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The use of a fitness app for customer recommendation: linear models and qualitative comparative analysis

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The use of technology within sports services has become an important field of study. Currently, the vast majority of sports services offer their users mobile applications to facilitate aspects such as communication and information. Within fitness centres, these mobile applications have become key elements to keep users informed and to reinforce behaviours such as loyalty towards the service. This study analyses the influence of mobile applications used in fitness centres on users' recommendations of the app. Two methodologies were used to measure users' perceptions: linear models and qualitative comparative analysis. The main results show that certain dimensions of the Mobile App Rating Scale (MARS) have a strong influence on users' future app recommendations as well as the influence of users' gender and age. It is important for managers of these sports services to implement technologies that provide two-way communication with users and therefore facilitate positive app recommendations. Furthermore, analysing the data using these two methodologies offers researchers a more detailed examination to better understand customers' perceptions and, consequently, to establish more precise actions within the service.

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Introduction

Technological innovation is a key factor in the sports services sector. Companies that provide sports services have a responsibility to satisfy their customers' needs and offer them the best possible service. Technological innovation is a fundamental tool for achieving this, as it enables companies to improve and modernise their services. In this way, companies can offer higher-quality products and services at more competitive prices. In addition, technological innovation is important for improving customer service. For example, many sports companies offer mobile applications that allow customers to easily access the information they need. In this way, users can keep track of their progress quickly and easily (García-Fernández et al., 2022).

In recent years, there has been a significant increase in the popularity of mobile applications related to physical activity, which underscores the need to investigate their impact on the behaviour of fitness centre users (Ahn and Park, 2023). Analysing the factors that influence a customer's intention to use a fitness app can be beneficial for companies by enabling them to design effective strategies to retain users.

Fitness centre apps are becoming increasingly popular because they allow users to schedule their activities within a facility, track their progress, and receive notifications about classes, events, and special offers. The use of fitness centre apps can also have a positive impact on customers' future behaviours (Chang et al., 2023). By improving the customer experience and providing greater motivation and control over their activities, customers can develop greater discipline and motivation to achieve their goals.

The aim of this investigation is to determine customers' evaluations of a chain of sports centres with regard to a fitness application and its influence on their future recommendations for the application. For this purpose, two different methodologies were used, linear models and fuzzy set qualitative comparative analysis, to obtain concrete and explanatory results that allow the sports service to improve its competitiveness. Obtaining results from two different methods offers several advantages to this research. For example, the use of fuzzy set qualitative comparative analysis (fsQCA) allows results to be identified through the combination of variables rather than only as a direct and unique relationship between variables (Calabuig Moreno et al., 2016).

This research considers the following research questions to address the aims of the study.

RQ1: What are the factors that influence future recommendations of mobile applications used in fitness centres?

RQ2: Do the age and gender of customers influence recommendations for the use of a mobile application of a sports service?

Literature review

New technologies in the sports sector. Due to the incorporation of new technologies, sports services have evolved and have adopted advanced solutions. Wearable technology, such as smartwatches and other monitoring devices, has had a great impact because it provides detailed and real information to users about their performance in different physical activities, such as distance travelled, steps taken, and heart rate. Many studies have analysed the performance of these wearable devices in the field of health and physical activity (Bao and Lee, 2023; Sousa et al., 2023). Kim et al. (2017) demonstrated that the use of wearable technology can improve performance in endurance sports and allow athletes to refine their training for better results.

Gabbett and Gahan (2016) conducted a study of a semiprofessional rugby league and analysed the use of technology, specifically GPS devices, to monitor the movements of players and to grant coaches the ability to control players' workload

during training or competition, thus reducing the risk of injury and improving the performance of these players. In addition, the popularity of social networks has had a significant impact on the promotion and marketing of sporting events. Social networks can be an effective tool for reaching and interacting with fans, which can increase attendance at and participation in sporting events. In short, the inclusion of new technologies has led to a significant transformation in the way sports services are managed and how users interact with them.

With regard to the fitness industry, new technologies have been adopted. In recent years, technological advances have revolutionised the operation of sports centres and have brought numerous advantages to both athletes and managers of these sports services.

