apunts

EDUCACIÓN FÍSICA Y DEPORTES

156

2.º trimestre (abril-junio) 2024
ISSN: 2014-0983

inefc

Generalitat de Catalunya

WoS
JCI-JCR
Q2 JIF 0.70
Scopus
Q1 CS 2.8

apunts
EDUCACIÓN FÍSICA Y DEPORTES

ISSUE 156

Published: April 1, 2024
https://doi.org/10.5672/apunts.2014-0983.es.(2024/2).156.01

Is it possible to combine professional football and higher education after the age of 18?

Neus Ramos-Agost[1,2,3*], Anna Jordana[1,2] & Miquel Torregrossa[1,2]

[1] Department of Basic, Developmental and Educational Psychology, Autonomous University of Barcelona (Spain).
[2] Institute for Sports Research, Autonomous University of Barcelona (Spain).
[3] Villarreal Club de Fútbol, Vila-real (Spain).

OPEN ACCESS

Cite this article
Ramos-Agost, N., Jordana, A. & Torregrossa, M. (2024). Is it possible to combine professional football and higher education after the age of 18? *Apunts Educación Física y Deportes, 156*, 1-9. https://doi.org/10.5672/apunts.2014-0983.es.(2024/2).156.01

Edited by:
© Generalitat de Catalunya
Departament de la Presidència
Institut Nacional d'Educació Física de Catalunya (INEFC)

ISSN: 2014-0983

***Corresponding author:**
Neus Ramos-Agost
neus.ramosa@autonoma.cat

Section:
Physical Activity and Health

Original language:
Catalan

Received:
July 18, 2023
Accepted:
November 7, 2023
Published:
April 1, 2024

Front cover:
Mountain biker enjoying nature and open air.
© Adobe Stock. Delcio F/ peopleimages.com

Abstract

The aim of this phenomenological and instrumental case study was to explore the combination of high-performance football and higher education at senior level. In order to go deeper into this topic, which is part of the research on dual careers, semi-structured interviews were conducted with 7 male student-football players between 18 and 19 years of age from the lower categories of a Primera División (Spanish Premier League) club. The data have been analysed using reflexive thematic analysis (Braun & Clarke, 2022). The results showed that student-football players can pursue a higher dual career: (a) if they identify the challenges they have to face and have the necessary skills and resources; (b) if the people around them accompany them in a way that suits their lifestyle; and (c) if the club promotes a culture that fosters a higher dual career and their mental health. The study also highlights some aspects not foreseen in the sample studied that should be incorporated into the implementation of the dual higher education career, such as a more individualised and flexible approach to cases, adapting each case to the specific circumstances.

Keywords: dual career, elite sport, football, higher education, mental health, senior.

Introduction

Dual career (DC) is the act of combining sport with studies or work (Stambulova & Wylleman, 2014). The benefits of following it include, among others, more positive identity development and improved emotional stability, and it fosters both intellectual stimulation and socialising (Stambulova & Wylleman, 2019). As the studies of Pallares et al. (2011) and Torregrossa et al. (2015), began to show, the complementarity of sport and studies can work as prevention work so that athletes can have alternatives while they are pursuing their sporting career and when they finish it. Within the Career Path Models (CPM; Perez-Rivases et al., 2017; Torregrossa et al., 2021), we can observe the four career paths that are proposed in relation to the combination of sport and studies/work: (a) a linear path, where athletes focus exclusively on sport, (b) a divergent path, where sport and studies/work are seen as separate and in conflict, (c) a convergent path, where sport and studies/work complement each other, and (d) a parallel path, where sport and studies/work are seen as separate but do not converge. McGuine et al. (2021) indicate that, as the level of both sport and education increases, combining sport and studies can become an increasingly complex challenge.

