

At-home virtual workouts: embracing exercise during the COVID-19 pandemic

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Abstract:

The objective of this study was to explore through the Model of Theory of Planned Behaviour the most important variables that influence the practice of physical and sports activity at home supported by virtual training in the context of the COVID-19 pandemic. A cross-study was proposed between countries from three continents, distributing the questionnaire in Spain (Europe), Pakistan (Asia), and Colombia (South America) to ensure a comprehensive study. The methodology of structural equations using partial least squares was used. The empirical exploratory study supported the hypotheses proposed, with the most important result that confinement due to the COVID-19 pandemic has been a factor causing the practice of physical and sports activity at home. This is one of the first studies to examine sports practice at home and the new context of sports practice that has generated disruptive technologies and the global crisis of the COVID-19 pandemic.

Keywords:

physical activity; sports; behaviour; homes; technology; COVID-19.

1 Introduction

Human behaviour regarding physical activity and sport has been widely analysed from psychological theories, especially motivational ones, finding that its prediction is complex and multidimensional (Apostolou and Lambrianou, 2017; Sánchez-Torres et al., 2020). Studies have examined this context in different types of physical and sports activities, from recreational physical activity to high-performance sports (Silva Cortés et al., 2017). Likewise, new trends in sports and social practice have been taken into consideration given that the socio-cultural changes worldwide have generated new sports practices, such as extreme sports, where physical activities limit risk and danger, a mixture of search for adventure and variety (Brymer and Houge Mackenzie, 2017). Among the new sports trends worldwide are physical and sports activities focused on personalised training (Mosquera-González et al., 2019), with controlled training supervision and the search for a specific achievement, such as CrossFit (Dominski et al., 2020).

On the other hand, the changes in life habits generated by the 4.0 revolution have caused changes in people's sports habits (Rojas-Berrio et al., 2023; Serrano Gómez, 2020; Thulin and Vilhelmson, 2019). The use of information and communication technologies (ICT) in daily life has led to the growth of physical and sports activity supported by smart watches, smartphones, tablets, smart televisions, and video game consoles, among other innovative technologies being developed and positively adopted by people (Carrillo Barrantes, 2020) given the ICT advantages regarding the reduction of walls and physical distances to allow interaction between the physical and the virtual (Thulin and Vilhelmson, 2019b; Vrontis et al., 2019). In addition, the global crisis that humanity is suffering with the unexpected COVID-19 pandemic has forced millions of people to confine themselves at home during quarantines and has prevented the practice of physical and sports activity outside their homes (Schnitzer et al., 2020). This brought with it a devastating loss of normal life habits in the population, causing many psychological and physical problems (Ammar et al., 2020; Chen et al., 2020). The pandemic has caused many people to carry out their sport and physical trainings at home (Ammar et al., 2020; Lucini et al., 2020). For example, in a study in Austria, confinement increased home training related to fitness (11%), aerobics/gymnastics (11%), and other forms of training (6%) (Schnitzer et al., 2020). In Germany, sports activities at home also increased during confinement due to the COVID-19 pandemic (Mutz and Gerke, 2020).

Virtual training supported by a technological multiplatform was the most used mechanism. A study found that the pandemic increased by 25% the use of virtual trainers through electronic devices such as smartphones (54%), smart watch (26%), and tablets (7%), specifically the use of videos with paid or free targeted trainings (AdColony,

2020). Likewise, social networks such as YouTube, Instagram, and Facebook have also served as platforms for coaches to record or transmit training directed to different types of physical and sports activities (Piedra, 2020) and new online sports services even emerged (Goldman and Hedlund, 2020). Physical and sports activity at home is a recent line of research, and the few studies carried out so far show that it tends to be adopted by people when they have difficulties travelling to sports club or practicing outdoors, even with long-term adhesion (Wilke et al., 2022).