Mujika and Padilla (2000) analysed the effects of high-intensity interval training among endurance athletes. These authors concluded that the use of heart rate monitors allowed athletes to train at the correct intensity, which resulted in improved performance. Wearable technology has become increasingly common and available to the majority of society, which enables new and innovative ways of approaching health, fitness and leisure activities (Girginov et al., 2020). This wearable technology also makes it possible to identify the achievement of previously set goals and to monitor progress over a long period of time.

In the context of fitness centres, wearable technology serves as a tool not only for managers with regard to attendance or service satisfaction but also for users themselves, who can track their physical activity, such as goals achieved (heart rate, calories, number of steps taken, etc.). These data can be used to create personalised training plans tailored to each individual's needs. Additionally, wearable technology can be used to motivate individuals by providing rewards for reaching certain milestones or goals. Wearable technology can also be used in a social context within a fitness centre. For example, it can be used to connect individuals with similar interests or goals to encourage collaboration and support (Schüll, 2016). It can also be used as a platform for competitions between members of a gym or even between different gyms. This encourages healthy competition while promoting collaboration among members. Overall, wearable technology has many potential uses in a fitness centre setting that can improve the overall experience for members. Tracking physical activity levels and providing personalised feedback on progress over time can help individuals reach their goals more effectively. Additionally, these features can provide a platform for social interaction among members, which can lead to increased motivation and collaboration within the gym environment.

Physical activity has a transcendental impact on health, as evidenced by the amount of research that demonstrates the positive relationship between the two. Research has demonstrated the effectiveness of physical activity on health, including cardiovascular health, such as reducing the risk of disease and improving mental well-being (Matthews et al., 2007; Telama et al., 2014). This research suggests the importance of a comprehensive understanding of the significance of sports practice on the health of society.

The quality of the mHealth apps: fitness apps. One way to measure and understand the benefits of physical activity on health is through mobile technology, such as mHealth. The field of mHealth has seen significant growth in recent years as the use of mobile technology in health care has become increasingly widespread. One of the key challenges in this field is the evaluation and assessment of mHealth apps, which is crucial for understanding the effectiveness and impact of these apps on health outcomes.

In their research, Yang et al. (2022) highlighted the importance of brand sponsorship in the mHealth app market and suggest that the relationship between brand sponsorship and app quality is complex and multifaceted. The authors suggest that to maximise the benefits of brand sponsorship, mHealth app developers should consider the relevance of the brand to the app and the level of brand involvement in the app. In addition, they suggest that mobile health app developers pay particular attention to the perceived quality of their app, which can have a significant impact on the intention to download the app. Stoyanov et al. (2015) proposed the Mobile App Rating Scale (MARS) as a tool to assess the quality of mobile health apps, which provides a valuable resource for healthcare professionals, researchers and app developers. This article represented a significant contribution to the field of health technology and highlights the need for standardised approaches to assess the quality of mobile health apps. Grundy et al. (2016) provided a comprehensive overview of the challenges and limitations associated with evaluating the quality of mHealth apps. The authors argued that despite the increasing importance of mHealth apps, there is a lack of consensus regarding the best methods for evaluating app quality. They further suggested that current methods for evaluating app quality are limited by a number of factors, including the use of subjective measures, the lack of standardised measures, and the difficulty in evaluating the impact of mHealth apps on health outcomes.

There has been an increase in fitness app downloads of mHealth fitness apps. In recent years, fitness apps have become increasingly popular as people increasingly turn to technology to achieve their health and fitness goals. For example, Muntaner-Mas et al. (2019) provided a comprehensive overview of the potential benefits and limitations of using fitness apps for remote assessment of cardiorespiratory fitness. The authors argued that fitness apps have the potential to provide objective and remote assessments of cardiorespiratory fitness, which has significant benefits for both clinical and sports applications.

There is a wide range of fitness applications on the market; therefore, it can be difficult for users to clarify the requirements for high quality and relevance. The quality of a fitness app refers to good design, functionality, and its ability to meet users' needs. A high-quality fitness app should be easy to use, intuitive, and provide accurate and reliable data (Perez-Aranda et al., 2023).

Valcarce-Torrente et al. (2021) concluded that technology in gyms influences the sporting habits of users. The use of mobile phones and apps has forced gyms to adapt to changing circumstances, such as the COVID-19 pandemic. Data from systematic reviews suggest that mobile apps and fitness trackers can improve physical activity levels (Tong et al., 2022). However, further research is needed on the scientific validity and reliability of existing or underdeveloped fitness apps.