In the case of football, which is considered the most popular and mediatised sport in the world (Samuel et al., 2017), some authors such as Jordana et al. (2022) point out that football players are beginning to have doubts about the path they have to choose during the transition from junior to senior (TJS), based on their beliefs. In this sense, when they start to become aware that they may become professional football players, their satisfaction with academic performance is significantly lower (Jornada et al., 2022; Torregrossa et al., 2021). Apart from this, in relation to the possibility of being able to pursue football in the future, statistical data shows that less than 10% of football players progress from junior to senior level and go on to become professionals (Dugdale et al., 2021). For this reason, this data suggests the need to develop a DC (Torregrossa et al., 2020) that facilitates the simultaneous development of an academic and sporting career. In this line, once past the TJS, when young and talented football players face a variety of challenges, if they do not have alternatives and remain dedicated to other areas of their lives (e.g. academic and personal; Chamorro et al., 2016), as argued in the systematic review by Kegelaers et al. (2022), they will be closer to having problems with their mental health (MH).

From the perspective of promoting DC in order to prevent MH problems, research such as that of Stambulova et al. (2015) and Schinke et al. (2018) have also stated that developing a DC tailored to the needs of student-athletes is a key resource that helps them to achieve sporting and educational goals, live a fulfilling life, and maintain health and well-being. However, Åkesdotter et al. (2020) found that the time of greatest commitment to combining sport and studies often coincides with the period of increasing problems of MH. Studies such as Brown et al. (2019) have also highlighted that student-athletes' emotional regulation may be impaired when trying to cope with the stressors they experience not only in the sport context (e.g., performance pressure, injuries, call-up problems), but also in the other contexts of their lives (e.g., educational, psychological, social, financial, and legal; Wylleman et al., 2020). Therefore, although we have argued that there are benefits to complementing sport and studies, the combination and demands of the different spheres of a football player's life place a number of demands (Sullivan et al., 2020) that may increase the likelihood of MH problems and early withdrawal from sport or studies (NCAA Sport Science Institute, 2016).

In order for football players to be able to perform DC under optimal conditions, some studies such as those by Defruyt et al. (2019) and Storm et al. (2021) stress that organisations and the people around them have a key role to play in helping them develop a favourable match. Similarly, other work emphasises the need to identify the specific challenges and protective factors that the environment could provide for student-athletes to develop healthy DC (e.g. Prieto-Ayuso, 2008; Kuttel & Larsen, 2020; Stambulova & Wylleman, 2019).

The Model of Dual Career Development Environments (MDCDE) by Henriksen et al. (2020) seeks to emphasise this role of the environment through the full inclusion of the student-athlete. Following this model, in the framework of a sport or academic institution that promotes the combination of sport with studies, the environment is structured as follows: the student-athlete occupies a central position surrounded by micro and macro levels, in which there is an interaction of three spheres—sport, academic and private—that are subject to the temporal dimensions of present, past, and future (Mejías et al., 2021).

Some authors show that DC environments vary considerably depending on the structure and organisation of geographic areas or states (e.g. Morris et al., 2021). However, it is worth noting that at the micro-level of football players (e.g. club, residence and academic programme), no study has explored, within a specific and delimited population, the resources and support structures of DC (Storm et al., 2021). The role of the people who help them to develop it has also not been analysed in detail (Defruyt et al., 2019). Moreover, most of the studies conducted so far on the reconciliation of sport and studies have focused on lower levels of sport or academics (e.g. Stambulova et al., 2020).

The present study goes a step further to find out how the 10% of football players who do go on to become professionals (Dugdale et al., 2021; Jordana et al., 2022) can develop an adaptive dual career at senior level. Therefore, the aim of this article was to explore the combination of high-performance football and higher education at senior level. Specifically, we provide the analysis of making high performance compatible with non-compulsory higher education (e.g. the last stage of the baccalaureate and university) in a male population. We will use the term "higher dual career" (HDC) to indicate this type of collation.

Methodology

Description of the context, participants, and selection criteria

The study focused on the environment of Villarreal C.F., a private club (CDPr; Mejías et al., 2021) with professional men's and women's teams at the highest levels of Spanish football. The club has a Psychology Department, which is in charge of the emotional well-being of the player; a Studies Department, which takes care of the class schedules and the academic reinforcements that the player needs; and a Residence Department, which is in charge of planning and organising the different tasks that they have on a daily basis, together with the technical staff. All three hold meetings on an ongoing basis to maintain the occupation and comprehensive care of the student-athlete.

The participants were seven male student-football players of Villarreal C.F. belonging to amateur B and amateur C. All were interviewed after the end of the 2020-2021 season. Table 1 summarises the characteristics of the participants in order to avoid confidentiality.

