Analyzing motivation for tele-exercise in adult fitness app users

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Background: Tele-exercise—using mobile apps or digital platforms—has expanded access to guided physical activity, potentially contributing to public health. The motivational mechanisms that drive individuals to use mobile fitness apps may differ from more traditional forms of exercise and remain limited. Given that motivation undeniably plays a role in the uptake and maintenance of exercise, this study aims to provide insight into the motivational regulation of tele-exercise users, based on the self-determination theory.

Methods: An *ad hoc* scale was developed. Exploratory (EFA) and confirmatory factor analyses (CFA) were conducted to assess the psychometric properties of the scale. Data were inferentially analysed using the Mann-Whitney *U* test, Kruskal-Wallis test, and Bonferroni *post hoc* tests.

Results: The *ad hoc* scale showed adequate consistency indices with reliability values ≥0.83, for all (i.e., intrinsic, identified, introjected) motivation dimensions. CFA confirmed the factor structure, with loads >0.51, and composite reliabilities 0.54 to 0.74, for each factor. Construct validity was proven adequate through adjustment of indices tests [Comparative Fit Index (CFI) =0.990; Tucker & Lewis Index (TLI) =0.976, root mean square error of approximation (RMSEA) =0.058]. Statistically significant differences were found relative to sex, previous activity level and fitness goal, for some but not all motivation types (n=753). No statistically significant differences were found for motivation, relative to age.

Conclusions: The common understanding that intrinsic motivation is desirable for sustained behavior change may need to be reinterpreted for the field of leisure-time, tele-exercise. These findings provide new insights into how motivation varies among fitness app users and suggest that digital interventions may benefit from reframing motivational strategies to better support exercise adherence.

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Introduction

Physical exercise has been shown to lead to beneficial health outcomes, especially when undertaken on a regular basis (1). Regular physical activity (PA) offers substantial physical and mental health benefits across all age groups. In adults, it helps prevent and manage immunomodulation (2), noncommunicable diseases such as cardiovascular diseases (3), cancer (4), obesity and diabetes (5), while also reducing symptoms of depression and anxiety (6) and supporting brain health (7) and overall well-being. Despite these benefits, 31% of adults and 80% of adolescents fail to meet recommended activity levels (8).

In recent years, the integration of technology has led to the emergence of tele-exercise, a subset of telehealth that delivers PA interventions remotely through telecommunications technology. This approach aims to make exercise programs more accessible, overcoming barriers such as geographic limitations and mobility constraints. Tele-exercise involves the remote delivery of exercise programs using various communication technologies, including video conferencing, mobile applications, and web-based platforms. This method allows individuals to engage in guided physical activities without the need to be physically present at a fitness facility or healthcare center (9-11). The primary goal is to provide flexible, accessible, and personalized exercise options that cater to diverse populations. Tele-exercise could be embedded within the term mobile health (mHealth), which according to the World Health Organization (WHO) includes both health and medical apps (12).

Research reflects that motivational level and prior expectations impact our commitment to PA (13). In line with this thought, motivation has been found to be a critical factor in sustaining PA and physical exercise (14,15). The self-determination theory (SDT) is a macro theory of human motivation and personality which posits that there are two main types of motivation—intrinsic and extrinsic—and that both are powerful forces in shaping who we are and how we behave (16,17). It establishes that some kind of self-determination underlines every human decision. It is based on the assumption that humans are growth-oriented, and growth occurs via interactions with the environment (18). According to SDT, and while different types of motivation are not self-excluding, intrinsic motivation comes from within (17) and intrinsically motivated individuals primarily value the sense of satisfaction and pleasure (19). Examples of internal drives that may inspire human behaviors include our interests, core values and sense of morality (20). Extrinsically motivated individuals, on the other hand, feel the drive to show a given conduct based on external sources (17) and perform activities to obtain reward that has no direct connection to the activity itself (17,19).

A better understanding of the extrinsic and intrinsic factors that stimulate PA has been pointed as essential in the prevention and treatment of some non-communicable

Highlight box

Key findings
- A new 10-item scale was developed and validated to assess motivation in users of a mobile fitness application.
- Three different motivation dimensions were identified: intrinsic, identified extrinsic, and introjected extrinsic motivation.
- Motivation levels varied according to sex, prior activity level, and fitness goals, but not age.
- Values for extrinsic motivation were higher than intrinsic, even among experienced fitness app users.

What is known and what is new?
- Motivation is a key factor influencing physical activity.
- Exercise motivation has been explored in traditional and clinical settings, but less is known about tele-exercise in healthy adult users.
- An self-determination theory-based scale specifically designed for app-delivered exercise provides new insights into the motivational profiles of fitness app users.

What is the implication, and what should change now?
- Tele-exercise designers should consider both intrinsic and extrinsic motivational factors when creating fitness apps.
- Designing digital exercise interventions based on user characteristics may increase engagement and adherence.
- Future interventions should incorporate evidence-based motivation strategies to better sustain tele-exercise.

diseases (21). A systematic review in 2012 found that identified regulation -a type of extrinsic motivation, predicted the initial and short-term adoption of exercise more strongly than intrinsic motivation. Notably, intrinsic motivation emerged as a stronger predictor of long-term adherence (15). However, a 2022 cluster analysis suggests that adult motivation for PA may be influenced by a combination of extrinsic and intrinsic factors, rather than relying solely on one type (22). Another analysis also reveals variations by sex (23). Furthermore, the complexity of understanding motivation is underscored by the challenge of measuring its dynamic changes over time (23,24).

To assess the motives and goals of adult exercisers, several scales have been designed and utilized in the past. The scales vary in terms of range of motives they encompass and their alignment with SDT (25). Excluding those specifically tailored for sports, a diverse array of scales has been developed to assess the motives and goals of adult exercisers (22,26-37).

Modern time has brought along a shift toward e-health and mobile applications. In 2015, Litman *et al.* estimated that the market already boasted over 1,000 exercise apps (38). In 2016, the World Health Organization issued a recommendation that digital health interventions be used to promote and support participation in PA (39). Following the coronavirus disease 2019 (COVID-19) pandemic, in February 2021, the number of health and fitness apps was determined at 79,730 (unique ids for the iOS App Store alone) (40). In spite of this, research on PA motivation in mobile application interventions remains limited (41).

This reality has opened windows of opportunity to different ways of motivating individuals to participate in synchronous or asynchronous tele-exercise sessions. Recently, several authors have already highlighted motivation as a dimension of adherence in mobile apps (42,43). Motivation has been extensively reviewed for traditional forms of exercise, and in clinical settings. Recently, systematic reviews have been published on intention to use fitness apps (44), satisfaction and dissatisfaction (45), user experience (46) and use of gamification to increase participation (47). Research on motivation to use app-delivered, leisure-time physical exercise, on the other hand, remains scarce even though it has been stated that fitness apps are “one of the necessities in our lives” (46). Our hypothesis is that motivation to exercise using mobile fitness apps can be effectively assessed through a multidimensional scale based on SDT, and that different motivational dimensions vary across user characteristics such as sex, age, previous PA level, and personal fitness goals. Thus, the objective of this study is to identify and compare the levels of distinct motivation types—intrinsic, identified extrinsic, and introjected extrinsic—among adult users of a fitness mobile application, relative to sociodemographic variables, using a newly developed scale informed by SDT.

Methods

Study design

This observational study aimed to understand individual motivation to physically exercise using tele-exercise, and the Mammoth Hunters (MH) fitness application in particular. MH was a fitness app launched in 2014 by a team of fitness experts and scientists in Barcelona, Spain. It promoted asynchronous tele-exercise through interval workouts requiring no heavy equipment, designed to be done anywhere, and aimed to improve strength, endurance, and mobility by encouraging natural movement patterns inspired by the active lifestyle of early humans. The app offered both a free version with limited access and a premium subscription with personalized plans and advanced tracking tools. MH accumulated over 719,000 users, both for Android and iOS, before ceasing operations in September 2021.

The study sample consisted of 753 participants. Inclusion criteria included being 18 years old, being actively subscribed to the MH newsletter mailing list, and having an account on the MH fitness app. Participation was voluntary, and no remuneration or rewards were offered to participants.

Development and analyses of the ad hoc scale

The accurate types of motivational regulation in fitness users were thought to be measurable and potentially useful towards the design of tailored strategies to promote engagement. Previous research is available that confirms this hypothesis, such as the study by Geller *et al.*, which showed that people who stayed active over time had higher levels of intrinsic and extrinsic motivation than those who did not (48). A scale was required that would prove reliable to assess motivation in users of asynchronous, app-delivered, interval leisure-time exercise. A theoretically-informed *ad hoc* scale was developed, based on SDT constructs. *Figure 1* reflects the stages followed for scale development.