Direito et al. (2015) attempted to determine whether applications can increase adults' levels of physical activity. The results showed that smartphone apps can be effective in promoting physical activity among young people. A systematic review of fitness apps by Muntaner-Mas et al. (2019) concluded that physiological cues are incorporated into apps during fitness, such as heart rate measurements using a smartphone camera or after exercise testing. More research is needed to determine the potential impact of mobile devices on health behaviours (Tong et al., 2022). Mobile apps and fitness tracking devices need to quickly adapt to changing circumstances, especially during health crises such as COVID-19. Therefore, the perception of app quality is a topic of interest and can influence the intention to use fitness apps (Yang et al., 2022; Yang and Koenigstorfer, 2020).

Martin-Payo et al. (2021) presented an adaptation and validation of the MARS scale and argued that this questionnaire

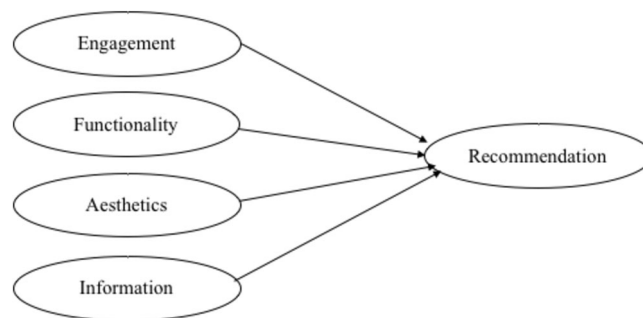


Fig. 1 Theoretical model. This figure reflects the theoretical model with the relationships between the independent variables that measure the quality of the mobile application and its influence on the recommendation of the same app by customers of a sports service.

is an important tool for assessing the quality of mHealth apps because it provides a comprehensive assessment of several aspects of app quality, including functionality, usability and reliability. This scale, which was developed to measure the performance of mobile applications, consists of four dimensions, such as engagement, which measures the user's commitment to the application, including interaction with the application or entertainment. Functionality measures performance, such as ease of use or navigation through the app. The aesthetics of the app, which involve its design and visual appeal, analyse aspects such as its graphic presentation or general design. A good design is more attractive to users. Finally, information, an important dimension of the relationship with users of a service, measures factors such as the relevance, accuracy or credibility of the information offered by the application. Good ratings on these dimensions ensure that users of these sports services obtain good perceptions of the app and, consequently, of the service in general. Due to the highly competitive market of the fitness sector, it is important to determine the influence on users' recommendations of apps (Fig. 1).

Methods

Participants. The sample included a total of 210 participants, 54 females and 156 males. The sample was identified using convenience sampling techniques. In terms of age, the male and female participation rates were similar for all age groups, with the largest concentration of participants aged 18 to 64 years and 26 to 57 years. The fidelity of the customers of the sports service was classified according to the number of months enrolled in the service and was classified as up to 12 months, between 13 and 36 months, and more than 37 months.

Instrument. This study used the MARS scale proposed by Stoyanov et al. (2015) and validated in Spanish by Martin-Payo et al. (2021). The scale consisted of 16 items divided into four dimensions to assess the perceived quality of the elements of the Fitbe® app (university spin-off) in this study: engagement (five items), functionality (four items), aesthetics (three items) and information (four items). The response format for all items was a 5-point Likert scale. The degree of agreement (1 to 5) was identified in relation to the recommendation of the fitness app as a dependent variable (Martin-Payo et al., 2021).

Procedure. To collect the data, the researchers contacted several fitness centres that used the Fitbe® app. Fitbe was developed at the University of Seville and uses software to manage a fitness centre. It has a linked fitness app so that users of the fitness centre

Table 1 Descriptive statistics of the variables analysed.