The selection criteria were: (a) being in the age range of 18 to 20 years; (b) having passed compulsory education and being in possession of a high school, higher education or university diploma (post-compulsory education); and (c) having been in the club for more than three years to be able to assess the support they have received, and to get to know their culture and customs.

Design

The study is phenomenological and instrumental single-case (Smith & Sparkes, 2016). In other words, it has focused on analysing the actions that an organisation has taken in recent years through the meaning given by the participants in enabling the development of a HDC. The study by Smith and Sparkes (2017) states that in this type of qualitative studies the most relevant thing is not the statistical representativeness, but the opportunity to observe in detail how the selected people experience the world. In this regard, the study states that the number of interviews will depend on how much, and what, you need to know about the interviewees. Therefore, Smith and Sparkes (2017) explain that the sample size needs to be small enough to have the necessary material, and large enough to provide a new, rich and structured understanding of the experience.

This design is the same as that used in the case study by Hodge et al. (2014), which is included within the interpretative paradigm and which recognises the researcher as a reflexive instrument. The interpretation of the interviewer, the first signatory of this article, is relevant, as she is a psychologist at the club and, together with the co-authors, has discussed the issues at stake.

A purposive sampling system was used to select information-rich cases (Patton, 2002). In order to get an overview of the club, and also as explained by Smith and Sparkes (2017) for this type of phenomenological study, seven interviews were considered sufficient to reach information saturation. In addition, to ensure the confidentiality of the participants, pseudonyms were used (Table 1).

Table 1
Descriptive characteristics of the participants interviewed who perform the HDC.

Participants	Sporting level	Academic level	Club years	Age
Ximo	1.ª RFEF	1st university year	4	19
Joan	1.ª RFEF	Baccalaureate and university entrance exams passed	4	19
Jordi	1.ª RFEF	Baccalaureate and university entrance exams passed	3	19
Gerard	1.ª RFEF	Completed higher grade and enrolled in another program	4	18
Pau	1.ª RFEF	2 subjects missing to obtain the baccalaureate	8	18
Vincent	3.ª división	1st university year	5	18
Jaume	3.ª división	2 subjects missing to complete the baccalaureate and enrolled to pursue higher education	5	19

Measures

Semi-structured interview

A semi-structured interview script was designed taking into consideration, on the one hand, research included in the DC theoretical framework (e.g. Torregrossa et al., 2020) and, on the other hand, a script provided by the GEPE group (UAB) and used in the study by Jordana et al. (2019). The main themes included were: (a) the challenges presented and the perceived assistance needed by student-football players in the sporting, academic and personal areas; (b) the exploration of other spheres of the holistic model (e.g. economic and legal management); and (c) club culture.

Procedure

This study is part of the HeDuCa project and has been approved by the Commission of Ethics in Animal and Human Experimentation (CEEAH) of the Autonomous University of Barcelona (Barcelona, Spain) with reference number CEEAH 4996 and is titled "Promotion of Healthy Dual Careers in sport, HeDuCa" Initially, the coordination of the Psychology Department of Villarreal C.F. was contacted to choose the seven participants. In order to maintain confidentiality, avoid minimising hierarchical dependency, and increase the validity of the data, only the interviewer knew which players would participate (World Medical Association, 2013).

The seven interviews were conducted on four different days. They lasted between 40 and 50 minutes and were carried out individually. They were made and recorded by the Zoom.us platform and transcribed with Verbatim. At the end of the study, the results were presented to the Villarreal C.F. Psychology Department.