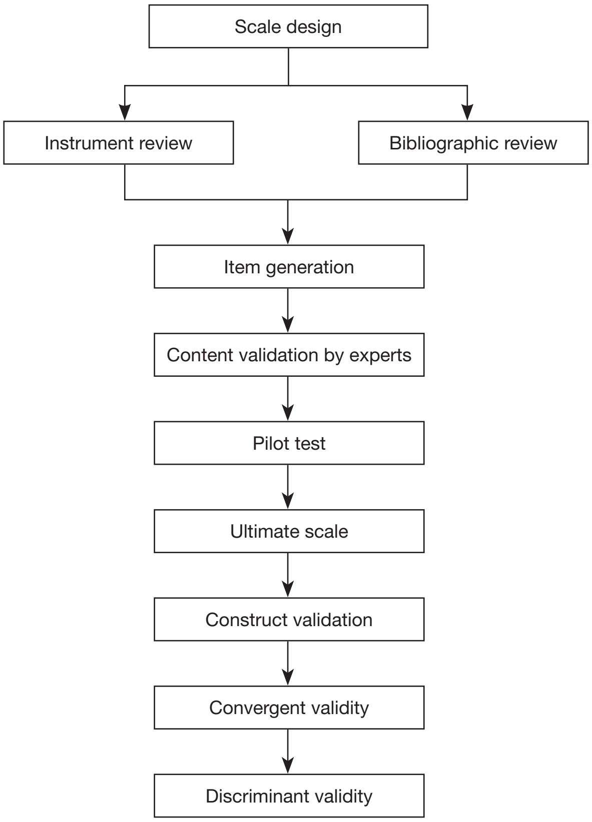

Figure 1 Stages of scale development.

Item development

The domain of interest was set to be human motivation to exercise physically by using fitness apps. A thorough literature search on the theoretical groundings of the construct and the available measuring tools was carried out and related measuring scales were studied.

A pool of items was generated. Items aimed to adequately capture the experiences of the app users, and to be expressed in a clear, respectful manner. Response options were structured in a 5-point Likert-style fashion, where 1 stood for ‘completely disagree’ and 5 equaled ‘completely agree’. The scale was subjected to assessment by a group of five academics. For each of the items, this group of experts was asked to express the sense of the conceptual content, and any potential difficulty one could encounter in understanding the written text. Their input and suggestions were implemented, the text was revised and potentially confusing sentences were simplified for easier interpretation. Based on the SDT, a dual probability (intrinsic *vs.* extrinsic motivation) was expected.

Scale development

An invitation was sent via email to 150,000 app users on March 20, 2022 whereby their voluntary participation was requested to participate in the survey. The mailing list consisted of those users who were subscribed to the app’s newsletter, at the time. The scale was delivered via Google Forms in Spanish language.

The scale was pretested on a subsample of users who responded to the survey but for whom no other data (i.e., sociodemographic; training) were available. A final study sample was selected for whom motivation, sociodemographic and training data were readily available, making full analysis possible.

The first stage towards the assessment of validity for the scale consisted of reliability and exploratory factor analysis (EFA) techniques. The total sample (n=753) was randomly divided into two groups: sample for EFA (n=377) and sample for confirmatory factor analysis (CFA) (n=376).

The items used were of a polytomic nature and did not present a normal distribution. Accordingly, the EFA was performed from a polychoric correlation matrix, by using the Unweighted Least Squares method (49). EFA analysis stemming from the polychoric correlations was carried out with Factor 10.8.04 software (50). EQS 6.2 for Windows was used for the CFA of the model, as well as for the measurement of invariance. The Robust maximum likelihood estimation method was chosen for the calculation of goodness of fit indices, as well as residuals, given its lesser sensitivity to the lack of multivariate normality (Mardia’s coefficient >5) the distribution of the resulting data presented.

Statistical analysis

Analyzed variables included sex (i.e., female *vs.* male), age, self-declared level of PA (i.e., inactive, active, very active), body mass index (BMI; based on declared height and weight), self-declared fat percentage (chosen based on images that best represented body type) and self-declared fitness goal (i.e., gain muscle, lose weight, anti-aging). Descriptive statistics were performed for all study variables to characterize the sample and summarize motivation scores. Given the non-normal distribution of the data, non-parametric tests were selected for inferential analysis. To assess differences in motivation dimensions across variables, the Mann-Whitney *U* test was used for comparisons between two groups (e.g., male *vs.* female), while the

Kruskal-Wallis test was applied for comparisons among more than two groups (e.g., age ranges, self-declared PA level, or fitness goals). When significant differences were detected, Bonferroni-adjusted *post hoc* tests were conducted to determine between which specific groups the differences occurred. Effect sizes were reported to complement p-values and provide information about the magnitude of observed effects. Statistical significance was defined as P<0.05. All analyses were conducted using SPSS (version 29.0).

Ethical statement

This study was conducted in accordance with the Declaration of Helsinki and its subsequent amendments, and the applicable national and international legislation on this matter, as well as The Charter of Fundamental Rights of the European Union. The investigation follows the rules that refer to the General Data Protection Regulation (GDPR), Regulation (EU) 2016/679; and privacy and confidentiality of data (LOPDGD) Organic Law (3/2018 of December 5) on the Protection of Personal Data and guarantee of Digital rights. Ethical approval was obtained from the Research Ethics Committee of the Ramon Llull University, in March 2020 (No. 1920003P). Participation was taken as proof of acceptance of the informed consent.

Results

Results of the validity analyses for the scale

Responses were received from a total of 2,328 users (response rate =1.55%), who voluntarily agreed to participate by providing their answers to the survey. A subsample was extracted, consisting of those whose training data was additionally available for later analysis. The sample consequently consisted of 753 MH users. The age of the users ranged from 20 to 78 years, with a median age of 45 years and an average age of 45.73 years. In terms of sex distribution, 48.93% of the users were female, and 51.07% were male.

Reliability and EFA

EFA on the 16-item prototype scale led to the identification of the most significant indicators and reflected three existing dimensions. A resulting scale, consisting of 10 items was generated. EFA was conducted on a random split-half sample of the data (n=377) to examine the factor structure of the 10-item scale (Appendix 1).

Upon application of the EFA, the resulting index for the Kaiser-Meyer-Olkim test for sample adequacy equaled 0.803 (close to 1), and the Bartlett's Test of Sphericity was significant [P<0.001; χ^2=943.9; (df=45)]. The results of the Exploratory Factor Analysis (EFA), derived from the polychoric correlation matrix (Unweighted Least Squares and direct Oblimin rotation), identified three extracted factors. These factors accounted for 68.6% of the total variance and demonstrated adequate fit [Comparative Fit Index (CFI) =0.990; Tucker & Lewis Index (TLI) =0.976]. The decision to keep 3 differentiated factors in the extraction was confirmed by the values obtained of the root mean square error of approximation (RMSEA) =0.058 (between 0.050 and 0.080: fair) and Goodness of Fit Index (GFI) =0.994 (>0.95), as well as the root mean square of residuals (RMSR =0.037), which was lower than the expected mean RMSR value, as per Kelley's criterion (0.0516). All three subscales showed high internal consistency indexes: reliability (Based on the results of the Explained variance of rotated factors and reliability of phi-information oblique Expected A Posteriori (EAP) scores calculation, for Factor 1 =0.949; reliability for Factor 2 =0.830; reliability for Factor 3 =0.831. Homogeneity indexes were also satisfactory, with item-total correlations above 0.4, for each of the indicators.

Taking these results into consideration, the resulting latent variables were conceptualized, according to the observable variables. This lead to the realization that the construct 'motivation to exercise through mobile app' can be structurally set up into three components or dimensions: (I) intrinsic motivation (when the individual's drive to follow a PA program is grounded on internal factors which generate a sense of satisfaction), (II) introjected extrinsic motivation (i.e., the cause for an individual to follow a PA program is a desire of self-approval); (III) identified extrinsic motivation (i.e., when external factors lead the person to follow a PA program, because they find it valuable and they regard it as important). Intercorrelations were significant for all of the resulting factors, and a second factor EFA revealed that they presented a unidimensional factorial structure. Consequently, and derived from the factorial synthesis of the 10 items, a second order factor was obtained. This factor accounted for 71.57% of the variance and was conceptually interpreted as "motivation to adhere to fitness app-delivered physical exercise". The construct can operationally be defined as "a given individual's drive to pursue a physical exercise program to satisfy their basic psychological, competence and relational needs."

