Self-efficacy (SE) in four articles, and PI, perceived playfulness, goal setting, attractiveness, privacy protection and barriers in one article. Other factors linked with other models that have been studied once were Insecurity, Discomfort, Need for interaction, Personal attachment, Word-of-mouth, Commitment and Quality aspects or Motivations. Appendix B shows all the variables analysed in each individual study.

Finally, considering the main results, it has been shown that, although the TAM factors (PU and PEOU) are widely studied and evidence has been found of the influence of both on UTI and PEOU on PU, there are many factors that also both directly and indirectly influence, using these two constructs as mediators of UTI. For example, PEN is a variable that eight studies have found to influence UTIs. SI and HA were other factors that also significantly influence UTI ($n = 5$ for each one). Other elements from the UTAUT/UTAUT2 models that have also been shown to influence UTI, to a lesser extent across studies, have been PV ($n = 3$), FC ($n = 2$), and HM ($n = 3$). Other aspects external to the TAM-based models that directly and significantly influence ITU were Innovativeness, Subjective Knowledge, Trust, Commitment, Perceived Playfulness, Health Consciousness, Personal Innovativeness, Autonomous Motivation, Self-efficacy, Attractiveness, Perceived Privacy Protection, Subjective Norms, Goal Setting, Risk Perception, Physical Appearance, Affiliation, Condition, Privacy Risk and Security Risk.

As for the indirect effects of the external variables considering PEOU/EE, PU/PE, or PEN as mediating variables, the influence of factors common to these three variables such as Innovativeness, Insecurity, Optimism, Perceived Attractiveness, Information Quality, and System Quality has been evidenced. Other external factors that significantly influenced both PEOU/EE and PU/PE were Subjective Knowledge, Task-Technology Fit, Accuracy, SE, PEN and Subjective Norms. While certain factors only influenced some of the variables considered, especially PU/PE, which was influenced by a greater number of external variables (Discomfort, Confirmation of Expectations, Trustworthiness, Perceived Benefits, Risk Perception, Perceived Threats), PEN only influenced Discomfort and PEOU/EE e-Lifestyles. Therefore, it was observed that there is no consensus in the scientific literature when it comes to addressing common external variables for further research in several contexts.

Discussion

The aim of this systematic review was to update research that has analysed the intention to use or adopt fitness apps from 2020 to May 2023, following the study conducted by Angosto et al. (2020). It is relevant to highlight the differences between this review and the previous one by Angosto et al. (2020). For this purpose, it is important to consider the review of studies that used UTAUT or UTAUT2 developed by Venkatesh et al. (2016) as a model. In this review, the author argues the need to expand

existing reference models with new exogenous, endogenous, moderating, or outcome mechanisms, as well as theorising influences at different levels. As a clear example in this line, the author himself increased the number of endogenous variables of the UAUT model including HM, PV and HA resulting in the UTAUT2 model or, in the case of Farooq et al. (2017), incorporating PI to obtain the UTAUT3 model. In addition, Davis (1989) proposed the initial TAM model by inducing external or exogenous variables in order to be able to analyse in different contexts.

Based on these aspects, the review previously carried out by Angosto et al. (2020) presents a clear limitation as it only focuses on analysing the influence of TAM or TAM2 factors, omitting the possible influences of exogenous, endogenous, or moderating variables. In this way, it should be noted that these authors do not carry out an in-depth analysis of user behaviour and its effects (both direct and indirect) that influence the ITU fitness app. On the other hand, another error is observed because the authors discriminated the variables of the UTAUT or UTAUT2 models, only focusing in the end on the studies based on TAM, TAM2, or TRAM. Therefore, when they conducted their analysis on the influence of variables, they omitted data from these studies as well. It should be noted that the UTAUT and UTAUT2 models are based on TAM, thus PE is the equivalent of PU, while EE is the equivalent of PEOU.

In view of the previous reasons, together with the period experienced by the world population as a result of the COVID-19 pandemic, it is necessary to update the previous review carried out by Angosto et al. (2020). It should be remembered that during the pandemic the population was forced to be confined to their homes. This has represented a milestone in the digitalisation of society and sports and fitness services. In fact, it can be observed that while in the review by Angosto et al. (2020), the authors identified 19 articles, from the beginning of the pandemic to the present day this review has found a total of 29 articles that met the inclusion/exclusion criteria. In short, the number of publications has more than doubled in the last three years. It is true that five research works overlapped with the prior review, which might explain why these studies were published in the press, and by assigning them a journal number, they seem published at a later date. This review emphasises the significance of this topic's rising popularity in the fitness sector from several domains such as sociology, psychology and management (Cai et al., 2022).

To summarise, the results of this review and the previous review by Angosto et al. (2020) will be compared. In general, regarding the location of the studies, an increase in the number of studies conducted in Europe was observed compared to the previous review (Acikgoz et al., 2022; Baubonytė et al., 2021; Damberg, 2021; Ferreira et al., 2021; García-Fernández et al., 2020; Gómez-Ruiz et al., 2022; Pérez-Aranda et al., 2021; Schomakers et al., 2022; Yang and Koenigstorfer, 2021), and a decrease in the number of studies in the Americas (Won et al., 2023). Concerning countries, there is an exponential increase in the number of studies conducted by authors in Chinese universities and, when compared to the previous review, there is a majority of studies from South Korea.

In relation to gender, both reviews obtained similar results in which the proportion of female participants was higher than male participants in most of the studies. Although the gender of the customers or users studied was primarily female, Baubonyte et al. (2021) believe this to be rather immaterial in research that compared the intention to use new technologies based on gender. When the mean age was analysed, this review showed that the mean age of the participants was around 30 years old, while in the review by Angosto et al. (2020), this was 24 years old. Also, it should be noted that the age groups with the highest

representation and the highest proportion of users were either very young (<23 years) or adult (30–50 years), while in this review most studies have a higher proportion of the population under 30 years versus adults. The reason for these results may be due to the fact that females tend to prioritise collective practice over individual practice (Vogler et al., 2008), and therefore there is a higher proportion of users of fitness centres or communities, while young people present fewer digital barriers when it comes to using apps than, perhaps, the adult population (Schreurs et al., 2017).