Statistical Analysis

Data analysis was carried out following Braun and Clarke's (2022) reflective thematic analysis (RTA) approach, using an inductive-deductive approach, from descriptive quotations to the elaboration of themes. This approach allows for the introduction of new terms based on the elaboration of a summary of the information obtained. This procedure consists of six phases: (a) reading and familiarisation; (b) creation of codes in a systematic way; (c) identification and grouping of themes; (d) review of extracted themes and codes; (e) definition and naming of themes; and (f) drafting of the article by choosing the quotes that best summarise the themes. Data analysis was carried out by analysing the interviews individually and as a whole. Based on the transcription of the interviews, in order to analyse the data, an Excel and a Word document were used to create the different versions of the tables (Table 2, 3, and 4). In order to make these tables concrete, questions were critically posed following the steps of RTA. The questions were oriented towards what was intended to be done in this research, how and why. The 6 phases of Braun and Clarke's (2022) study explained above were then applied. The most time was spent on data familiarisation, which involves getting to know the data in depth and supplementing it with notes from the analysis. With regard to coding, an attempt was made to capture repetitions of meanings in an exhaustive manner in order to make the codes more concrete and to avoid overlapping. With regard to the identification of the themes, different schemes and tables were created in order to group the initial codes and generate the most relevant themes for the study. At this point, we found that there were themes subordinate to the main theme that focused on a particular aspect of the main theme. Therefore, sub-themes were also specified (see tables 2, 3 and 4). Finally, the different topics were discussed with the authors of the article and the final name of each topic was agreed upon.

Results

The presentation of the results takes into account the Model of Dual Career Developmental Environments (MEDCD; Henriksen et al., 2020): (a) table 2 corresponds to the individual level and includes the theme challenges and the subthemes management of non-normative transitions and locus of control, flexibility and adaptability, availability of means, organisation and planning, and coping with demands in stressful situations; (b) table 3 corresponds to the micro level and includes the theme accompaniment of collectives and the sub-themes management of competitiveness, emotional validation and HDC support, management of transitions and trust, organisation and planning, understanding and adaptation to HDC, social support and emotional availability; and (c) table 4 corresponds to the macro level and includes the theme culture of the sport environment and the sub-themes self-awareness, self-regulation, compassion, identity and commitment.

Challenges

Table 2 is a summary of how the theme challenges has been derived from: (a) the codes, which describe the challenges that the student-football players have to face in their HDC; and (b) the sub-themes, which correspond to the actions and competences that need the help of the club in order to face them.

In terms of injuries, they explained that it helps them if the club provides them with resources and tools to manage this type of non-normative transition (i.e. events with low predictability and not occurring within a set plan). In this sense, it would be necessary to enhance learning in the management of setbacks in sport in order to redirect the focus to other areas. With regard to timetables, transport, and facilities, it helps them to have these resources adapted to them and to be able to feel this flexibility on the part of

the environment. However, they would need to take more account of individual differences and better tailor resources to different profiles of people. Finally, they consider it necessary to be able to rely on organisation and planning with realistic goals during their daily routine (e.g. training, physical preparation, and study), as well as to receive attention and adaptation when they have assessment tests (e.g. sports competitions and exams).

Accompaniment of the collectives

Table 3 shows how the theme of accompanying groups has been defined on the basis of: (a) the codes, which describe the aspects that the accompanying groups must take into account in their HDC; and (b) the sub-themes, which correspond to the competences that these groups must have in order to accompany the student-football players and facilitate the matching.

The main responsibility for conflict resolution lies with the coaching staff and psychologists. They need emotional validation, support, understanding, and adaptation to the HDC from the most important groups in their environment: team, technical staff, psychologists, residence tutors, teachers, family, partners, and friends. The participants of this study consider that the care of these groups helps them a lot if they take into account the individual differences of each one. Psychological specialists are also often the ones who accompany them in managing transitions and provide them with the confidence and tools to face challenges while taking care of their mental health. The competences related to organisational management and planning, above all, belong to the tutors and teachers in residence and to the psychologists, who are in charge of helping to communicate the tasks and needs presented by the student-football players to the rest of the professionals and family members. Finally, they consider the role of families and couples to be fundamental.

Table 2
Footballers-students' perceptions of the challenges they face and the resources they need during their HDC.