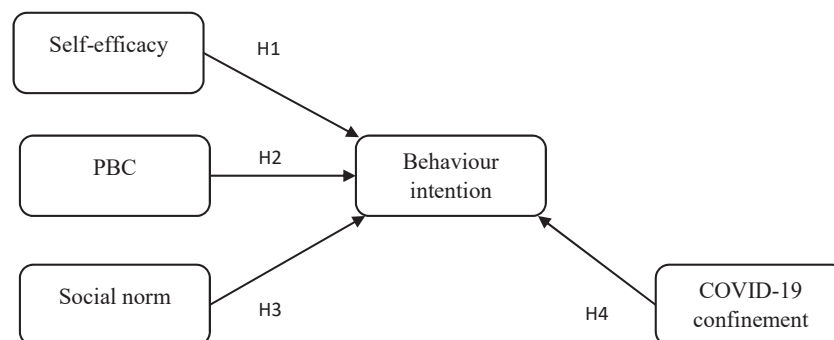
In the current context, three fundamental elements require analysis: first, an advance of ICTs as a support for sports activity; second, a context of lived a mandatory confinement due to the COVID-19 pandemic is presented and people have been confined for many months and have already practiced sports at home, making this research timely; and third, analyse if the COVID-19 pandemic has been an enhancer or generator of it (Valeriani et al., 2023). Therefore, the objective of this study is to explore this context through the Model of Theory of Planned Behaviour (TPB) (Ajzen, 1991).

1.1 Model proposal and hypotheses

One of the traditional models to explain behaviour regarding the practice of physical and sports activity is the theory of reasoned action (TRA) (Fishbein and Ajzen, 1975) which was developed based on different behavioural and motivational theories. It explains the intention towards the behaviour from two factors: the attitude towards the behaviour and the subjective norm (external referents). This theory was later complemented with the social cognitive theory (SCT) (Bandura, 1977) which introduces self-efficacy as an element that allows the individual to receive information exteriorly, process it, and generate an expectation that he or she will value to perform the exercise. Motivational factors are very important.

To complete the proposed model that explains sports practice at home, given the COVID-19 pandemic (Figure 1).

Figure 1 Proposed model



This study takes as a positive variable to sport at home the subjective norm, since people will share close experiences of their practices and training at home with other people in their close circle, generating possible effects of similar behaviours. Also, the pandemic and the confinements generated a social reinforcement to practice sports at home for the care of all members of the community (Ravalli and Musumeci, 2020; Sharma and Singh, 2022):

H1: The social norm positively affects the intention to practice physical and sports activity at home, directed by virtual training.

As a second element to analyse, self-efficacy is another generator of home workouts with virtual support, since, to perform physical exercise and sports at home, the individual will evaluate the facility he or she has available:

H2: The self-efficacy of achieving physical activity or exercise at home through virtual training positively affects the intention to practice physical and sports activity at home, directed by virtual training.

The TPB (Ajzen, 1991) complements the explanation of human behaviours, adding as a central element the intention as a predictor of behaviour and the integration of non-motivational elements that are necessary to generate the behaviour within a context of 'opportunity', including a new factor called perceived behaviour control (PBC), defined as the perception of the capacity to carrying out a certain behaviour. This will be the result of the analysis of the resources and available capacities perceived by the user to carry out the practice of physical and sports activity at home, directed by virtual training, and it will be considered another generating element of the intention and behaviour:

H3: PBC positively affects the intention to practice physical and sports activity at home, directed by virtual training.

To complete the proposed model that explains sports practice at home, given the COVID-19 pandemic, it is proposed to include a construct that explains whether a reason for this behaviour is the confinement that the global COVID-19 crisis has caused (Liu et al., 2022; Menhas et al., 2023; Valeriani et al., 2023; Wilke et al., 2022). Specifically, a worldwide study (Ammar et al., 2020) showed that confinement due to the pandemic has increased the use of ICTs and training directed virtually at home for physical activity and sports, leading to the following hypothesis:

H4: The confinement due to the COVID-19 pandemic positively affects the intention to practice physical and sports activity at home, directed by virtual training.

2 Materials and methods

2.1 Measurement of the variables

A questionnaire was adapted on the basis of instruments previously validated in the literature from studies in sport. The item self-efficacy was based on the study by (Rodrigues et al., 2020) and the items PBC, social norm, and behaviour intention were adapted from (Hagger et al., 2002). To measure the influence on sports practice at home through virtual training, the questionnaire asked whether this type of activity started or increased due to the confinement generated by COVID-19. It should be clarified that this variable (COV1) is only measured with an indicator of initiation or increase of virtual training at home generated by the COVID-19 pandemic confinement, and therefore it is presented as a control variable, not a theoretical variable.

All responses were measured on seven-point Likert-type scales, ranging from 1 (strongly disagree) to 7 (strongly agree). The questionnaire was completed with a section that collected demographic information on age, gender, and country, and another section

with two questions related to the type of physical activity and exercise performed at home and the technological device used to receive virtual training (Table 1).