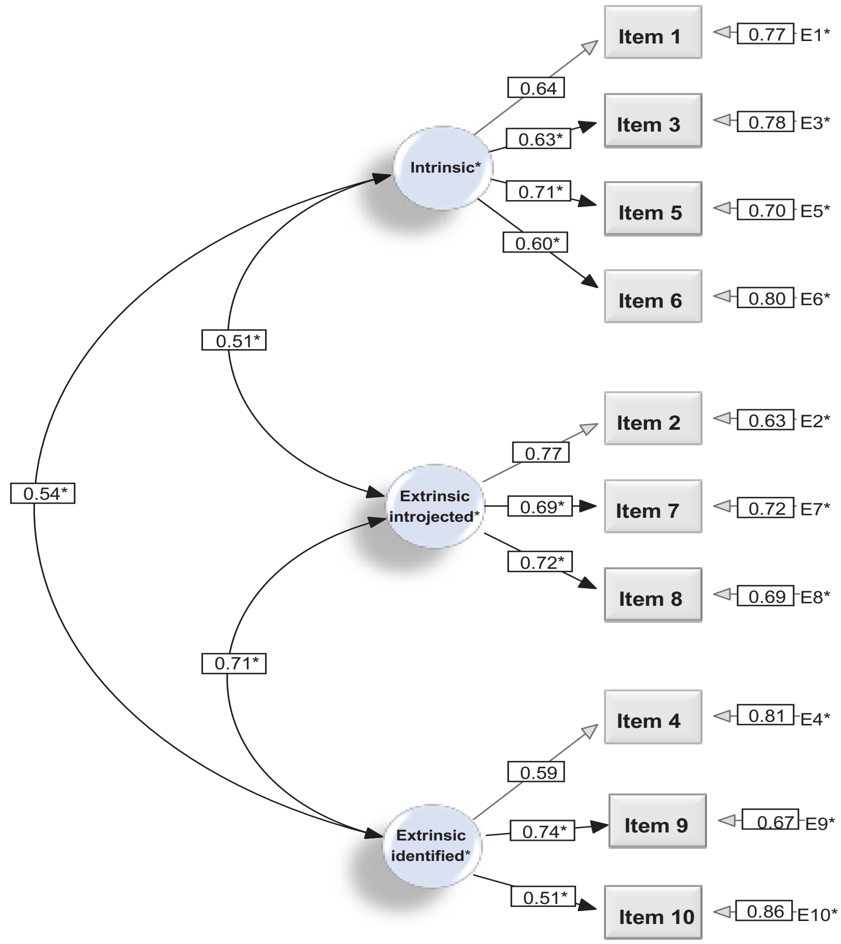

Figure 2 Standardized parameter estimates for the measurement model of the scale (n=376). *, P<0.001.

CFA

To confirm the factor structure, a CFA was conducted in the second random sample (n=376). Two rival measurement models (both plausible from a theoretical and empirical standpoint) were assessed upon the sample. Results suggest that the model with three correlated factors presented the most satisfactory adjustment indexes.

Satorra-Bentler (S-B) scaled χ^2 statistic was significant, a common occurrence in a large sample (S-B χ^2=93.17; df=32; P<0.001). The model's Parsimonious fit (normed chi-square =2.91) was within the recommended ranges (Iacobucci, 2010). When checking for adjustment, the Normed Fit Index (NFI) showed a value =0.876, the Non-Normed Fit Index (TLI) =0.879 and the CFI = 0.914. All the aforementioned values indicated satisfactory goodness of fits. Additionally, the RMSEA (Hu and Bentler, 1999) was 0.071, with a 90% confidence interval 0.055 to 0.088, indicative of an adequate fit. If these results are compared with those obtained using the Maximum Likelihood estimation method, we can see that the indices improve slightly, but not the RMSEA value, which has a higher value than with the Robust method: χ^2=107.25 (df=32; P<0.001); the normed chi-square =3.35; NFI =0.894, TLI =0.891; and CFI =0.922; and RMSEA =0.079, with a 90% confidence interval 0.063 to 0.096.

Results from all index calculations showed adequate adjustment between the postulated theoretical model and the data derived from the sample. As seen in *Figure 2*, indicators showed factorial loads >0.51, and composite reliabilities (CR) between 0.54 and 0.74 for each construct. Factor average variance extracted (AVE) ranged between 0.28 and 0.4, reflecting acceptable convergent validity (51).

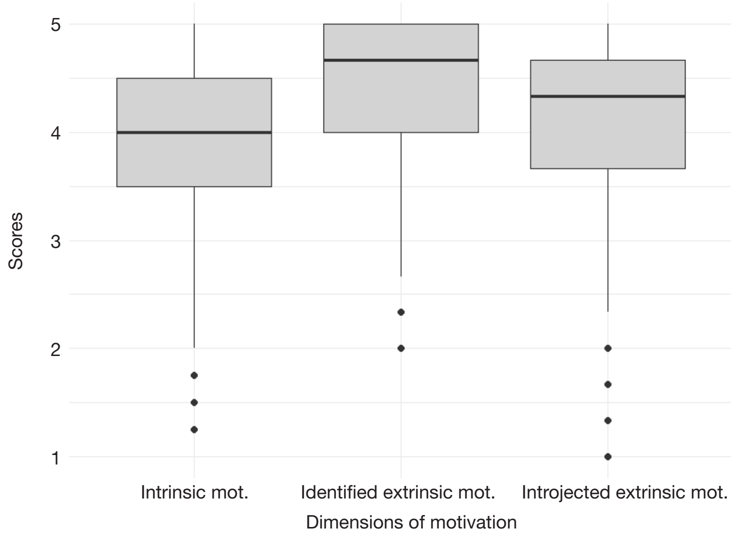

Figure 3 Boxplots of the distribution of motivation dimension scores.

Lastly, the construct was checked for discriminant validity. The square root of AVE showed greater correlation values for this construct, compared to those with other latent constructs (52). On top of this, maximum shared variance and average shared variance values were below those of the AVE, therefore complying with the standards recommended by Hair *et al.* (53).

Results for motivation analysis in fitness app users (n=753)

The sample consisted of 753 individuals (51.1% males), age range 45 through 54, with self-reported fat percentages of 24.1 (SD =9.4) for males and 23.7 (SD =7.1) in females. 11.23% of respondents self-declared as 'very active', 56.02% were 'active', and 32.75% were 'inactive'. Their BMI ranged from 10.30 to 41.66, with a median BMI of 23.71 and an average BMI of 24.31 kg/m^2. Subjective body fat percentage among respondents ranged from 6% to 50%, with a median of 25% and an average of 23.87%. According to the self-declared fitness goal, 43.45% wished to 'lose weight', 39.04% aimed to 'gain' muscle mass, and 17.51% pursued 'anti-aging' effects.

Results to the descriptive analyses of motivation levels in the study showed a mean score of 3.90 (SD =0.82) for intrinsic motivation; a mean of 4.38 points (SD =0.58) for identified extrinsic motivation; and a mean of 4.15 points (SD =0.74) for introjected extrinsic motivation (see *Figure 3*).

Exploratory analysis of motivation types was conducted, relative to sex, age range, self-reported level of activity, and personal training goals.

Differences by sex

Differences according to sex were found for all three types (i.e., intrinsic, identified extrinsic, introjected extrinsic) of motivation with males showing, overall, the highest figures. Differences were statistically significant for intrinsic motivation (P=0.01; ηp^2=0.038) and for introjected extrinsic (P=0.006; ηp^2=0.031) on the Mann-Whitney test (see *Table 1* and *Figure 4*), and not significant for identified extrinsic motivation (P=0.44; ηp^2=0.010).

Differences by age group

As shown in *Table 2*, no statistically significant differences were found among age ranges using the Kruskal-Wallis test for intrinsic motivation (P=0.61; ηp^2=0.012), identified extrinsic motivation (P=0.28; ηp^2=0.021), or introjected extrinsic motivation (P=0.79; ηp^2=0.016). However, statistically significant differences were observed before the adjustment between the age groups 31–35 and 56–60 years (P=0.02) for identified extrinsic motivation, with the older group showing higher values for this motivation dimension. Statistically significant differences were also found before the adjustment between the age groups 20–25 and 31–35 years for identified extrinsic motivation, with the latter group showing higher values (P=0.01).

Table 1 Dimensions of motivation, relative to sex (n=753)

Dimension	Gender		U	ηp^2	P
	Female (n=368)	Male (n=385)			
Intrinsic	3.78 (0.90)	3.99 (0.71)	78,452.00	0.038	0.01*
Identified, extrinsic	4.44 (0.55)	4.47 (0.54)	73,078.00	0.010	0.44
Introjected, extrinsic	4.07 (0.77)	4.22 (0.70)	78,917.00	0.031	0.006**

Data of gender are presented as mean (SD). *, P≤0.05; **, P≤0.01. ηp^2, partial eta squared; SD, standard deviation; U, Mann-Whitney's U value.