	Male	Female	17-30	31-40	41-50	51-65	<12 m	-36 m	>37 m
	M SD	M SD	M SD	M SD	M SD	M SD	M SD	M SD	M SD
ENG	3.71 (0.84)	3.48 (0.67)	3.68 (0.81)	3.42 (0.80)	3.77 (0.76)	3.89 (0.89)	3.68 (0.81)	3.61 (0.75)	3.51 (0.99)
FUNCT	4.07 (0.75)	3.77 (0.86)	3.92 (0.86)	3.83 (0.86)	4.15 (0.70)	4.05 (0.78)	3.93 (0.84)	4.08 (0.72)	4.07 (0.85)
AEST	4.00 (0.78)	3.56 (0.89)	3.83 (0.90)	3.79 (0.90)	3.92 (0.72)	4.05 (0.98)	3.83 (0.93)	3.94 (0.71)	4.00 (0.66)
INFO	4.20 (0.62)	3.89 (0.73)	4.26 (0.59)	4.05 (0.71)	4.11 (0.62)	4.10 (0.76)	4.13 (0.68)	4.09 (0.63)	4.09 (0.66)
REC	3.94 (0.99)	3.60 (0.93)	3.90 (1.00)	3.68 (0.98)	3.83 (0.96)	4.15 (1.05)	3.81 (1.00)	3.95 (0.98)	3.57 (0.94)

ENG Engagement, FUNCT Functionality, AEST Aesthetics, INFO Information, REC Recommendation, M mean, SD standard deviation.

can keep track of their training, keep in touch with their trainers or book a sports activity. The researchers explained the aim of the study to the fitness centre managers and invited them to participate in the study. The importance of the study lies in the perceived quality of the app and therefore the ability of users to use it. Ultimately, eight fitness centres decided to participate. The questionnaire took approximately 7–8 min to complete.

Data analysis. Descriptive and regression analyses were performed using SPSS (Statistical Package for the Social Sciences, Version 25, IBM), and the fsQCA 2.0 software package was changed to calculate the fsQCA models.

First, hierarchical regression of the different dimensions of the scale was conducted as well as permanence in the sports service and the sociodemographic variables (age and gender). Second, the analysis was conducted with fuzzy set qualitative comparative analysis (QCA), an analysis method based on set theory where a result is achieved through a causal combination of variables (equifinality). Unlike hierarchical regression, which measures the individual contribution of each variable, it measures the contribution of each attribute in combination with the other attributes analysed. In this fsQCA analysis method, first, descriptors and calibration values were calculated. Once the data were transformed, the need and sufficiency analyses were calculated, which predicted high levels (presence) or low levels (absence) of the dimensions analysed, permanence, gender and age. In the analyses with fsQCA, the explained variance was reflected in the coverage of the solution, while consistency represented a measure of model fit (Prado-Gascó and Calabuig-Moreno, 2016).

Within the fsQCA models, a condition on the result is necessary when its consistency is greater than or equal to 0.90 (Ragin, 2008). Finally, sufficiency analysis allows for three types of solutions, that is, complex, parsimonious, and intermediate (Eng and Woodside, 2012). The intermediate solution is recommended in the literature (Ragin, 2008). The application of this method of analysis within the sports management literature has increased in recent years (Crespo-Hervás et al., 2019; Escamilla-Fajardo et al., 2019; García-Pascual et al., 2021). When applying this method, the fsQCA models allow more complete information to be obtained because they provide more detailed results (Ragin, 2008) by allowing for combinations of variables. This approach allows us to explain that the conditions that lead users to have high app recommendations are not necessarily the same as those that lead them to have low app recommendations.

Results

Hierarchical regression model. Table 1 shows that the main variables of the scale that measured the app rating had a significant impact on the variance of the app recommendation. In the first step, they explained 52% (R^2 adjusted = 0.52) of customers' future recommendations. Considering the different steps, in

Table 2 Hierarchical regressions of the effect of variables (ENG, FUN, AES, INF) and age, gender and fidelity on customer recommendation.

	Recommendation	
	ΔR^2	β
Step 1	0.52***	
Engagement		0.01
Functionality		0.13
Aesthetic		0.36***
Information		0.30***
Step 2	0.01	
Engagement		0.1
Functionality		0.14
Aesthetic		0.36***
Information		0.30***
Age		0.3
Gender		0.1
Fidelity		-0.6
	0.52***	

ΔR^2 , R-square change; β , standardised beta; *** $p \leq 0.001$.

the case of recommendation prediction, engagement ($\beta = 0.01$; $p = 0.89$), functionality ($\beta = 0.13$; $p = 0.075$), aesthetics ($\beta = 0.36$; $p = 0.000$) and information ($\beta = 0.30$; $p = 0.000$) assumed a $\Delta R^2 = 0.52$ ($p < 0.001$).

However, in step 2, when age, gender and loyalty were included, the model did not show a differential increase in variance, and the incorporation of these sociodemographic variables did not show significance ($\Delta R^2 = 0.01$; $p = 0.611$).