Table 1 Measurement items

<i>Construct</i>	<i>Item</i>	<i>Literature support</i>
Behaviour intention to practice sport	BI1. I like to do exercises or sports at home through virtual training workouts.	Rodrigues et al. (2020)
	BI2. I constantly do exercises or sports at home through virtual training workouts.	
	BI3. I definitely cannot stop doing exercises or sports at home through virtual training workouts	
Social norm	NS1. Most of the important people to me do exercises or sports at home through virtual training workouts.	Hagger et al. (2002)
	NS2. Most of the people important to me suggest or motivate me to do physical activity or sport at home through virtual training workouts.	
	NS3. I do physical activity or sport because most of the people important to me also do it through virtual training	
Self-efficacy	SE1. Follow an exercise plan or routine over a set period of time through virtual training workouts	Hagger et al. (2002)
	SE2. Include an exercise plan or routine through virtual training workouts in your weekly schedule	
	SE3. Organise your schedule to be able to carry out constantly an exercise plan or routine through virtual training workouts	
Perceived behavioural control (PBC)	PB1. Carrying out an exercise plan or routine at home through virtual training workouts is entirely up to me.	Hagger et al. (2002)
	PB2. In general, it is up to me to practice physical or sports activities at home with an exercise plan or routine through virtual training workouts.	
	PB3. I consider that I have total control of the physical or sports practice that I do at home with a plan or exercise routine through virtual training	
Influence of COVID-19	COV1. With the confinements due to the COVID-19 pandemic, I started or increased workouts at home with an exercise plan or routine using virtually targeted workouts	By Authors

2.2 Information collection and sample

A cross-study was proposed between countries from three continents, distributing the questionnaire in Spain (Europe), Pakistan (Asia), and Colombia (South America) to ensure a comprehensive study. To determine the sample, a non-probabilistic sampling was applied by quotas and with a snowball-type deployment through actions on social networks and mailing. The goal of the questionnaires to be collected by each country was established at around 100 samples per country, since for the exploratory analysis of the empirical model, the methodology of structural equations using partial least squares

(PLS) was used, which is suitable for analysing predictive models and allows to work with a relatively small sample (Sarstedt et al., 2020).

The final sample obtained was 305 correct questionnaires, of which 81 were obtained from Spain, 115 from Pakistan, and 109 from Colombia. Multigroup-analysis tests were made between groups by countries without finding differences, so no separate results are presented, and a similar behaviour can be assumed for this study in the three countries.

Of the total number of participants, 45% (137) were male and 55% (168) female, with women participating the most in the overall study; however, disaggregating this result by country, in the case of Pakistan only 36% (42) of the sample were women, which may be due to cultural factors. Also, a multigroup test was performed without finding significant differences between men and women.

For the age groups, the multi-group analysis did not show differences either, with 47% (143) belonging to an age range of 16 to 25 years, 18.5% (57) to an age range of 26 to 32 years, 14% (43) to an age range of 33 to 45 years, 16% (48) to an age range of 46 to 55 years, and 4.5% (14) older than 55 years. Regarding the technological device used for virtual training, 54% of participants said smartphones are preferred, 20% smart televisions, 12% laptops, 10% other devices (smart watches, consoles, special devices), and 4% tablets.

Finally, for the characteristic sample, regarding the type of physical and sports activity performed at home, participants practice the following activities in order of choice: cardiopulmonary activity, specific core and abdominal workouts, strength training and weight lifting, dance activities (including directed activities with music such as Zumba) and aerobics, simulation and sports techniques with and without equipment, and yoga exercises like stretching and relaxation training.

3 Results

The measurement model was evaluated by examining the load indicator, which indicates that at loads higher than 0.708, the construct explains the variance of the indicators of the same variable by more than 50% (Hair et al., 2019) thus accepting reliability of the indicators for all variables. This result will be significantly validated by the bootstrapping test, which is explained later, showing that the weights of the indicators were close to 1 (no collinearity) and were satisfactorily validated (Table 2) (Hair et al., 2020)

Next, the reliability of the internal consistency was evaluated, using composite reliability tests, in which values greater than 0.6 are acceptable (Henseler et al., 2014); likewise, other internal consistency tests such as the Cronbach's alpha test and Dillon-Goldstein value were greater than 0.70 for all variables, confirming that the factorial model is correct (Gefen et al., 2000). Finally, convergent validity analysis was performed through the average variance extracted (AVE) for the items of the same construct, with all acceptable values greater than 0.5 (Table 3) (Hair et al., 2019).