Depending on the type of app analysed in the different studies, variations have also been observed with respect to the previous review. The previous review emphasised that most studies considered fitness and diet apps while fitness or sports apps were the least considered. This review reports completely inverse results where the large majority of apps analysed were fitness apps followed by sport, while diet-fitness apps have been the least evaluated, with only one study. This change in trend may be clearly influenced by the context of the COVID-19 pandemic where the population forced to stay at home due to confinement felt the need to do physical exercise to be active and use leisure time in a more entertaining way. A significant proportion of the scientific literature highlights the features and functions and results of using fitness and sports apps (Kim et al., 2017), despite the fact that some studies have evaluated other health-related apps alongside this type of app (Aboelmaged et al., 2022; Chiu et al., 2021; Chiu and Cho, 2021; Zhu et al., 2023), or that of diet (Chiu et al., 2021). It is vital to highlight that the link between physical activity, fitness and health is extremely close, as is eating to live a healthy lifestyle.

Most research that has analysed technology adoption or intention to use has used the TAM model, which offers an understanding of why people embrace these technologies based on their PU and PEOU views (Márquez et al., 2020). However, this study found that recent research increasingly employs theories developed from the TAM, such as the TRAM model (Aboelmaged et al., 2022; Chiu and Cho, 2021), the UTAUT (Guo, 2022; Pérez-Aranda et al., 2021; Vinnikova et al., 2020; Wei et al., 2021), or the UTAUT2 model (Damberg, 2021; Dhiman et al., 2020; Ferreira-Barbosa et al., 2021; Kim and Lee, 2022; Schomakers et al., 2022; Yang and Koenigstorfer, 2021). In addition, other theories also appear in different articles such as the ECM (Chiu et al., 2021; Zhang and Xu 2020), the TNSB (Yeoh et al., 2022) or the TCV/TPR (Zhu et al., 2023). An interesting aspect to note is that, although no study based on the UTAUT3 model suggested by Farooq et al. (2017) has been found, Dhiman et al. (2020) proposed the UAUT2 model, but incorporated the PI variable which is included as a new endogenous variable within the UTAUT3.

In general, previous research on the acceptance of new technologies in the sports industry has found that PEOU (Mohammadi and Isanejad, 2018), or PU are the primary influences on the 'intention to use' (Kim et al., 2017). According to Venkatesh (2000), when a customer or user sees a technology to be simple to use, he or she would also regard it to be valuable. According to Cho and Kim (2015), PEOU typically has a benefit for users since it helps them to carry out activities with a more comfortable and simple method while driving the desire to continue using the app. In this regard, Liu et al. (2017) revealed that PEOU was the most important belief since the majority of fitness users thought apps were easy and simple to use when they met their expectations. Based on one research work, if the user must make an effort to learn how to use the app, this will favourably affect the consumer's propensity to use the app (Lin et al., 2020). When a customer has a strong desire to use the app, the person is more likely to promote it to others (Cheng et al., 2021). As a result, the

usage of fitness apps will be related to an increase in physical activity levels and, consequently, in health (Kim, 2022; Litman et al., 2015).

However, in spite of this more than contrasted evidence in the scientific literature, it is important to address the extent to which other variables (exogenous, endogenous, or moderating) can influence the ITU fitness app. To begin with the influence of exogenous variables, the TR model has been shown in different studies to have an external influence on TAM factors (Aboelmaged et al., 2022; Chen and Lin, 2018; Chiu and Cho, 2021). For example, PEOU is moderately influenced by Innovativeness and slightly influenced by Optimism and Insecurity, while PU is moderately influenced by Optimism and slightly influenced by Innovativeness, Discomfort and Insecurity (Aboelmaged et al., 2022; Chang et al., 2023; Chiu and Cho, 2021). Furthermore, Chiu and Cho (2021) found that both positive (Innovativeness and Optimism) and negative (Discomfort and Insecurity) factors of TR significantly influenced PEN. In another context, Raman and Aashish (2022), evaluating wearables, revealed that positive aspects of the TR positively influenced PEOU and PU, while negative aspects of TR negatively influenced these variables.

In contrast, Acikgoz et al. (2022) found a moderate influence of Innovativeness on PU and Subjective Knowledge on both PEOU and PU. Chang et al. (2023) reported a slight influence of the variable Task-Technology Fit on PEOU and PU. Other influential variables on PEOU have also been shown to be Self-efficacy (Dhiman et al. 2020), e-Lifestyles (García-Fernández et al., 2020), Perceived Attractiveness (Gómez-Ruiz et al., 2022; Jeong and Chung, 2022), Accuracy (Jeong and Chung, 2022), Information Quality and System Quality (Won et al., 2023) and Subjective Norms (Yu et al., 2021). As for external influential variables also in PU/PE, there are Confirmation of Expectations (Chiu et al., 2021), Perceived Attractiveness (Gómez-Ruiz et al., 2022), Accuracy and Trustworthiness (Jeong and Cheung, 2022), Self-efficacy, Perceived Barriers, Perceived Benefits, Risk Perception, and Perceived Threats (Wei et al., 2021), Information Quality and System Quality (Won et al. 2023) and Subjective Norms (Yu et al., 2021). Won et al. (2023) also found the influence of Information Quality and System Quality on PEN.