Qualitative comparative analysis results. Table 2 shows the calibration of the variables' engagement (ENG), functionality (FUN), aesthetic (AES) and information (INF). The five thresholds obtained after recalibrating the values of the variables (10, 50 and 90) were also observed (Woodside, 2013).

Necessary analysis of customer recommendations. The necessary analysis was conducted to determine which conditions were necessary for the positive and negative impacts of the fitness app rating on users' future fitness app recommendations. To establish a condition as necessary, consistency of >0.90 is needed, as reported in the literature (Ragin, 2009). As shown in Table 3, for both high and low levels of customer recommendation, no necessary condition was found.

Necessary analysis of customer recommendations. The sufficiency analysis was conducted to determine whether the conditions of the model were sufficient. As shown in Table 4, which shows the most important combinations of conditions of the intermediate solution, both the high and low levels of customer

Table 3 Descriptive statistics and calibration values.

	ENG	FUN	AES	INF
Mean	869.20	301.39	65.47	323.98
SD	894.57	189.21	35.76	186.39
Minimum	2.00	8.00	1.00	9.00
Maximum	3750.00	625.00	150.00	750.00
Percentiles				
5	36.00	20.70	12.00	72.00
10	71.20	59.40	19.80	106.80
50	576.00	256.00	64.00	256.00
90	2255.40	625.00	125.00	625.00
95	3125.00	625.00	125.00	625.00

ENG Engagement, FUN Functionality, AES Aesthetics, INF Information.

Table 4 Necessary conditions for positive and negative COVID-19 impacts considering crisis measures (business model adaptation).

	REC		~ REC	
	Cons	Cov	Cons	Cov
ENG	0.674621	0.887029	0.580985	0.575832
-ENG	0.677403	0.682003	0.886018	0.672411
FUN	0.754806	0.847567	0.629195	0.532571
-FUN	0.583727	0.676206	0.819911	0.715960
AES	0.722176	0.875946	0.585794	0.535590
-AES	0.617116	0.664035	0.864318	0.701053
INF	0.787015	0.854449	0.642506	0.525815
-INF	0.676387	0.676387	0.822148	0.744228
AGE	0.667706	0.736651	0.702125	0.583908
-AGE	0.622850	0.735024	0.683334	0.607861
GEN	0.227656	0.519231	0.279642	0.480769
-GEN	0.772344	0.587179	0.720358	0.412821
FID	0.593255	0.756559	0.639038	0.614301
-FID	0.697555	0.719391	0.746756	0.580522

- absence of condition, Cons consistency, Cov coverage, ENG Engagement, FUN Functional, AES Aesthetics, INF Information, GEN Gender, FID Fidelity.

recommendation (0.86; 0.87) were adequate since they had consistency values greater than 0.75 (Eng and Woodside, 2012). The threshold for high app recommendations was 0.96. The most important combination configuration for high fitness app recommendations was high engagement*being female (consistency: 0.89; raw coverage: 0.54). The second most relevant combination was the high functionality of the app*high quality of the app*elderly users (consistency: 0.96; gross coverage: 0.47). The third combination was good information quality through the app*having a long stay in the sports service (consistency: 0.93; gross coverage: 0.46). These three solutions were able to explain 54, 47 and 46% of the variance in high levels of recommendation from sports service customers.

Three solutions were proposed to explain low fitness app recommendations by users. The threshold for low app recommendations was 0.95. This threshold is correct in relation to the minimum threshold suggested by the literature of 0.75 in the truth table (Ragin, 2008). The combination of sets that explained lower app recommendation was engagement with the app*low levels of app functionality*low levels of aesthetics*female user (consistency: 0.90; raw coverage: 0.31). The second combination of sets that explained low levels of app recommendation was low engagement with the app*low app functionality*high levels of app aesthetics*low quality of information through the app*being a female user (consistency: 0.94; raw coverage: 0.30). Finally, the third solution offered by the sufficiency analysis for low levels of

Table 5 Three main conditions of sufficiency analysis for uMARS dimensions, permanence, age and gender (intermediate solution).