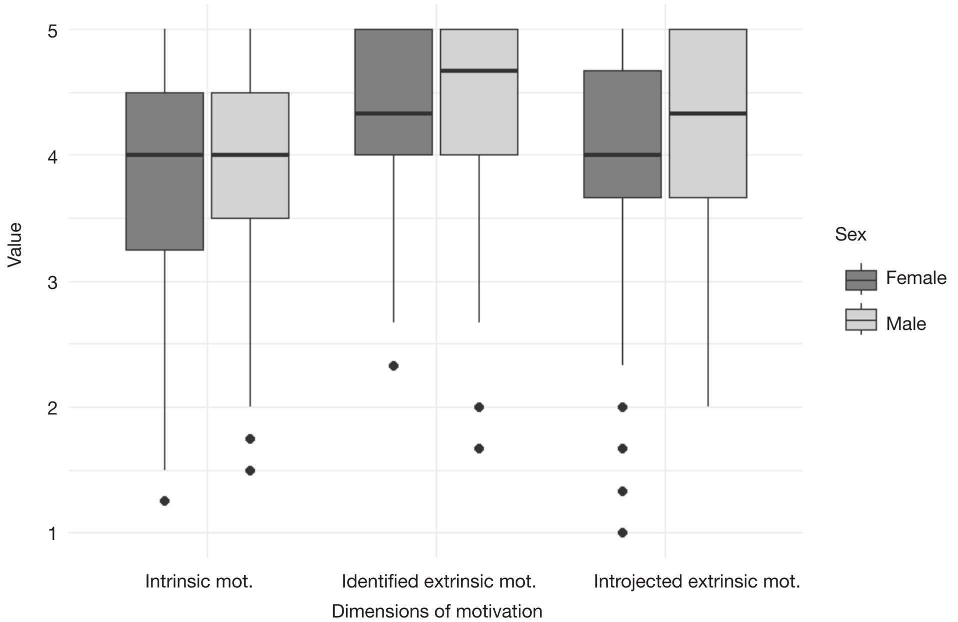

Figure 4 Box plots of the distribution of motivation scores by sex.

Differences by previous self-declared level of PA

The differences between the three levels of declared previous PA at registration were highly statistically significant for intrinsic motivation (P<0.001), identified extrinsic motivation (P<0.001) and introjected extrinsic motivation (P=0.004), with a moderate-to-low effect size (ηp^2<0.02) for extrinsic motivations, and strong effect size for intrinsic motivation (ηp^2=0.18) (*Table 3*).

Post hoc comparisons showed statistically significant differences between all pairs of activity levels for intrinsic motivation. That is: 'active' *vs.* 'inactive' (U=9.19; P<0.001), 'very active' *vs.* 'inactive' (U=9.85; P<0.001), and 'very active' *vs.* 'active' (U=4.25; P<0.001). Levels were highest among individuals who declared themselves as 'very active' (*Table 4*).

For identified extrinsic motivation, *post hoc* comparisons showed statistically significant differences between some pairs of activity levels: 'very active' *vs.* 'inactive' (U=3.52; P=0.001) and 'active' *vs.* 'inactive' (U=2.67; P=0.02). The highest levels of identified extrinsic motivation were found for 'very active' individuals. No statistically significant differences were found between 'very active' and 'active' individuals.

Finally, *post hoc* comparisons for introjected extrinsic motivation also showed significant differences between some pairs of activity levels: 'very active' *vs.* 'inactive' (U=3.29; P=0.003), and 'very active' *vs.* 'active' (U=2.63; P=0.03). Introjected extrinsic motivation was highest in 'very active' individuals. No statistically significant differences were found between 'inactive' and 'active' respondents.

Table 2 Motivation dimensions, relative to age range

Dimensions	Age range, years	n	M	SD	H	P	ηp^2
Intrinsic	20–25	13	3.54	1.07	6.373	0.61	0.012
	26–30	12	3.94	0.51			
	31–35	54	4.01	0.83			
	36–40	86	3.96	0.84			
	41–45	219	3.88	0.77			
	46–50	163	3.84	0.83			
	51–55	114	3.93	0.87			
	56–60	55	3.85	0.89			
	≥61	34	3.95	0.62			
	Total	750	3.89	0.82			
Identified, extrinsic	20–25	13	4.15	0.63	9.856	0.28	0.021
	26–30	12	4.56	0.48			
	31–35	54	4.56	0.52			
	36–40	86	4.47	0.55			
	41–45	219	4.45	0.57			
	46–50	163	4.46	0.51			
	51–55	114	4.47	0.54			
	56–60	55	4.33	0.57			
	≥61	34	4.43	0.54			
	Total	750	4.45	0.55			
Introjected, extrinsic	20–25	13	3.87	1.32	4.632	0.80	0.016
	26–30	12	4.39	0.63			
	31–35	54	4.15	0.67			
	36–40	86	4.08	0.81			
	41–45	219	4.17	0.71			
	46–50	163	4.13	0.72			
	51–55	114	4.23	0.67			
	56–60	55	4.11	0.85			
	≥61	34	3.98	0.71			
	Total	750	4.14	0.74			

Multivariate analysis of variance (n=750). H, Kruskal Wallis H value; M, mean; ηp^2, partial eta squared; SD, standard deviation.

Differences by declared fitness goal

The preliminary analysis by Kruskal-Wallis test showed highly statistically significant (intrinsic motivation P<0.001; identified extrinsic motivation P=0.006; introjected extrinsic motivation P=0.002) differences between groups, relative to individual fitness goals, with a low-to-moderate (ηp^2 between 0.03 and 0.06) effect size. This was observed for all three dimensions of motivation (*Table 5*).

A more in-depth analysis for intrinsic motivation showed that there were no statistically significant differences

Table 3 Motivation dimensions, relative to self-reported level of physical activity at registration

Dimension	Activity level	M	SD	H	ηp^2	P
Intrinsic	1. Very active	$4.42_{(2)\,(3)}$	0.54	129.79	0.180	<0.001***
	2. Active	$4.06_{(1)\,(3)}$	0.68			
	3. Inactive	$3.42_{(1)\,(2)}$	0.88			
Identified, extrinsic	1. Very active	$4.58_{(3)}$	0.53	14.31	0.019	<0.001***
	2. Active	$4.49_{(3)}$	0.51			
	3. Inactive	$4.35_{(1)\,(2)}$	0.60			
Introjected, extrinsic	1. Very active	$4.38_{(2)\,(3)}$	0.58	10.82	0.017	0.004**
	2. Active	$4.15_{(1)}$	0.72			
	3. Inactive	$4.05_{(1)}$	0.80			

Multivariate analysis of variance (n=753, of which n=84 very active; n=422 active and n=247 inactive). The activity levels with which they present significant differences are shown in parentheses (Bonferroni *post hoc* test; P<0.05). **, P<0.01; ***, P<0.001. H, Kruskal Wallis H value; M, mean; ηp^2, partial eta squared; SD, standard deviation.

Table 4 *Post hoc* comparison of motivation factors by declared level of previous physical activity

Motivation	Comparison	*U*	P
Intrinsic	Active-Inactive	9.19	<0.001***
	Very Active-Inactive	9.85	<0.001***
	Very Active-Active	4.25	<0.001***
Identified, extrinsic	Active-Inactive	2.67	0.02*
	Very Active-Inactive	3.52	0.001**
	Active-Very Active	1.93	0.16
Introjected, extrinsic	Active-Inactive	1.27	0.61
	Very Active-Inactive	3.29	0.003**
	Very Active-Active	2.63	0.03*

*, P<0.05; **, P<0.01; ***, P<0.001. P, adjusted P value; *U*, Mann-Whitney's *U* value.

(P=0.83) between the 'anti-aging' and 'lose weight' groups. However, statistically significant differences (*U*=−4.60, P<0.001) were found when comparing the 'gain muscle' and 'lose weight' groups, with the 'gain muscle' group showing the highest figures. Additional statistically significant differences (*U*=2.46, P=0.042) were observed between the 'gain muscle' and 'anti-aging' groups, being the results in the 'gain muscle' group higher (*Table 6*).

Regarding identified extrinsic motivation, no statistically significant differences (*U*=−2.14, P=0.10) were found when comparing the 'lose weight' with the 'anti-aging' group, nor when contrasting the 'gain muscle' to the 'anti-aging' group (*U*=0.18, P>0.99). On the other hand, differences were statistically significant (*U*=−2.99, P=0.008) between the 'gain muscle' (higher identified) and 'lose weight' (lower) groups.