Discriminant validity was then evaluated, which measures that a construct is empirically different from the other constructs of the model. In this case, two tests were carried out: the Fornell-Larcker test, which compares the AVE of each construct with the correlation between squared constructs (using the variance), and discriminant validity, which is accepted when the shared variance for all the model constructs is not greater than their AVE (Table 4) (Fornell and Larcker, 1981).

Table 2 Loads of indicators

<i>Indicator</i>	<i>Load</i>	<i>t-value*</i>
BI1	0.868	51.370
BI2	0.915	75.631
BI3	0.868	51.886
COV1	1.000	–
NS1	0.815	31.344
NS2	0.844	32.474
NS3	0.846	37.163
PBC1	0.877	38.698
PBC2	0.887	39.225
PBC3	0.874	59.489
SE1	0.928	85.652
SE2	0.935	106.340
SE3	0.888	52.678

*All items had significance with a p-value < 0.001.

Table 3 Composite reliability test

<i>Variable</i>	<i>Cronbach's alpha</i>	<i>Composite reliability</i>	<i>Average variance extracted (AVE)</i>
BI	0.860	0.915	0.781
COV	1.000	1.000	1.000
NS	0.783	0.874	0.699
PBC	0.858	0.911	0.773
SE	0.905	0.941	0.841

Table 4 Fornell–Larcker test

	<i>BI</i>	<i>COV</i>	<i>PBC</i>	<i>SE</i>	<i>NS</i>
BI	0.884				
COV	0.556	1.000			
PBC	0.469	0.399	0.879		
SE	0.665	0.504	0.565	0.917	
NS	0.496	0.279	0.161	0.334	0.835

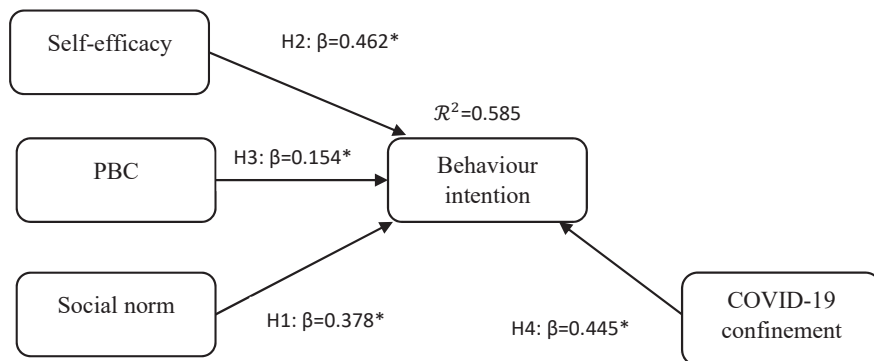
Likewise, the heterotrait–monotrait test (HTMT) was applied, which is defined as the mean value of the correlation of the indicators between constructs in relation to the mean of correlations for the items that measure the same construct. Values greater than 0.90 present constructs that similarly measure two variables, and therefore the tool would not be validated (Henseler et al., 2014). For this study, the results were lower than 0.90, so the discriminant validity of the measurement tool is verified (Table 5).

Table 5 Heterotrait–Monotrait ratio test (HTMT)

	<i>BI</i>	<i>COV</i>	<i>PBC</i>	<i>SE</i>	<i>NS</i>
BI					
COV	0.601				
PBC	0.524	0.422			
SE	0.756	0.530	0.628		
NS	0.601	0.316	0.182	0.397	

To validate the model and the hypotheses, the weighting technique is applied to determine the statistical significance of the hypotheses. The bootstrapping method is also used, which guarantees to build confidence intervals based on bootstraps. A total of 5000 subsamples were used to guarantee an adequate process (Hair et al., 2020) which allows measuring the statistical significance of all the model indicators and the cause–effect relationships of the model constructs.