Some studies have also assessed the effects of exogenous or endogenous variables on attitudes as a moderator with ITU. Some variables that had a significant influence were PU/PE (García-Fernández et al., 2020; Pérez-Aranda et al., 2021; Yu et al., 2021), PEOU/EE (Pérez-Aranda et al., 2021; Yu et al., 2021), PEN, Gamification and Satisfaction (Pérez-Aranda et al., 2021). Cai et al. (2022) found that Satisfaction acted as a moderating variable for PEOU, PU and Trust with ITU. Regarding the influence of endogenous variables that influenced ITU in addition to PEOU, PU, or PEN we found Subjective Knowledge (Acikgoz et al., 2022), Commitment (Chiu et al., 2021; Cho et al., 2020), PV (Damberg, 2021; Dhiman et al., 2020; Yang and Koenigstorfer, 2021), HA (Damberg, 2021; Dhiman et al., 2020; Ferreira et al., 2021; Schomakers et al., 2022; Yang and Koenigstorfer, 2021), Health Consciousness (Damberg, 2021), Perceived Playfulness (Damberg, 2021), SI (Dhiman et al., 2020; Ferreira et al., 2021; Guo, 2022; Vinnikova et al., 2020), PI (Dhiman et al., 2020), HM (Ferreira et al., 2021; Schomakers et al., 2022); FC (Ferreira et al., 2021; Yang and Koenigstorfer, 2021), Perceived Trust (Gómez-Ruiz et al., 2022), Autonomous Motivation (Guo, 2022), SE (Huang and Ren, 2020; Vinnikova et al., 2020), Privacy Perceived Protection (Kim and Lee, 2022), Subjective Norms (Pérez-Aranda et al., 2021) and Goal-setting (Vinnikova et al., 2020).

Particularly interesting are the studies that did not rely on TAM models or derivatives that found different variables that significantly influenced ITU. For example, Zhu et al. (2023) showed that the variables of General Health, Affiliation, Physical

appearance, Condition, Perceived Risk and Security Risk influenced UTI. Yeoh et al. (2022) indicated that Outcome Expectation, Descriptive Norms and Perceived Behavioural Control influence UTI. Pérez-Aranda et al. (2023) found that attitudinal, cognitive and behavioural antecedents increase the intention to continue using a sports app. Finally, according to the influence on outcome variables, Cheng et al. (2021) observed that the ITU significantly influenced the Word-of-Mouth outcome variable. On the other hand, Ferreira et al. (2021) found that ITU influenced current use and Satisfaction, and Guo (2022) that ITU and Controlled Motivation also influenced current use. At the same time, SI, SE and Goal-setting also influenced current use (Vinnikova et al., 2020).

Lastly, we will discuss some evidence reported by other studies focused on the sport context, but which did not take into account fitness apps. For example, Wang et al. (2022) noted in a fitness software that SI, PE and EE significantly affected the ITU of university students. In an e-Sport game during a pandemic, Ong et al. (2023) showed that HA was the most significant factor in UTI, followed by usability, FC, SI and HM. In a similar vein, Yang et al. (2022) found that HA was the only predictor for the use of metaverse technology for basketball learning in college students. Ahn and Park (2023) showed that hedonic, user burden, pragmatic and social values were key predictors of fitness app user satisfaction. Gu et al. (2022) observed that attitudes toward exercise and the use of sports apps have a significant impact on physical activity intentions. Finally, Ferreira et al. (2023) demonstrated that the relationship between UTIs and members' overall satisfaction with the gym is positively mediated by e-Lifestyles.

Limitations and future research. There are obvious limitations to this systematic review. The first point to mention is maybe the shorter time restriction compared to the prior review by Angosto et al. (2020). However, this is required since the COVID-19 pandemic is still active and national governments are implementing preventative measures based on the pandemic's progress (Ferrer, 2021; Official State Bulletin, 2021). Many nations are enacting new temporary confinements, which may encourage the usage of exercise or health applications. Other potential constraints include publication bias, which occurs when journals publish research with favourable and significant results while rejecting papers with irrelevant outcomes. Another source of bias might have been the language, since there may have been publications in languages other than those specified in the inclusion criteria (English, Spanish and Portuguese). Another constraint might be the choice of search databases, because missing specific databases may result in prospective articles not being detected for inclusion in the review. A third issue is inclusion bias, which occurs when the inclusion or exclusion criteria itself prejudices against a research work. The last limitation is that the great diversity of variables analysed by the authors does not allow the generation of an adequate database that would enable a more in-depth analysis of the results through a meta-analysis beyond the TAM variables such as PEOU and PU.

Future research should try to assess sports consumers or users in other European or American contexts, with the possibility of analysing the results according to socio-demographic characteristics such as gender, age, sport, or digital experience. Age is an interesting aspect to investigate since, depending on the generation to which the person belongs, he or she will identify with new technologies to different degrees. In addition, there are variables such as those in the UTAUT model and derivatives or TR that have been more common than others, but there is still a need to increase the number of studies that use them. Other

studies could take a longitudinal approach, assessing the consumer's desire to use and actual use of the application, as well as whether or not this affects their behaviour towards a more active or healthy life.

Future lines of research relating to the evaluation of the intention to use fitness apps, or any other form of app or wearable, should examine the differences between the models in the same population using the TAM model and some of the other derived models such as the UTAUT or UTATU2. Furthermore, the proposed theoretical models should be assessed by linking them to other factors related to smartphones or other technical devices, such as attachment to the gadget, social influence for its usage, or actual use of the item, among others. Theoretical models such as the TAM, TAM2, UTAUT, UTAUT2 or UTAUT3 should be examined in various sports settings such as the usage of apps for managerial duties, sports training, or marketing/sports products.

Another key issue that has not been studied is the variation in intention to use across the different age groups of the population, since the elderly population may have a different aim than the younger population. Along similar lines, additional elements such as educational level or socioeconomic position may impact the inclination to use the fitness app or any other gadget or technology. Finally, longitudinal research might be utilised to determine how well the intention to use fitness apps matches the actual use of them.

Conclusions

This systematic review update highlights that research on the usage intention and adoption of fitness apps is a topic of interest within the digital sports marketing industry. In recent years there has been a significant increase in the number of publications, with an increasing number of European studies focusing on fitness or sports apps themselves and not associated with health or diet. In addition, the models used beyond the TAM itself are becoming more diversified, as well as the number of exogenous, endogenous and moderating variables in the different studies. Although there is no consensus on analysing the same variables in greater depth in order to generate data for a better joint analysis, there is no consensus on analysing the same variables in greater depth in order to generate data for a better joint analysis.