For introjected extrinsic motivation, differences were not statistically significant (*U*=−1.48, P=0.42) between the 'lose weight' and the 'anti-aging' groups, nor between the 'gain muscle' and the 'anti-aging' groups (*U*=1.30, P=0.58). Statistically significant (*U*=−3.59, P=0.001) differences were observed between the 'gain muscle' (higher introjected) and the 'lose weight' groups (lower).

Figure 5 summarizes the observed correlations between motivation and study variables. Notably, sex, PA level, and fitness goal were positively associated with motivational measures, whereas age demonstrated a divergent pattern,

Table 5 Dimension of motivation, relative to self-declared training goals

Motivation	Goals	M	SD	H	ηp^2	P
Intrinsic	1. Lose	$3.77_{(2)}$	0.83	21.56	0.052	<0.001***
	2. Gain	$4.05_{(1)(3)}$	0.76			
	3. Anti-aging	$3.85_{(2)}$	0.82			
Identified, extrinsic	1. Lose	$4.37_{(2)(3)}$	0.59	10.18	0.039	0.006**
	2. Gain	$4.52_{(1)}$	0.49			
	3. Anti-aging	$4.51_{(1)}$	0.50			
Introjected, extrinsic	1. Lose	$4.04_{(2)}$	0.76	12.93	0.039	0.002**
	2. Gain	$4.26_{(1)}$	0.69			
	3. Anti-aging	4.15	0.76			

Multivariate analysis of variance (n=753). The self-declared training goals with which they present significant differences are shown in parentheses (Bonferroni *post hoc* test; P<0.05). **, P<0.01; ***, P<0.001. H, Kruskal Wallis H value; M, mean; ηp^2, partial eta squared; SD, standard deviation.

Table 6 *Post hoc* comparison of motivation factors by goals

Motivation	Comparison	U	P
Intrinsic	Lose-Anti-aging	−1.09	0.83
	Lose-Gain	−4.60	<0.001***
	Gain-Anti-aging	2.46	0.042*
Identified, extrinsic	Lose-Anti-aging	−2.14	0.10
	Lose-Gain	−2.99	0.008**
	Gain-Anti-aging	0.18	>0.99
Introjected, extrinsic	Lose-Anti-aging	−1.48	0.42
	Lose-Gain	−3.59	0.001**
	Gain-Anti-aging	1.30	0.58

*, P<0.05; **, P<0.01; ***, P<0.001. P, adjusted P value; *U*, Mann-Whitney's *U* value.

showing non-significant correlation with motivation.

Discussion

One of the key contributions of this study is the development of a reliable, 10-item scale to assess motivation among fitness app users. SDT was chosen as the theoretical framework given its wide use and acceptance. An additional reason was that, within the realm of exercise motivation, this theory had previously demonstrated considerable efficacy (54-57). A multidimensional approach was followed based on recommendations by Wilson *et al.* (58).

This study provides new insights into the motivational dimensions of adults engaging in asynchronous, app-delivered tele-exercise. By developing and validating a reliable, SDT-based scale that is able to differentiate between three distinct motivation types—intrinsic, identified extrinsic, and introjected extrinsic—our findings reflect that motivation dimensions vary meaningfully according to sex, prior activity level, and personal fitness goals. Notably, extrinsic motivations were found to be prominent even among experienced users, challenging the widely-spread conventional view that intrinsic motivation is the sole ideal for sustained behavior (59,60).

The age of our respondents ranged from 20 to 78 years, with an average of 45.73 years. Taking into consideration

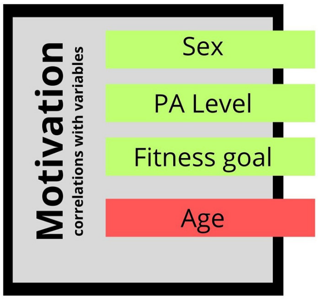

Figure 5 Correlations between motivation and studied variables. In green: statistically significant ($P<0.05$). In red: not statistically significant ($P>0.05$). PA, physical activity.

that our study targeted only the adult population, our results are similar to those presented in Stecher *et al.*'s 2023 systematic review on mobile health application use. Their review studied a total of 3,555 participants whose mean age was 39.6 years, with a standard deviation of 6.5 years (61). The proportion of males they found, across the 22 studied interventions, was 42.8%, while the figures of our study were 51.07%. Our slightly higher percentage could be due to the high-intensity nature of the training programs in the MH app.

Our respondents declared relatively high levels of previous PA (67.25% of respondents self-declared as 'active' or 'very active'). This information is key to interpretation of our results, for it establishes that many of the respondents to our motivation survey were so-called 'maintainers' (25,37,48), as opposed to beginners in regular PA practice. Average BMI was 24.31 kg/m^2, which could be considered within healthy ranges, despite the presence of outliers (e.g., BMIs of 10.30 and 41.66 kg/m^2). It should be noted that all sociodemographic data collected by the app was self-reported by the user upon registration, and need to be interpreted with caution.

Based on both previous quantitative (62) and qualitative (63) findings in China, we were expecting medium-to-high scores in both intrinsic and extrinsic motivation. Our results were well above 2.5 for all motivation dimensions. Mean intrinsic equaled 3.9, mean identified extrinsic was 4.38 and mean introjected was 4.15, in a Likert-type scale from 1 (lowest) to 5 (highest). Extrinsic motivation values were higher than the values for intrinsic motivation. We did not record their current stage of action but several authors have pointed that extrinsic motivation is characteristic of initial stages of exercise behavior (64,65), while the more self-determined regulations (including intrinsic and identified) are characteristic of maintenance stages (65). However, this belief has been refuted by authors such as Buckworth *et al.*, who found no changes in motivation throughout stages, for non-digital exercise (62). In the realm of tele-exercise, continued and sustained use could be attributable to factors such as the user's degree of health consciousness (66) and self-regulation (67), perceived value and usefulness of the software (68-70), complexity of instructions (71-74) and occurrence of app glitches (43), elements of socialization (74-78) and persuasion (79,80), self-efficacy (76,77), degree of self-consciousness (81), exercise identity (82), e-lifestyle factor (83) and potential barriers such as excessive competitiveness (84) or perceived lack of time (85,86). All of these would be worth exploring in future pieces of research.

Evidence so far has repeatedly found that females show increased appearance motives than men (26,58,87-91), even though opposing evidence also exists (92). And evidence also exists that men favor higher intensity programs (93-95) like those in the MH app, over women. The male group in our survey showed higher levels of intrinsic and introjected extrinsic motivation, which partially aligns with the expressed literature. Nonetheless, a deeper, maybe qualitative analysis, would be required to understand the reasons behind these observations. Science has reported men's and women's motives to exercise to be different (56) possibly because of cultural differences (21). However, while it seems to be commonly accepted that men and women have different motives to exercise, there is also broad evidence (collected from a sample of 10,646 exercise maintainers, with over 10 years of experience) that both women and men greatly value factors such as activation, fitness/health and aesthetics (25). Male to female motive differences could therefore have a greater impact in activity selection rather than in the maintenance of a given choice of activity.

In relation to motivation and age, existing research has pointed to age affecting exercise motives (25,89,90) and correlating positively with the importance of health-related motives (32,91,96). Notwithstanding, our data showed no statistically significant differences in motivation across age groups, for any of the analyzed motivation dimensions (i.e., intrinsic, identified, introjected). More research in this area would be advised that contemplates the specificities of the scenario. Evidence to date is contradictory, with authors such as Molanorouzi *et al.* having shown that externally regulated motives are more important for middle-aged adults rather than for young adults (32), and large observational studies—with up to 163,000 participants, pointing in the opposite direction (87,92).

Relationships between self-declared previous level of PA and motivation were expected (22). SDT theory establishes that likelihood of maintained exercise is higher for individuals with higher intrinsic motivation (15). Our finding that previously 'active' or 'very active' individuals showed statistically significant higher levels of intrinsic motivation aligns with this well-established idea. In our study, intrinsic motivation was highest for the group that self-declared as 'very active', which indicates there could have been a correlation between intrinsic motivation and PA dose. In our study, the 'very active' group also showed statistically higher extrinsic (both identified and introjected) motivations, when compared to the 'inactive group'. This seems to contradict abundant previous evidence, including a 2014 large (n=2,308), Finland-based cohort study, which showed that 'inactive' individuals express higher levels of extrinsic motivation ("conforming to others' expectations") than those with higher levels of PA (26). Our findings, which involved a much smaller and digital sample, do not match this statement, but should nonetheless be interpreted with caution as the obtained effect sizes were low for the external forms of motivation.