The hypotheses were statistically validated (Table 6), since hypothesis H1 ($\beta = 0.378$) supports that the subjective norm has a positive effect on the practice of physical activity and sport at home through virtual training; that is, people value positively what their social circle of influence suggests them about practicing sports at home through virtual training (Sharma and Singh, 2022). Hypothesis H2 ($\beta = 0.462$) obtained a very high value in terms of its influence on sports practice at home through virtual training, which supports that the self-efficacy perceived by individuals regarding this practice at home is fundamental for its achievement; that is, the easier it is to train at home with virtual support, the more this practice will continue (Antwi et al., 2022). Hypothesis H3 ($\beta = 0.154$) is supported, validating the influence of PBC on the practice of physical and sports activity at home through virtual training, which highlights the importance of individuals having control of the necessary conditions to carry out these trainings at home. Hypothesis H4 ($\beta = 0.445$) supports that confinement due to the COVID-19 pandemic generates or increases the practice of sports at home through virtual training (Liu et al., 2022; Menhas et al., 2023; Valeriani et al., 2023; Wilke et al., 2022) (Figure 2).

Figure 2 General empirical model

Finally, model prediction tests were applied having, with the R squared value to behaviour intention of $\mathcal{R}^2 = 0.585$. This measure explained the variance of the exogenous variables over the endogenous one, indicating that values greater than 0.5 are considered moderate to high (Table 6).

Table 6 Summary of the structural model

<i>Hypothesis</i>	<i>Effect</i>	<i>Original sample (β)*</i>	<i>R squared adjusted</i>	<i>T statistics (O/STDEV)</i>	<i>P values</i>
H2	Supported	SE $\rightarrow$ BI	0.462*	BI: 4.748	0.000
H3	Supported	PBC $\rightarrow$ BI	0.154*	$\mathcal{R}^2 = 0.585$. 2.661	0.000
H1	Supported	NS $\rightarrow$ BI	0.378*	3.499	0.000
H4	Supported	COV $\rightarrow$ BI	0.445*	5.609	0.000

Significant at $*p < 0.05$ t-value > 1.960 .

Significant at $*p < 0.05$ t-value > 1.960 .

4 Discussion

The objective of this study was to explore through the TPB (Ajzen, 1991) the most important variables that influence the practice of physical and sports activity at home supported by virtual training. This study supports the most important hypotheses that from the point of view of behaviour explain sports practice. Particularly, it is one of the first papers that explores the TPB regarding the practice of physical activity and sports at home through virtual training.

Likewise, this study examined whether the context of confinement at home encouraged initiating or increasing this type of training at home, showing that people have resorted to this practice to continue their sports habits, adapting to spaces within their homes and using as support all the elements and services offered by ICTs for virtual training sessions. An interesting finding in this study is that the most used technological means is the smartphone, something that agrees with what is suggested (Liu et al., 2022; Vrontis et al., 2019).

Although no significant differences were found among age groups in this study, it is important to differentiate the needs and motivations of each generation regarding physical activity and sports at home, especially for more vulnerable populations like the elderly (Goethals et al., 2020).

5 Conclusions, limitations, and future research

The proposed model was fully supported for all countries, and the scientific implication of this study can be inferred in an exploratory and initial way for the three countries analysed and even as a general behaviour worldwide. Although this line of research in the context of virtual training at home is recent, the global situation of the COVID-19

pandemic and its impact on life habits have been broad and complex, especially in the practice of physical and sports activity. Such activity has had many limitations and regulations worldwide throughout the year 2020 due to confinements and temporary closure of all sports spaces, especially sports club, arenas, gyms, and other places, in order to avoid contagion.

The implications of this study for the management of sports programs for public health lie in the importance of examining emergency programs that maintain the practice of physical and sports activity in times of confinement, given that the future is expected to be uncertain as to possible future pandemics, for which governments and the public and private sports sectors must be prepared. This study is an initial source for public and private sports organisations to take into account that the future of the practice of physical and sports activity has changed, and a transition will continue towards the integration of different forms of practice, change in traditional places, and intrusion of ICTs and other innovative technologies, which must be taken into account to adapt, support, reinforce, and promote the practice of physical and sports activities.

The limitations of this study lie in the non-inclusion of other possible behavioural variables that can better explain this context. Likewise, this study does not directly analyse the use and adoption of ICTs as a support for virtual training. Therefore, it is proposed as future lines of research to add other variables, such as reasons or needs. It is also proposed to analyse the adoption of ICTs to support these activities, such as virtual training apps, smart watches, programs for consoles, and recorded and streaming trainings on social networks such as YouTube and Instagram, which opens a broad line of research.

Conflict of interest

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

Author contributions

All authors contributed to conception and design of the study. All authors organised the database. All authors performed the statistical analysis. All authors wrote the first draft of the manuscript. All authors wrote sections of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

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