Finally, a practical aspect of sports organisation management is the desire that this sort of study may assist in learning the opinions of users or customers while adopting or establishing new policies with a digital transformation. This is especially important because it allows for improving the organisation's communication in a bidirectional way. In short, the implementation of the use of apps in sports centres implies more direct and closer communication with users. In addition, physical activity and management might be monitored without eliminating travel and human interaction. For example, sports organisations make extensive use of sports digital marketing, through the use of social tools, to make the organisation more visible and to offer a more direct image and contact with current or future consumers (Angosto et al., 2022). However, not all users have the same social media, therefore the use of push notifications and in-app communication in a venue allows for better notification of relevant news and at a lower cost.

Furthermore, the theoretical models reviewed above identify factors that influence the ITU of technology, such as PU, PEOU, SI and FC. Sport managers can therefore use these models to identify and assess which factors are relevant in their particular context. This will help them to understand the needs and preferences of their users and to adapt their strategies accordingly.

Also, PU is a critical factor in the intention to use technology. Therefore, sports managers should assess how their users perceive

the usefulness of technology in their sport context. Among the actions to be taken, they can conduct surveys, interviews or focus groups to collect data on how users feel technology can enhance their sport experience. This will allow sports managers to identify areas for improvement or additional features that can add value to the user experience. Similarly, PEOU is also an important factor in the acceptance and use of technology. In this regard, sports managers must ensure that the technology they use is easy to use and accessible to their users. This involves providing clear instructions, intuitive interfaces and adequate training to ensure that users feel comfortable using the technology.

Another variable that has been shown to influence ITU is SI. In this regard, sports managers could leverage these positive SI to promote the adoption of technology in their sports community. For example, they can collaborate with influential athletes or well-known coaches to support and promote the use of technology. They could also encourage social interaction among technology users by creating online communities or support groups. Finally, FC and perceived barriers have also been shown to influence the intention to use. Sports managers should identify and address any potential barriers that may hinder the adoption and use of technology in their sport environment. This may include a lack of technology resources, resistance to change, or privacy and security concerns. By proactively addressing these barriers, sports managers could encourage greater acceptance and use of technology.

Data availability

The datasets generated during and/or analysed during the current study are available in the Figshare repository, <https://figshare.com/s/d0a13d89538847f00b67>.

Received: 13 February 2023; Accepted: 28 July 2023;

Published online: 17 August 2023

References

- Abaelmaged M, Ali I, Hashem G (2022) Mobile apps use for wellness and fitness and university students' subjective wellbeing. *Inform Develop* 38(4):672–687. <https://doi.org/10.1177/02666669211020498>
- Acikgoz F, Filieri R, Yan M (2022) Psychological predictors of intention to use fitness apps: the role of subjective knowledge and innovativeness. *Int J Hum Comp Interact*. <https://doi.org/10.1080/10447318.2022.2074668>
- Ahn H, Park E (2023) Motivations for user satisfaction of mobile fitness applications: an analysis of user experience based on online review comments. *Humanit Soc Sci Commun* 10(1). <https://doi.org/10.1057/s41599-022-01452-6>
- Ajzen I, Fishbein M (1980) Understanding attitudes and predicting social behavior. Prentice-Hall, Englewood Cliffs, NJ
- Angosto S, García-Fernández J, Valantine I, Grimaldi-Puyana M (2020) The intention to use fitness and physical activity apps: a systematic review. *Sustainability* 12(16):16. <https://doi.org/10.3390/su12166641>
- Angosto S, Lara-Bocanegra A, Bohorquez MR, García-Fernández J, Zhang JJ (2022) Challenges in sport marketing: a systematic review of digital sport marketing. In: Byon KK, Yim BH, Zhang JJ (eds) *Marketing analysis in sport business. Global perspectives*, 1st edn. Routledge, London, pp. 70–92
- Ardern CL, Büttner F, Andrade R, Weir A, Ashe MC, Holden S, Impellizzeri FM, Delahunt E, Dijkstra HP, Mathieson S, Rathleff MS, Reurink G, Sherrington C, Stamatakis E, Vicenzino B, Whittaker JL, Wright AA, Clarke M, Moher D, Page MJ, Khan KM, Winters M (2022) Implementing the 27 PRISMA 2020 Statement items for systematic reviews in the sport and exercise medicine, musculoskeletal rehabilitation and sports science fields: the PERSiST (implementing Prisma in Exercise, Rehabilitation, Sport medicine and Sport Science) guidance. *Br J Sports Med* 56(4):175–195. <https://doi.org/10.1136/bjsports-2021-103987>
- Baubonytė S, Deliautaitė K, Narkevičienė KM, Valantinė I (2021) The use of sports apps for engaging in physical activity. *Balt J Sport Health Sci* 121(2):28–33
- Beh PK, Ganesan Y, Iranmanesh M, Foroughi B (2021) Using smartwatches for fitness and health monitoring: the UTAUT2 combined with threat appraisal as moderators. *Behav Inf Technol* 40(3):282–299. <https://doi.org/10.1080/0144929X.2019.1685597>