Frequency cutoff: 1;	Recommendation			~Recommendation		
	Consistency cutoff: 0.96			Consistency cutoff: 0.95		
	1	2	3	1	2	3
Engagement	●			●	○	
Functionality		●		○	○	○
Aesthetic Information		●	●	○	●	●
Age		●				○
Gender				○	○	
Permanence			●			●
Raw coverage	0.54	0.47	0.46	0.31	0.30	0.29
Unique coverage	0.05	0.01	0.01	0.03	0.01	0.03
Consistency	0.89	0.96	0.93	0.90	0.94	0.91
Total solution consistency			0.86			0.87
Total solution coverage			0.85			70

-, absence (low levels) of condition; ●, presence (high levels) of condition; ○, absence (low levels) of condition. Expected vector for recommendation: 1.1.1.0.1.1 (0: absent; 1: present), expected vector for - recommendation: 0.0.0.0.1.0.0 (0: absent; 1: present) using the format of Fiss (2011).

app recommendation by users was low app functionality*high levels of app aesthetics*young user*long-term user of the service (consistency: 0.91; raw coverage: 0.29). These three solutions were able to explain 31, 30 and 29% of the variance in low levels of recommendation from sports service customers (Table 5).

Discussion and conclusion

This study analysed the evaluations offered by customers of a chain of sports centres about the mobile application used in this sports service. In addition, two complementary methodologies were used to determine their influence on the recommendations offered by these customers about the app.

The last few years have seen a growth in fitness apps that have transformed the way people approach their physical health and well-being. With the growing popularity of smartphones and wearable devices, people can now access a wide range of fitness apps that offer personalised exercise routines and other health-related aspects (Statista, 2002). One of the most significant aspects of fitness apps is the power they have to influence customer behaviour (Ahn and Park, 2023). By providing users with real-time data on their progress, these apps motivate users to stay active, set new goals, and track their progress. In addition, these apps include social aspects that allow users to connect with like-minded people and even share their achievements, further reinforcing healthy habits. The influence of fitness apps is not limited to individuals but extends to companies in the fitness industry. Gyms and fitness centres can take advantage of these apps to promote their services and attract customers by offering personalised exercise routines and training programmes that are tailored to the customer's fitness goals (Elsotouhy et al., 2022).

With regard to the two methodologies used in this study, hierarchical regression and fsQCA, hierarchical regression analyses the engagement produced by the use of the app that has no significance for users' future recommendation of the app. In contrast, for the fsQCA methodology, this dimension of engagement appears to have the most explanatory influence to produce high levels of recommendation of the app in the future. Bardus et al. (2019) concluded that engagement was an important

dimension for achieving sustained app usage. In this same study, engagement was closely related to subjective quality. In this research, engagement was closely related to subjective quality. User engagement encompasses the frequency and duration of app use as well as the user's experience with the technology as a whole.

This paper also shows that the incorporation of socio-demographic variables in the linear models does not significantly influence future app recommendations. However, when observing the results of the fsQCA method, it can be seen that both gender and age influence the different paths for high or low user recommendations for the app. This variation in the results obtained according to the different methods used has been shown by previous research studies (González-Serrano et al., 2018; Guasp Coll et al., 2020).

The fsQCA sufficiency analysis shows that gender influences recommendations to use the app since for both positive and negative recommendations, women appear within the combination of variables. Generally, with respect to the perceptions of fitness centre users, women tend to score higher on the service quality and loyalty dimensions than men do (García-Pascual et al., 2020; León-Quismondo et al., 2020). León-Quismondo et al. (2020) found that both women and men have the same priorities, but women give these priorities more importance. Baer et al. (2022) recently claimed that the existence of gender differences might depend on the app itself and therefore do not indicate a general difference for all. The analysis of the linear model focused on the individual contribution of each variable without analysing the interaction between the different independent variables. For this reason, we chose to use the fsQCA analysis model, which allowed us to determine the combination of different variables that explain a result (equifinality).

The results obtained by the fsQCA method show that none of the conditions is necessary, but there are sufficient combinations of sets to explain positive recommendations of the app. The combination that best explains the high recommendations of the app by users of the sports service is being a woman and positively valuing the engagement provided by the app. Flaherty et al. (2021) evaluated health apps and concluded that women's application of the app boosted their engagement with the app. On the other hand, the dimension that measures the app's information appeared in two of the three combinations for high recommendations. This dimension analyses aspects such as the quality, credibility or accuracy of the mobile application. The accuracy of the information is of great relevance in health-related applications since users select apps based on their perception of the quality of the design and ease of use (Bardus et al., 2019). The quality of an app is essential to its effectiveness; users are more likely to continue using an app if it provides value and meets their expectations.