Interesting findings were encountered when analyzing exercise motivation relative to participant's fitness goal. Our comparisons revealed differences in all three dimensions of motivation, relative to the user's declared fitness goal (i.e., 'gain muscle', 'lose weight', 'anti-aging'). Before us, researchers Ingledew *et al.* had shown that different participation motives predict different regulation processes (97). In our sample, participants in the 'gain muscle' group showed the highest levels for all types of motivation.

Some of our findings seem opposed to foundational instruction from the SDT. For instance, people who pursued 'anti-aging' goals—which in SDT could be interpreted as a highly identified motivation, did not show differences when compared to people pursuing muscle 'gain'—which in SDT could have been interpreted as a less self-determined motivation (98). Similarly, our results did not show higher externally regulated motivations in individuals pursuing weight loss. This could arguably be due to goals of 'muscle gain' being not just a motive of appearance but maybe also for increased health. Or it could be a sign of 'anti-aging' being interpreted in more aesthetic terms (e.g., looking younger rather than being solely health oriented). In fact, previous reports had found both appearance and weight to predict external and introjected regulation (97) which partially aligns with our results. In our study, intrinsic motivation was clearly led by participants aiming to 'gain muscle'. We believe these findings could be related to the nature of the MH fitness app, which marketed itself as high intensity training. Since intrinsic motivation is associated with enjoyment and satisfaction, individuals who enjoy the challenge could be better predisposed to using MH. Other researchers before us have found that challenge can be predictive of intrinsic motivation (99).

Our results differ to previous findings showing that identified regulation is predicted by increased health and stress-related motives (97). In our study, the 'anti-aging' group—presumably the one that was more closely related to health-oriented motives—did not show relevant findings in their identified regulation. In fact, the highest levels for identified extrinsic motivation were found in the 'muscle gain' group. An important question arises here with the interpretation of health and health-oriented actions, and how apparently more superficial goals, such as bulking up or shredding pounds, may implicitly contain health-oriented motives. It is also worth mentioning that correlations between identified regulation and intrinsic motivation have been proven common in SDT-based studies on PA (15), as they both constitute forms of autonomous regulation and often coexist (54). In our study, this was true when comparing the 'lose weight' with 'gain muscle' groups, but not when comparing 'anti-aging' with 'gain muscle' or 'anti-aging' versus 'lose weight'. It would be worth exploring why the 'anti-aging' group seemed slightly less determined than the others.

We would like to bring attention to an interesting insight and potentially a line of future research. Intrinsic motivation has undisputedly been positioned as the 'ideal' for PA maintenance in the past (15,100). However, because exercise is often not an immediately rewarding or enjoyable experience, less internalized forms of motivation, such as 'identified extrinsic' could be prominent (57). Our findings point to the importance of both intrinsic and extrinsic forms of motivation for sustained physical exercise in time, and encourage further investigation to determine potential relationships between intrinsic /extrinsic motivations and stage of training, personal goals, attitudes, beliefs and other.

Strengths and limitations

This study introduces a newly developed, theory-informed scale specifically designed to measure motivation in the context of mobile fitness applications—a growing but underexplored area in digital health research. The scale is grounded in SDT and underwent psychometric validation. Analyzing a commercial app provides realistic data that is directly transferable to society. While it is one of the few studies providing motivational data relative to sociodemographic variables in fitness app users, some limitations need to be acknowledged. These include the survey invitation (by mailing list) and delivery mode (on Google Forms), which implies a selection bias and potential lack of control over the authenticity of responses. It is also possible that a desirability bias was incurred, with the survey being conducted directly by the provider of the service. Measures were self-reported and, additionally, response rate was low, which makes strict probability design unviable, thereby limiting the generalizability of findings. The cross-sectional design of the study potentially implies having omitted confounders and reverse causation between variables. It should also be noted that this survey was undertaken shortly after the COVID-19 pandemic, which could have influenced perspectives. Taking all of this into consideration, results should be interpreted with caution and further studies are required to advance in the scientific understanding of motivations to train with a fitness app.

Future research

This study provides a reliable tool for assessing motivation in fitness app users and highlights relevant differences across demographic and behavioral groups. Nonetheless, several aspects remain open for further research. First, longitudinal studies are needed to explore how motivation evolves over time and whether specific motivational profiles predict sustained engagement or dropout in digital exercise programs. When conducting future longitudinal studies, or studies which may involve a broader set of items, researchers are encouraged to consider using expanded model approaches to further explore causal and mediational pathways among motivational constructs.

Second, recruitment modes should be carefully considered in order to minimize bias. Third, qualitative research could provide deeper insights into the subjective experiences and contextual factors influencing motivation, particularly among underrepresented or less active populations. Last, future studies should examine the effectiveness of personalized motivational strategies—such as adaptive goal setting or feedback mechanisms—within app environments to enhance adherence.

Additionally, expanding research to include a more diverse population across different cultural, socioeconomic, and geographic contexts would strengthen the generalizability of findings. Integrating physiological or behavioral data from app usage (e.g., session frequency, duration, or intensity) could also enrich the understanding of how motivation translates into actual exercise behavior. Finally, comparative studies evaluating motivation across various digital platforms, including gamified apps or those targeting specific health outcomes, would be useful to tailor interventions more effectively.

Conclusions

The newly developed scale proved reliable to assess for intrinsic, identified and introjected dimensions of motivation. Differences in motivation were found according to sociodemographic variables. Interestingly, extrinsic motivations—often considered less desirable—were prominent even among experienced users, suggesting that sustained app-based exercise may not rely solely on intrinsic drivers. These insights can inform future tele-exercise design strategies to better match user profiles and promote long-term adherence to PA.

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Footnote

Data Sharing Statement: Available at https://mhealth.amegroups.com/article/view/10.21037/mhealth-25-11/dss

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. This study was conducted in accordance with the Declaration of Helsinki and its subsequent amendments, and the applicable national and international legislation on this matter, as well as The Charter of Fundamental Rights of the European Union. The investigation follows the rules that refer to the General Data Protection Regulation (GDPR), Regulation (EU) 2016/679; and privacy and confidentiality of data (LOPDGD) Organic Law (3/2018 of December 5) on the Protection of Personal Data and guarantee of Digital rights. Ethical approval was obtained from the Research Ethics Committee of the Ramon Llull University, in March 2020 (No. 1920003P). Participation was taken as proof of acceptance of the informed consent.

References

1. World Health Organization. Global action plan on physical activity 2018-2030: more active people for a healthier world. In Geneva: World Health Organization; 2018. p. 101. Available online: https://iris.who.int/handle/10665/272722
2. Ciolac EG, Rodrigues da Silva JM, Vieira RP. Physical Exercise as an Immunomodulator of Chronic Diseases in Aging. J Phys Act Health 2020;17:662-72.
3. Souza HCD, Philbois SV, Veiga AC, et al. Heart Rate Variability and Cardiovascular Fitness: What We Know so Far. Vasc Health Risk Manag 2021;17:701-11.
4. Fiuza-Luces C, Valenzuela PL, Gálvez BG, et al. The effect of physical exercise on anticancer immunity. Nat Rev Immunol 2024;24:282-93.
5. Melmer A, Kempf P, Laimer M. The Role of Physical Exercise in Obesity and Diabetes. Praxis (Bern 1994) 2018;107:971-6.
6. Grasdalsmoen M, Eriksen HR, Lønning KJ, et al. Physical exercise, mental health problems, and suicide attempts in university students. BMC Psychiatry 2020;20:175.
7. Valenzuela PL, Castillo-García A, Morales JS, et al. Exercise benefits on Alzheimer's disease: State-of-the-science. Ageing Res Rev 2020;62:101108.
8. World Health Organization, editor. Global status report on physical activity 2022 . Geneva; 2022. Available online: https://www.who.int/teams/health-promotion/physical-activity/global-status-report-on-physical-activity-2022#:~:text=Global Status Report on Physical Activity 2022. Let's get moving!
9. Gomes Costa RR, Ribeiro Neto F, Winckler C. Tele-health, tele-exercise and tele-assessment: an example of a fitness app for individuals with spinal cord injury. Mhealth 2023;9:20.
10. Gomes Costa RR, Ramos BL, Ribeiro Neto F, et al. Tele-exercise in individuals with spinal cord injury: a systematic review. Mhealth 2025;11:19.
11. Costa RRG, Dorneles JR, Veloso JH, et al. Synchronous and asynchronous tele-exercise during the coronavirus disease 2019 pandemic: Comparisons of implementation and training load in individuals with spinal cord injury. J Telemed Telecare 2023;29:308-17.
12. WHO Global Observatory for eHealth. mHealth: new horizons for health through mobile technologies: second global survey on eHealth. World Health Organization; 2011. p. viii, 102 p. (Global observatory for eHealth Series, 3).
13. Rosa JP, de Souza AA, de Lima GH, et al. Motivational and evolutionary aspects of a physical exercise training program: a longitudinal study. Front Psychol 2015;6:648.
14. Hsu RMCS, Cardoso FL, Varella MAC, et al. Comparing Different Typologies of Physical Activities With a Focus on Motivation. Front Psychol 2022;13:790490.
15. Teixeira PJ, Carraça EV, Markland D, et al. Exercise, physical activity, and self-determination theory: a systematic review. Int J Behav Nutr Phys Act 2012;9:78.
16. Gagné M, Deci EL. Self-determination theory and work motivation. J Organ Behav 2005;26:331-62.
17. Ryan RM, Deci EL. Overview of self-determination theory: An organismic-dialectical perspective. In: Handbook of self-determination research. Rochester, NY, US: University of Rochester Press; 2002. p. 3-33.
18. Sebire SJ, Standage M, Vansteenkiste M. Predicting objectively assessed physical activity from the content and regulation of exercise goals: evidence for a mediational model. J Sport Exerc Psychol 2011;33:175-97.
19. Staples C, Palermo M, Rancourt D. Intrinsic and extrinsic motivations as moderators of the association between exercise frequency and exercise behavior. Eat Weight