- Beldad AD, Hegner SM (2018) Expanding the technology acceptance model with the inclusion of trust, social influence, and health valuation to determine the predictors of German users' willingness to continue using a fitness app: a structural equation modeling approach. *Int J Hum-Comput Interact* 34(9):882–893. <https://doi.org/10.1080/10447318.2017.1403220>
- Byun H, Chiu W, Bae J (2018) Exploring the adoption of sports brand apps: an application of the modified technology acceptance model. *Int J Bus Inf Manag* 9(1):52–65. <https://doi.org/10.4018/IJABIM.2018010105>
- Cai J, Zhao Y, Sun J (2022) Factors influencing fitness app users' behavior in China. *Int J Hum-Comput Interact* 38(1):53–63. <https://doi.org/10.1080/10447318.2021.1921483>
- Chang CJ, Yang SC, Wolzok E (2023) Examining the use of fitness apps in sports centers in Taiwan: incorporating task-technology fit into a technology readiness acceptance model. *Manag Sport Leis*. <https://doi.org/10.1080/23750472.2023.2165532>
- Cheng LK, Huang HL, Lai CC (2021) Continuance intention in running apps: the moderating effect of relationship norms. *Int J Sports Mark Spons* 23(1):132–154. <https://doi.org/10.1108/IJSMS-08-2020-0143>
- Chen MF, Lin NP (2018) Incorporation of health consciousness into the technology readiness and acceptance model to predict app download and usage intentions. *Internet Res* 28:351–373. <https://doi.org/10.1108/IntR-03-2017-0099>
- Chiu W, Cho H (2021) The role of technology readiness in individuals' intention to use health and fitness applications: a comparison between users and non-users. *Asia Pac J Mark Logist* 33(3):807–825. <https://doi.org/10.1108/APJML-09-2019-0534>
- Chiu W, Cho H, Chi CG (2021) Consumers' continuance intention to use fitness and health apps: an integration of the expectation-confirmation model and investment model. *Inf Technol People* 34(3):978–998. <https://doi.org/10.1108/ITP-09-2019-0463>
- Cho H, Chi C, Chiu W (2020) Understanding sustained usage of health and fitness apps: incorporating the technology acceptance model with the investment model. *Technol Soc* 63:101429. <https://doi.org/10.1016/j.techsoc.2020.101429>
- Cho J, Kim SJ (2015) Factors of leading the adoption of diet/exercise apps on smartphones: application of channel expansion. *J Internet Comput Serv* 16(1):101–108. <https://doi.org/10.7472/jksii.2015.16.1.101>
- Clement J (2020) Health and fitness App downloads worldwide from 1st quarter 2019 to 2nd quarter 2020. Statista. Available via STATISTA. <https://www.statista.com/statistics/1127248/health-fitness-Apps-downloads-worldwide> Accessed 19 Dec 2022
- Damberg S (2021) Predicting future use intention of fitness apps among fitness app users in the United Kingdom: the role of health consciousness. *Int J Sports Mark Spons* 23(2):369–384. <https://doi.org/10.1108/IJSMS-01-2021-0013>
- Davis FD (1989) Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Q* 13(3):319–340. <https://doi.org/10.2307/249008>
- Davis FD, Bagozzi RP, Wharshaw PR (1989) User acceptance of computer technology: a comparison of two theoretical models. *Manag Sci* 35(8):982–1003. <https://doi.org/10.1287/mnsc.35.8.982>
- Dhiman N, Arora N, Dogra N, Gupta A (2020) Consumer adoption of smartphone fitness apps: an extended UTAUT2 perspective. *J Indian Bus Res* 12(3):363–388. <https://doi.org/10.1108/IJBR-05-2018-0158>
- Dillon A (2001) User acceptance of information technology. In: Karwowski K (ed) 555 Encyclopedia of human factors and ergonomics. Routledge, London, pp. 556–561
- Dutta DK, Gwebu KL, Wang J (2015) Personal innovativeness in technology, related knowledge and experience, and entrepreneurial intentions in emerging technology industries: a process of causation or effectuation? *Int Entrep Manag J* 11(3):529–555. <https://doi.org/10.1007/s11365-013-0287-y>
- Eshet E, Bouwman H (2015) Addressing the context of use in mobile computing: a survey on the state of the practice. *Interact Comput* 27(4):392–412. <https://doi.org/10.1093/iwc/iwu002>
- Farooq MS, Salam M, Jaafar N, Fayolle A, Ayupp K, Radovic-Markovic M, Sajid A (2017) Acceptance and use of lecture capture system (LCS) in executive business studies: extending UTAUT2. *Interact Technol Smart Educ* 14(4):329–348. <https://doi.org/10.1108/ITSE-06-2016-0015>
- Ferreira H, García-Fernández J, Pedragosa V, Cepeda-Carrión G (2021) The use of fitness centre apps and its relation to customer satisfaction: a UTAUT2 perspective. *Int J Sports Mark Spons* 23(5):966–985. <https://doi.org/10.1108/IJSMS-01-2021-0010>
- Ferreira H, García-Fernández J, Cepeda-Carrión G (2023) The mediating role of e-Lifestyles to use the fitness center app. *Int J Human Comp Interact*. <https://doi.org/10.1080/10447318.2023.2204273>
- Ferrer I (2021) Países Bajos impone un confinamiento estricto hasta el 14 de enero para frenar los contagios por la variante ómicron. El País. Available via ELPAIS. <https://elpais.com/sociedad/2021-12-18/paises-bajos-impone-un-confinamiento-estricto-hasta-el-14-de-enero-para-frenar-los-contagios-por-la-variante-omicron.html> Accessed 20 Dec 2022