Some papers argue for a direct relationship between the weekly frequency of users of a fitness centre and future recommendations of it (Gonçalves et al. 2016). This research showed that having attended the fitness centre for a long time, measured by permanence, influenced different combinations of high and low recommendations of the application. Valcarce-Torrente et al. (2021) concluded that the degree of permanence and loyalty was related to users' commitment and continued use of mobile applications. In this research, the QCA sufficiency analysis showed that adult users and elderly users appear in the combinations for high app recommendations. However, for low recommendations of the mobile application, it is young users who appear in these combinations. This result is analogous to the result of a systematic review of the use of fitness apps by Angosto et al. (2020), which concluded that age is a significant factor that affects the intention to use fitness and physical activity apps.

Finally, for low app recommendations, the functionality dimension that evaluates performance, ease of use and navigation influences all paths, showing that low levels of this functionality influence low recommendations. Therefore, it is crucial for companies that develop these fitness applications to prioritise both quality and relevance in the design of their applications. A poorly designed or irrelevant app can frustrate users and harm their health and well-being. Users must be able to trust that the information and guidance provided by the app is accurate and safe.

Although the two methodologies used in this research, were complementary and should be used together for complete information, the results obtained with the fsQCA method provide greater information because this method allows for a combination of explanatory factors. The results obtained with the fsQCA method provide more information by allowing for the combination of explanatory factors, as demonstrated in different works in the literature (Dos-Santos et al., 2023; Escamilla-Fajardo et al., 2022; Guasp Coll et al., 2020; Villanueva et al., 2022). In view of the above, the main conclusions of this article are as follows.

—Women who find that they use the app frequently and find it interesting give the most positive recommendations for its use.

—For users to be loyal to the use of the app, in terms of quality, the app must provide value, and the user must see that it meets pre-established expectations.

—Age is a significant factor that influences the practice of physical activity as well as the intention to use the app. Older users are found in the combinations that make positive recommendations for the use of the mobile application.

Based on the findings of this study, various limitations are apparent. One of the limitations to the use of fitness apps is that in some cases, they cannot take into account the specific needs and objectives of each user as well as the existence of some pathology or disease of the user and that the application does not run the correct recommendation or custom training. Another limitation found in this study was the size of the sample; the perceptions of the customers of only a single private fitness centre were analysed. Another limitation may be that this research analysed the context of a single country, in this case, Spain.

Additionally, this model only analysed the variables that consider the quality of the mobile application and its relationship with app recommendations. However, it remains unclear whether there are significant relationships with other variables, such as user satisfaction or loyalty to the service. For this reason, future research should incorporate more complex algorithms that analyse more subjective options, such as pathologies or preferences, thus increasing the benefits of the application and, consequently, obtaining good recommendations for the app and the sports service. This can also be related to obtaining larger and more representative samples to analyse users' perceptions of the quality of the apps offered by fitness centres and sports services. It is possible to analyse how these services are managed to determine whether there are differences from public sports centres. Comparison of the quality of the app with others that offer similar services could also provide interesting results. Finally, future research could analyse the possible relationship between recommendations of the application and users' loyalty to the sports service to obtain valuable information for sports managers for better and more profitable management.

Additionally, it is important to note that while technology can be beneficial, it should be used in conjunction with traditional training methods rather than replacing them. It is a priority for the managers of these sports centres to guarantee that the implementation of the technology is carried out in a responsible manner while taking into account the privacy and security of user data. Additionally, this work shows the relevance of using two different analysis methods. Although these methodologies have

different objectives and are used separately, sports managers can combine them in a complementary way. The results obtained in this way provide more relevant information for the literature and, in turn, for the management of these sports services.

Data availability

Data sharing is not applicable to this research as no data were generated or analysed.

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Author contributions

Introduction, FG-P; software, FC and JG-F; method, JG-F and FC; procedure, MV-T and FG-P; results, FC and JG-F; discussion, FG-P and MV-T. All authors have read and agreed to the published version of the manuscript.

Competing interests

The authors declare no competing interests.

Ethical approval

The Ethics Department and the Human Research Committee of the university where this research was carried out do not consider ethical approval necessary to conduct an opinion survey on a professional situation or a topic with different aspects.

Informed consent

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

Additional information

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