Disord 2022;27:2801-9.
20. Olafsen AH, Niemiec CP, Halvari H, et al. On the dark side of work: a longitudinal analysis using self-determination theory. Eur J Work Organ Psychol 2017;26:275-85.
21. Rosenfeld CS. Sex-dependent differences in voluntary physical activity. J Neurosci Res 2017;95:279-90.
22. Martinez Kercher VM, Burton D, Pickering MA, et al. Profiling Physical Activity Motivation Based on Reasons for Exercise: A Cluster Analysis Approach. Psychol Rep 2024;127:124-41.
23. Borges JC, de Oliveira Filho GG, de Lira CAB, et al. Motivation Levels and Goals for the Practice of Physical Exercise in Five Different Modalities: A Correspondence Analysis. Front Psychol 2021;12:793238.
24. Sweet SN, Fortier MS, Blanchard CM. Investigating motivational regulations and physical activity over 25 weeks. J Phys Act Health 2014;11:1052-6.
25. Ley C. Participation Motives of Sport and Exercise Maintainers: Influences of Age and Gender. Int J Environ Res Public Health 2020;17:7830.
26. Aaltonen S, Rottensteiner M, Kaprio J, et al. Motives for physical activity among active and inactive persons in their mid-30s. Scand J Med Sci Sports 2014;24:727-35.
27. Barbosa MLL. Propriedades métricas do inventário de motivação à prática regular de atividade física (IMPRAF-126). In 2006. Available online: https://api.semanticscholar.org/CorpusID:177010805
28. Boiché J, Gourlan M, Trouilloud D, et al. Development and validation of the 'Echelle de Motivation envers l'Activité Physique en contexte de Santé': A motivation scale towards health-oriented physical activity in French. J Health Psychol 2019;24:386-96.
29. Expósito González C, Fernández Ozcorta EJ, Almagro BJ, Sáenz-López P. Cuadernos de psicología del deporte. Cuad Psicol del Deport . 2001 (cited 2024 Oct 17);12(2):49–56. Available online: https://scielo.isciii.es/scielo.php?script=sci_arttext&pid=S1578-84232012000200006&lng=es&nrm=iso&tlng=es
30. Markland D, Hardy L. On the factorial and construct validity of the Intrinsic Motivation Inventory: conceptual and operational concerns. Res Q Exerc Sport 1997;68:20-32.
31. McAuley E, Duncan T, Tammen VV. Psychometric properties of the Intrinsic Motivation Inventory in a competitive sport setting: a confirmatory factor analysis. Res Q Exerc Sport 1989;60:48-58.
32. Molanorouzi K, Khoo S, Morris T. Validating the Physical Activity and Leisure Motivation Scale (PALMS). BMC Public Health 2014;14:909.
33. Ryan RM, Connell JP. Perceived locus of causality and internalization: examining reasons for acting in two domains. J Pers Soc Psychol 1989;57:749-61.
34. Ryan RM, Frederick CM, Lepes D, et al. Intrinsic motivation and exercise adherence. Int J Sport Psychol 1997;28:335-54.
35. Sebire SJ, Standage M, Vansteenkiste M. Examining intrinsic versus extrinsic exercise goals: cognitive, affective, and behavioral outcomes. J Sport Exerc Psychol 2009;31:189-210.
36. Lehnert K, Sudeck G, Conzelmann A. BMZI: Berner Motiv- und Zielinventar im Freizeit- und Gesundheitssport. Diagnostica 2011;57:S146-59.
37. Sutin AR, Luchetti M, Stephan Y, et al. Sense of purpose in life and motivation, barriers, and engagement in physical activity and sedentary behavior: Test of a mediational model. J Health Psychol 2022;27:2068-78.
38. Litman L, Rosen Z, Spierer D, et al. Mobile Exercise Apps and Increased Leisure Time Exercise Activity: A Moderated Mediation Analysis of the Role of Self-Efficacy and Barriers. J Med Internet Res 2015;17:e195.
39. WHO. WHO | Monitoring and evaluating digital health interventions. WHO; 2016.
40. Kalgotra P, Raja U, Sharda R. Growth in the development of health and fitness mobile apps amid COVID-19 pandemic. Digit Health 2022;8:20552076221129070.
41. Emberson MA, Lalande A, Wang D, et al. Effectiveness of Smartphone-Based Physical Activity Interventions on Individuals' Health Outcomes: A Systematic Review. Biomed Res Int 2021;2021:6296896.
42. Fuente-Vidal A, Guerra-Balic M, Roda-Noguera O, et al. Adherence to eHealth-Delivered Exercise in Adults with no Specific Health Conditions: A Scoping Review on a Conceptual Challenge. Int J Environ Res Public Health 2022;19:10214.
43. Yang X, Ma L, Zhao X, Kankanhalli A. Factors influencing user's adherence to physical activity applications: A scoping literature review and future directions. Int J Med Inform 2020;134:104039.
44. Angosto S, García-Fernández J, Grimaldi-Puyana M. A systematic review of intention to use fitness apps (2020–2023). Humanit Soc Sci Commun 2023;10:512.
45. Kim M, Lee SM. Unpacking the Drivers of Dissatisfaction and Satisfaction in a Fitness Mobile Application. Behav Sci (Basel) 2023;13:782.
46. Ahn H, Park E. Motivations for user satisfaction of mobile