- Fox S, Duggan M (2021) Mobile fact sheet. Pew Research Center. Available via PRC. <http://www.pewinternet.org/data-trend/mobile> Accessed 20 Dec 2022
- Gao T, Rohm AJ, Sultan F, Huang S (2012) Antecedents of consumer attitudes toward mobile marketing: a comparative study of youth markets in the United States and China. *Thunderbird Int Bus Rev* 54(2):211–224. <https://doi.org/10.1002/tie.21452>
- García-Fernández J, Gálvez-Ruiz P, Grimaldi-Puyana M, Angosto S, Fernández-Gavira J, Bohórquez MR (2020) The promotion of physical activity from digital services: influence of E-lifestyles on intention to use fitness apps. *Int J Environ Res Public Health* 17(18):6839. <https://doi.org/10.3390/ijerph17186839>
- Gómez-Ruiz AA, Gálvez-Ruiz P, Grimaldi-Puyana M, Lara-Bocanegra A, García-Fernández J (2022) Investigating the intention to use fitness app: the role of the perceived attractiveness of fitness center customers. *Sport Bus Manag* 12(4):537–553. <https://doi.org/10.1108/SBM-12-2021-0145>
- Gopinath K, Selvam G, Narayanamurthy G (2022) Determinants of the adoption of wearable devices for health and fitness: a meta-analytical study. *Commun Assoc Inform Syst* 50(1):23. <https://doi.org/10.17705/1CAIS.05019>
- Gu P, Liang Z, Zhang H, Zhang D (2022) Effects of attitudes towards exercise behaviour, use of sports apps and COVID-19 on intentions to exercise. *J Person Med* 12(9):1434. <https://doi.org/10.3390/jpm12091434>
- Gu P, Zhang H, Liang Z, Zhang D (2022) Impact of public risk perception in China on the intention to use sports APPs during COVID-19 pandemic. *Int J Environ Res Public Health* 19(19):11915. <https://doi.org/10.3390/ijerph191911915>
- Gunasinghe A, Hamid JA, Khatibi A, Azam SF (2020) The adequacy of UTAUT-3 in interpreting academician's adoption to e-Learning in higher education environments. *Interact Technol Smart Educ* 17(1):86–106. <https://doi.org/10.1108/ITSE-05-2019-0020>
- Guo J (2022) Influencing factors of college students' use of sports apps in mandatory situations: based on UTAUT and SDT. *BioMed Res Int* 2022:9378860. <https://doi.org/10.1155/2022/9378860>
- Gupta S, Mathur N, Narang D (2022) E-leadership and virtual communication adoption by educators: an UTAUT3 model perspective. *Glob Knowl Mem Commun*. <https://doi.org/10.1108/GKMC-01-2022-0001>
- Hu J, He W, Zhang J, Song J (2023) Examining the impacts of fitness app features on user well-being. *Inf Manag* 60(5):103796. <https://doi.org/10.1016/j.im.2023.103796>
- Huang G, Ren Y (2020) Linking technological functions of fitness mobile apps with continuance usage among Chinese users: moderating role of exercise self-efficacy. *Comput Human Behav* 103:151–160. <https://doi.org/10.1016/j.chb.2019.09.013>
- Jeong SH, Chung JY (2022) Integrated technology acceptance model (TAM) of sports team smartphone application (STSA) in the stimulus organism response (SOR) framework. *J Phys Educ Sport* 22(9):2152–2161
- Jin CH (2020) Predicting the use of brand application based on a TRAM. *Int J Hum-Comput Interact* 36(2):156–171. <https://doi.org/10.1080/10447318.2019.1609227>
- Jones P, Ratten V, Hayduk T (2020) Sport, fitness, and lifestyle entrepreneurship. *Int Entrep Manag J* 16(3):783–793. <https://doi.org/10.1007/s11365-020-00666-x>
- Kercher VM, Kercher K, Bennion T, Levy P, Alexander C, Amaral PC, Li YM, Han J, Liu Y, Wang R, Huang HY, Gao BH, Batrakoulis A, Gómez Chávez LFJ, Haro JL, Zavalza ARP, Rodríguez LEA, Veiga OL, Valcarce-Torrente M, Romero-Caballero A (2022) Fitness trends from around the globe. *ACSM's Health Fit J* 26(1):21–37. <https://doi.org/10.1249/FT.0000000000000737>
- Kim HM (2022) Social comparison of fitness social media postings by fitness app users. *Comput Hum Behav* 131:107204. <https://doi.org/10.1016/j.chb.2022.107204>
- Kim B, Lee E (2022) What Factors Affect a User as Intention to Use Fitness Applications? The Moderating Effect of Health Status: A Cross-Sectional Study. *INQUIRY J Health Care Organiz Prov Financ* 59:1–13. <https://doi.org/10.1177/0046958022109582>
- Kim SC, Yoon D, Han EK (2016) Antecedents of mobile app usage among smartphone users. *J Mark Commun* 22(6):653–670. <https://doi.org/10.1080/13527266.2014.951065>
- Kim T, Chiu W (2019) Consumer acceptance of sports wearable technology: The role of technology readiness. *Int J Sports Mark Spons* 20(1):109–126. <https://doi.org/10.1108/IJSMS-06-2017-0050>
- Kim Y, Kim S, Rogol E (2017) The effects of consumer innovativeness on sport team applications acceptance and usage. *J Sport Manag* 31(3):241–255. <https://doi.org/10.1123/jism.2015-0338>
- Koenig-Lewis N, Marquet M, Palmer A, Zhao AL (2015) Enjoyment and social influence: predicting mobile payment adoption. *Serv Ind J* 35(10):537–554. <https://doi.org/10.1080/02642069.2015.1043278>
- Lim JS, Noh GY (2017) Effects of gain-versus loss-framed performance feedback on the use of fitness apps: mediating role of exercise self-efficacy and outcome expectations of exercise. *Comput Hum Behav* 77:249–257. <https://doi.org/10.1016/j.chb.2017.09.006>