fitness applications: An analysis of user experience based on online review comments. Humanit Soc Sci Commun 2023;10:3.
47. Xu L, Shi H, Shen M, et al. The Effects of mHealth-Based Gamification Interventions on Participation in Physical Activity: Systematic Review. JMIR mHealth uHealth 2022;10:e27794.
48. Geller K, Renneke K, Custer S, Tigue G. Intrinsic and Extrinsic Motives Support Adults' Regular Physical Activity Maintenance. Sport Med Int Open 2018;2:E62-6.
49. Lloret S, Ferreres A, Hernández A, et al. Exploratory Item Factor Analysis: a practical guide revised and updated. An Psicol 2014;30:1151-69.
50. Ferrando PJ, Lorenzo-Seva U. Program FACTOR at 10: Origins, development and future directions. Psicothema 2017;29:236-40.
51. de la Rubia JM. Revisión de los criterios para validez convergente estimada a través de la Varianza Media Extraída. Psychologia 2019;13:25-41.
52. Fornell C, Larcker DF. Evaluating structural equation models with unobservable variables and measurement error. J Mark Res 1981;18:39-50.
53. Hair JF, Matthews LM, Matthews RL, et al. PLS-SEM or CB-SEM: updated guidelines on which method to use. Int J Multivar Data Anal 2017;1:107-23.
54. Friederichs SAH, Bolman C, Oenema A, et al. Exploring the working mechanisms of a web-based physical activity intervention, based on self-determination theory and motivational interviewing. Internet Interv 2016;3:8-17.
55. Hagger M, Chatzisarantis N. Self-determination Theory and the psychology of exercise. Int Rev Sport Exerc Psychol 2008;1:79-103.
56. Klenk S, Reifegerste D, Renatus R. Gender differences in gratifications from fitness app use and implications for health interventions. Mob Media Commun 2017;5:178-93.
57. Weman-Josefsson K, Fröberg K, Karlsson S, et al. Mechanisms in Self-Determined Exercise Motivation: Effects of a Theory Informed Pilot Intervention. Curr Psychol 2017;36:90-100.
58. Wilson PM, Rodgers WM, Fraser SN, et al. Relationships between exercise regulations and motivational consequences in university students. Res Q Exerc Sport 2004;75:81-91.
59. Vuckovic V, Duric S. Motivational variations in fitness: a population study of exercise modalities, gender and relationship status. Front Psychol 2024;15:1377947.
60. Vuckovic V, Cuk I, Duric S. Purchase Channels and Motivation for Exercise in the Slovenian Population: Customer Behavior as a Guarantee of Fitness Center Sustainability. Behav Sci (Basel) 2023;13:447.
61. Stecher C, Pfisterer B, Harden SM, et al. Assessing the Pragmatic Nature of Mobile Health Interventions Promoting Physical Activity: Systematic Review and Meta-analysis. JMIR Mhealth Uhealth 2023;11:e43162.
62. Buckworth J, Lee RE, Regan G, et al. Decomposing intrinsic and extrinsic motivation for exercise: Application to stages of motivational readiness. Psychol Sport Exerc 2007;8:441-61.
63. Huang J, Chen J, Zhou L. Motivation crowding effects on the intention for continued use of gamified fitness apps: a mixed-methods approach. Front Psychol 2023;14:1286463.
64. Ingledew DK, Markland D, Medley AR. Exercise motives and stages of change. J Health Psychol 1998;3:477-89.
65. Zamarripa J, Castillo I, Baños R, et al. Motivational Regulations Across the Stages of Change for Exercise in the General Population of Monterrey (Mexico). Front Psychol 2018;9:2368.
66. Chen MF, Lin NP. Incorporation of health consciousness into the technology readiness and acceptance model to predict app download and usage intentions. Internet Res 2018;28:351-73.
67. Baretta D, Perski O, Steca P. Exploring Users' Experiences of the Uptake and Adoption of Physical Activity Apps: Longitudinal Qualitative Study. JMIR Mhealth Uhealth.2019;7:e11636.
68. Lupton D, Smith GJD. 'A Much Better Person': The Agential Capacities of Self-tracking Practices. In: Ajana B, editor. Metric Culture. Emerald Publishing Limited; 2018. p. 57-75.
69. Neal DT, Wood W, Labrecque JS, et al. How do habits guide behavior? Perceived and actual triggers of habits in daily life. J Exp Soc Psychol 2012;48:492-8.
70. Touzani M, Charfi AA, Boistel P, et al. Connecto ergo sum! an exploratory study of the motivations behind the usage of connected objects. Inf Manag 2018;55:472-81.
71. Al-shamaileh O, Sutcliffe A. Why People Choose Apps: An Evaluation of the Ecology and User Experience of Mobile Applications. Int J Hum Comput Stud. 2022;170:102965.
72. Krebs P, Duncan DT. Health App Use Among US Mobile Phone Owners: A National Survey. JMIR Mhealth Uhealth 2015;3:e101.
73. Martin LR, Williams SL, Haskard KB, et al. The challenge of patient adherence. Ther Clin Risk Manag 2005;1:189-99.
74. Soulé B, Marchant G, Verchère R. Sport and fitness app uses: a review of humanities and social science perspectives.

Eur J Sport Soc 2022;19:170-89.
75. Biocca F, Harms C, Burgoon JK. Toward a More Robust Theory and Measure of Social Presence: Review and Suggested Criteria. Presence Teleoperators Virtual Environ 2003;12:456-80.
76. Kim HM, Cho I, Kim M. Gamification Aspects of Fitness Apps: Implications of mHealth for Physical Activities. Int J Human–Computer Interact . 2023;39:2076-89.
77. Luo C. An Exploration of the Impact of Fitness Apps on Individual Exercise Behaviour. Rev Psicol del Deport 2024;33:385-93.
78. Sundar SS, Jia H, Waddell TF, et al. Toward a Theory of Interactive Media Effects (TIME): Four Models for Explaining How Interface Features Affect User Psychology. In: Sundar SS, editor. The Handbook of the Psychology of Communication Technology . 1st ed. Wiley; 2015. p. 47-86.
79. Huotari K, Hamari J. Defining gamification: a service marketing perspective. In: AcademicMindTrek '12: International Conference on Media of the Future . ACM; 2012. p. 17-22.
80. Oinas-Kukkonen H, Harjumaa M. A Systematic Framework for Designing and Evaluating Persuasive Systems. In: Oinas-Kukkonen H, Hasle P, Harjumaa M, Segerståhl K, Øhrstrøm P, editors. Persuasive Technology . Berlin, Heidelberg: Springer Berlin Heidelberg; 2008. p. 164-76.
81. Cho J, Park D, Lee HE. Cognitive factors of using health apps: systematic analysis of relationships among health consciousness, health information orientation, eHealth literacy, and health app use efficacy. J Med Internet Res 2014;16:e125.
82. Cai J, Zhao Y, Sun J. Factors Influencing Fitness App Users' Behavior in China. Int J Hum Comput Interact 2022;38:53-63.
83. García-Fernández J, Gálvez-Ruiz P, Grimaldi-Puyana M, et al. The Promotion of Physical Activity from Digital Services: Influence of E-Lifestyles on Intention to Use Fitness Apps. Int J Environ Res Public Health 2020;17:6839.
84. Goodyear VA, Armour KM. Young People's Perspectives on and Experiences of Health-Related Social Media, Apps, and Wearable Health Devices. Soc Sci 2018;7:137.
85. Pagnan CE, Seidel A, MacDermid Wadsworth S. I Just Can't Fit It in! Implications of the Fit Between Work and Family on Health-Promoting Behaviors. J Fam Issues 2016;38:1577-603.
86. Trost SG, McIver KL, Pate RR. Conducting accelerometer-based activity assessments in field-based research. Med Sci Sports Exerc 2005;37:S531-43.
87. Elmose-Østerlund K, Dalgas BW, Bredahl TVG, et al. Motives for leisure-time physical activity participation: an analysis of their prevalence, consistency and associations with activity type and social background. BMC Public Health 2023;23:2399.
88. Ferrand C, Perrin C, Nasarre S. Motives for regular physical activity in women and men: a qualitative study in French adults with type 2 diabetes, belonging to a patients' association: Motives, physical activity and diabetes. Health Soc Care Community 2008;16:511-20.
89. Molanorouzi K, Khoo S, Morris T. Motives for adult participation in physical activity: type of activity, age, and gender. BMC Public Health 2015;15:66.
90. van Lankveld W, Linskens F, Stolwijk N. Motivation for Physical Activity: Validation of the Dutch Version of the Physical Activity and Leisure Motivation Scale (PALMS). Int J Environ Res Public Health 2021;18:5328.
91. Zervou F, Stavrou NAM, Koehn S, et al. Motives for exercise participation: The role of individual and psychological characteristics. Roca A, editor. Cogent Psychol 2017;4:1345141.
92. Murcia JA, Gimeno EC, Camacho AM. Measuring self-determination motivation in a physical fitness setting: validation of the Behavioral Regulation in Exercise Questionnaire-2 (BREQ-2) in a Spanish sample. J Sports Med Phys Fitness 2007;47:366-74.
93. Bauman AE, Reis RS, Sallis JF, et al. Correlates of physical activity: why are some people physically active and others not? Lancet 2012;380:258-71.
94. Hallal PC, Andersen LB, Bull FC, et al. Global physical activity levels: surveillance progress, pitfalls, and prospects. Lancet 2012;380:247-57.
95. Hands B, Parker H, Larkin D, et al. Male and Female Differences in Health Benefits Derived from Physical Activity: Implications for Exercise Prescription. J Womens Heal 2016;5.
96. Ley C, Krenn B. Erhebung sportartspezifischer Motivausprägungen bei sportlich aktiven Personen mit dem Berner Motiv- und Zielinventar (BMZI). Diagnostica 2017;63:285-96.
97. Ingledew DK, Markland D. The role of motives in exercise participation. Psychol Health 2008;23:807-28.
98. Deci EL, Ryan RM. The "What" and "Why" of Goal Pursuits: Human Needs and the Self-Determination of Behavior. Psychol Inq 2000;11:227-68.
99. Yoganathan D, Kajanan S. What Drives Fitness Apps

Usage? An Empirical Evaluation BT - Creating Value for All Through IT. In: Bergvall-Kåreborn B, Nielsen PA, editors. Berlin, Heidelberg: Springer Berlin Heidelberg; 2014. p. 179-96.

100. Rhodes RE, Blanchard CM, Bellows KH. Exploring cues to sedentary behaviour as processes of physical activity action control. Psychol Sport Exerc 2008;9:211-24.

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