- Lin CT, Shen CC, Mao TY, Yang CC (2019) Empirical investigation of sports management, behavior growth and usage of sports APP: new learning perspective. *Pol J Manag Stud* 19(1):225–234. <https://doi.org/10.17512/pjms.2019.19.1.17>
- Lin CW, Mao TY, Huang YC, Sia WY, Yang CC (2020) Exploring the adoption of Nike+ Run Club App: an application of the theory of reasoned action. *Math Probab Eng* 2020:e8568629. <https://doi.org/10.1155/2020/8568629>
- Litman L, Robinson J, Rosenzweig C (2015) The relationship between motivation, monetary compensation, and data quality among US- and India-based workers on Mechanical Turk. *Behav Res Methods* 47(2):519–528. <https://doi.org/10.3758/s13428-014-0483-x>
- Liu XD, Ly XY, Ren PR (2017) Research on user adoption behavior of fitness App. *Enterp Econ* 36(11):48–54. <https://doi.org/10.13529/j.cnki.enterprise.economy.2017.11.007>
- Marquez A, Cianfrone BA, Kellison T (2020) Factors affecting spectators' adoption of digital ticketing: the case of interscholastic sports. *Int J Sports Mark Spons* 21(3):527–541. <https://doi.org/10.1108/IJMSMS-07-2019-0080>
- Middelweerd A, Mollee JS, van der Wal CN, Brug J, Velde SJ (2014) Apps to promote physical activity among adults: a review and content analysis. *Int J Behav Nut Phys Act* 11(1):97. <https://doi.org/10.1186/s12966-014-0097-9>
- Mohammadi S, Isanejad O (2018) Presentation of the extended technology acceptance model in sports organizations. *Ann Appl Sport Sci* 6(1):75–86. <https://doi.org/10.29252/aasjournal.6.1.75>
- Newzoo (2021) Global mobile market report. Newzoo. Available via DIALG. <https://newzoo.com/key-numbers/>. Accessed 19 Dec 2022
- Núñez Sánchez JM, Gómez Chacón R, Jambrino-Maldonado C, García Fernández J (2022) Can a corporate well-being programme maintain the strengths of the healthy employee in times of COVID-19 and extensive remote working? An empirical case study. *European J Govern Econ* 11(1):51–72. <https://doi.org/10.17979/ejge.2022.11.1.8978>
- Official State Bulletin (2021) Royal Decree-Law 30/2021, of December 23, adopting urgent prevention and containment measures to address the health crisis caused by COVID-19 (No. 30; pp. 159762–159770). *Off State Bull.* Available via BOE. https://www.boe.es/diario_boe/txt.php?id=BOE-A-2021-21307
- Ong AKS, Prasetyo YT, Robas KPE, Persada SF, Nadlifatin R, Matillano JSA, Macababbab DCB, Pabustan JR, Taningco KAC (2023) Determination of factors influencing the behavioral intention to play “Mobile Legends: Bang-Bang” during the COVID-19 pandemic: integrating UTAUT2 and system usability scale for a sustainable E-sport business. *Sustainability* 15(4):3170. <https://doi.org/10.3390/su15043170>
- Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, Shamseer L, Tetzlaff JM, Akl EA, Brennan SE, Chou R, Glanville J, Grimshaw JM, Hróbjartsson A, Lalu MM, Li T, Loder EW, Mayo-Wilson E, McDonald S, McGuinness LA, Stewart LA, Thomas J, Tricco AC, Welch VA, Whiting P, Moher D (2021) The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *Syst Rev* 10(1):89. <https://doi.org/10.1186/s13643-021-01626-4>
- Parasuraman A (2000) Technology Readiness Index (Tri): a multiple-item scale to measure readiness to embrace new technologies. *J Serv Res* 2(4):307–320. <https://doi.org/10.1177/109467050024001>
- Perez-Aranda J, González EM, Alarcón P (2023) Understanding antecedents of continuance and revisit intentions: the case of sport apps. *J Retail Cons Serv* 72:103288. <https://doi.org/10.1016/j.jretconser.2023.103288>
- Perez-Aranda J, González Robles EM, Alarcón P (2021) Sport-related physical activity in tourism: an analysis of antecedents of sport based applications use. *Inf Technol Tour* 23(1):97–120. <https://doi.org/10.1007/s40558-019-00161-2>
- Pinto AS, Abreu A, Costa E, Paiva J (2022) Using UTAUT-3 to understand the adoption of Mobile Augmented Reality in Tourism (MART). In: Carvalho JVD, Liberato P, Peña A (eds) *Advances in tourism, technology and systems. Smart innovation, systems and technologies*, vol 284. Springer
- Rahman SA, Taghizadeh SK, Ramayah T, Alam MMD (2017) Technology acceptance among micro-entrepreneurs in marginalized social strata: the case of social innovation in Bangladesh. *Technol Forecast Soc Change* 118:236–245. <https://doi.org/10.1016/j.techfore.2017.01.027>
- Raman P, Aashish K (2022) Gym users: an enabler in creating an acceptance of sports and fitness wearable devices in India. *Int J Sport Mark Spons* 23(4):707–726. <https://doi.org/10.1108/IJMSMS-08-2021-0168>
- Rivera M, Gregory A, Cobos L (2015) Mobile application for the timeshare industry: the influence of technology experience, usefulness, and attitude on behavioral intentions. *J Hosp Tour Technol* 6(3):242–257. <https://doi.org/10.1108/JHTT-01-2015-0002>
- Ruth J, Willwacher S, Korn O (2022) Acceptance of digital sports: a study showing the rising acceptance of digital health activities due to the SARS-CoV-19 pandemic. *Int J Environ Res Public Health* 19(1):596. <https://doi.org/10.3390/ijerph1901596>
- Schillewaert N, Ahearne MJ, Frambach RT, Moenaert RK (2005) The adoption of information technology in the sales force. *Ind Mark Manag* 34(4):323–336. <https://doi.org/10.1016/j.indmarman.2004.09.013>
- Schomakers EM, Lidynia C, Vervier LS, Calero Valdez A, Ziefle M (2022) Applying an extended UTAUT2 model to explain user acceptance of lifestyle and therapy mobile health apps: survey study. *JMIR mHealth uHealth* 10(1):e27095. <https://doi.org/10.2196/27095>
- Schreurs K, Quan-Haase A, Martin K (2017) Problematizing the digital literacy paradox in the context of older adults' ICT use: aging, media discourse, and self-determination. *Can J Commun* 42(2):359–377. <https://doi.org/10.22320/cjc.2017v42n2a3130>
- Schulz KF, Altman DG, Moher D (2010) CONSORT 2010 statement: updated guidelines for reporting parallel group randomised trials. *J Pharmacol Pharmacother* 1(2):100–107. <https://doi.org/10.4103/0976-500X.72352>
- Thatcher JB, Perrewé PL (2002) An empirical examination of individual traits as antecedents to computer anxiety and computer self-efficacy. *MIS Q* 26(4):381–396
- Thompson WR (2022) Worldwide survey of fitness trends for 2022. *ACSM's Health Fit J* 26(1):11–20. <https://doi.org/10.1249/FIT.0000000000000732>
- Ting DSW, Carin L, Dzau V, Wong TY (2020) Digital technology and COVID-19. *Nat Med* 26(4):4. <https://doi.org/10.1038/s41591-020-0824-5>
- Venkatesh V (2000) Determinants of perceived ease of use: integrating control, intrinsic motivation, and emotion into the technology acceptance model. *Inf Syst Res* 11(4):342–365. <https://doi.org/10.1287/isre.11.4.342.11872>
- Venkatesh V, Davis FD (2000) A theoretical extension of the technology acceptance model: four longitudinal field studies. *Manag Sci* 46(2):186–204. <https://doi.org/10.1287/mnsc.46.2.186.11926>
- Venkatesh V, Morris MG, Davis GB, Davis FD (2003) User acceptance of information technology: toward a unified view. *MIS Q* 27(3):425–478. <https://doi.org/10.2307/30036540>
- Venkatesh V, Thong JYL, Xu X (2012) Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. *MIS Q* 36(1):157–178. <https://doi.org/10.2307/41410412>
- Venkatesh V, Thong JY, Xu X (2016) Unified theory of acceptance and use of technology: A synthesis and the road ahead. *J Assoc Inform Syst* 17(5):328–376. <https://ssrn.com/abstract=2800121>
- Vinnikova A, Lu L, Wei J, Fang G, Yan J (2020) The use of smartphone fitness applications: the role of self-efficacy and self-regulation. *Int J Environ Res Public Health* 17(20):1–16. <https://doi.org/10.3390/ijerph17207639>. Scopus
- Vogler C, Lyonette C, Wiggins RD (2008) Money, power and spending decisions in intimate relationships. *Sociol Rev* 56(1):117–143. <https://doi.org/10.1111/j.1467-954X.2008.00779.x>
- Wang C, Wu G, Zhou X, Lv Y (2022) An empirical study of the factors influencing user behavior of fitness software in college students based on UTAUT. *Sustainability* 14(15):9720. <https://doi.org/10.3390/su14159720>
- Wei J, Vinnikova A, Lu L, Xu J (2021) Understanding and predicting the adoption of fitness mobile apps: evidence from China. *Health Commun* 36(8):950–961. <https://doi.org/10.1080/10410236.2020.1724637>
- Won D, Chiu W, Byun H (2023) Factors influencing consumer use of a sport-branded app: the technology acceptance model integrating app quality and perceived enjoyment. *Asia Pac J Mark Logist* 35(5):1112–1133. <https://doi.org/10.1108/APJML-09-2021-0709>
- Yang F, Ren L, Gu C (2022) A study of college students' intention to use metaverse technology for basketball learning based on UTAUT2. *Heliyon* 8(9):e10562. <https://doi.org/10.1016/j.heliyon.2022.e10562>
- Yang Y, Koenigstorfer J (2021) Determinants of fitness app usage and moderating impacts of education-, motivation-, and gamification-related app features on physical activity intentions: cross-sectional survey study. *J Med Internet Res* 23(7):e26063. <https://doi.org/10.2196/26063>
- Yeoh R, Kim HK, Kang H, Lin YA, Ho AD, Ho KF (2022) What determines intentions to use mobile fitness apps? The independent and joint influence of social norms. *Int J Hum Comput Interact*. <https://doi.org/10.1080/10447318.2022.2111040>
- Yin S, Cai X, Wang Z, Zhang Y, Luo S, Ma J (2022) Impact of gamification elements on user satisfaction in health and fitness applications: a comprehensive approach based on the Kano model. *Comput Hum Behav* 128:107106. <https://doi.org/10.1016/j.chb.2021.107106>
- Yu CY, Jeffe DB, Kenna MA, Germiller JA, Lieu JEC (2021) Validation of a parent proxy Quality-of-Life measure for young children with hearing loss. *Laryngoscope* 131(3):663–670. <https://doi.org/10.1002/lary.28891>
- Yuan S, Ma W, Kanthawala S, Peng W (2015) Keep using my health apps: discover users' perception of health and fitness apps with the UTAUT2 model. *Telmed E-Health* 21(9):735–741. <https://doi.org/10.1089/tmj.2014.0148>
- Zhang X, Xu X (2020) Continuous use of fitness apps and shaping factors among college students: a mixed-method investigation. *Int J Nur Sci* 7:S80–S87. <https://doi.org/10.1016/j.ijnss.2020.07.009>
- Zhu Y, Wang R, Zeng R, Pu C (2023) Does gender really matter? Exploring determinants behind consumers' intention to use contactless fitness services during the COVID-19 pandemic: a focus on health and fitness apps. *Internet Res* 33(1):280–307. <https://doi.org/10.1108/INTR-07-2021-0454>

Acknowledgements

This research was funded by the Junta de Andalucía, Regional Ministry of Economic Transformation, Industry, Knowledge and Universities (grant number AT 21_00031). SA is funded by the European Union—NextGenerationEU through a postdoctoral contract with Margarita Salas.

Author contributions

Conceptualization, SA, JG-F, and MG-P; methodology, SA and JG-F; formal analysis, SA; investigation, SA, JG-F; resources, SA; data curation, MG-P; writing—original draft preparation, SA, JG-F and MG-P; writing—review and editing, SA and JG-F; project administration, JG-F and MG-P; funding acquisition, JG-F and SA.

Competing interests

The authors declare no competing interests.

Ethical approval

This article does not contain any studies with human participants performed by any of the authors.

Informed consent

This article does not contain any studies with human participants performed by any of the authors.

Additional information

Supplementary information The online version contains supplementary material available at <https://doi.org/10.1057/s41599-023-02011-3>.

Correspondence and requests for materials should be addressed to Jerónimo García-Fernández.

Reprints and permission information is available at <http://www.nature.com/reprints>

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this license, visit <http://creativecommons.org/licenses/by/4.0/>.

© The Author(s) 2023