Descriptive quotes from student-athletes	Codes	Sub-themes
"When you are injured, it is very difficult to have courage"; "Psychologists teach you to have other objectives"; "Being dedicated to your studies helps you to see that there are other things apart from football."	Injuries	Non-normative transitions and locus of control management
"If we don't have everything planned and organised in advance, we have the worry of lack of time and it causes us stress"; "I have managed to get everything done because of the conditions we have."	Timetables	Flexibility and adaptability
"Having all these resources helps us to combine everything"; "For those of us who are not in residence, it would be good to have classrooms where we can advance our work when we have free time."	Transport and facilities	Availability of means
"The organisation, planning and understanding of everyone is the key"; "The timetable they provide us with and the techniques they give us psychologists help us to be able to follow through with the objectives."	Daily routine	Organisation and planning
"Not knowing how to combine everything can cause us stress and make us want to give it up, especially studies"; "Not being penalised by changes in timetables is what helps us most to be able to do the DC."	Evaluation tests	Adaptation of demands in stressful situations

Table 3
Perception that student-football players have of the support they should receive from the people around them in order to be able to cope with the HDC.

Descriptive quotes from student-football players	Codes	Sub-themes
"The higher the category, the more complicated it is to manage competitiveness and we need help"; "Learning to see colleagues as people who can help us."	Conflicts	Competitiveness management
"We need people who are empathetic"; "Who understand that each person is different and has different needs"; "Who can adapt their schedules and give us energy."	Diversity	Emotional validation and HDC support
"Psychologists are the people who give you the most confidence and support in any situation"; "We need them to teach us not to depend only on football to be able to be well."	Mental Health	Transition management and trust
"In the residence you have everything, it's amazing all the facilities they give you"; "The tutors also have contact with the relatives, and that gives the parents a lot of peace of mind."	Resources and contact	Organisation and planning
"Even if you are unmotivated and tired, they help you and you end up doing everything"; "They help you feel better and make you change your mind."	Attention	Understanding and adapting to the HDC
"If we have their support, we feel less pressure"; "Problems in our environment affect our HDC"; "The communication they have with the psychologists at the club helps a lot."	Interaction and communication	Social support and emotional availability

Table 4
Footballers-students' perceptions of the culture that a club should have in order to facilitate HDC.

Descriptive quotes from student-football players	Codes	Sub-themes
"The talks we have given have helped us to be aware and prevent catastrophes"; "These spaces help us to relativise our demands."	Lifestyle	Self-awareness
"We need tools to manage money because otherwise we lose our heads"; "We could work a bit more on managing our emotions and thoughts for the lifestyle we have."	Demand management	Self-regulation
"We value what we have more when we see how people without resources and with disabilities are happy to see us"; "We empathise and learn about life thanks to Endavant"; "We get out of our bubble."	Awareness of different realities	Compassion
"At the club they always tell us that we have to study because you never know what can happen to you"; "They tell us that before being football players, we are people and we have a life beyond football."	Establishing values	Identity and commitment

Culture of the sporting environment

Table 4 is a summary of how the theme culture of the sporting environment has been derived from: (a) the codes, which describe the aspects that clubs should take into account to foster the HDC of student-football players; and (b) the sub-themes, which correspond to the competences and values that should be worked on within the club in order to provide them with the necessary resources and to foster their MH.

On the one hand, the student-football players receive advice from the club through a series of talks (e.g. gambling, social networks, sexuality, nutritional aspects, independence) and workshops (e.g. economics, use of mobile phones, study techniques, mindfulness) that help them acquire skills related to self-awareness and self-regulation. On the other hand, from the establishment of a specific methodology and programmes such as *Endavant Igualtat* (a Corporate Social Responsibility programme with the aim of getting players to carry out activities of coexistence and collaboration with other social groups so that they can experience other ways of living different from their own reality), the club promotes a series of values related mainly to compassion, identity, commitment, equality, and responsibility. They perceive this club philosophy as helping them to establish values that foster HDC. In addition, *Endavant Igualtat* helps them to reflect on individual differences, limitations, and capabilities of human beings. However, because of their lifestyle, they report that they would need more resources related to administrative and emotional management on an individual level.

Discussion

The participants in this article are among the 10% of football players who become professionals at senior level (Dugdale et al., 2021), and the results indicate that the club and the people around them help them to follow a convergent trajectory (Torregrossa et al., 2021), i.e. they facilitate them to pursue higher education at the same time. Authors such as Jordana et al. (2022) and Torregrossa et al. (2021) have studied that athletes in the TJS who believe they will become football professionals tend to choose a linear trajectory and therefore end up dropping out of school. However, the results of this study show that student-football players can develop HDC provided they have an environment in which there are conditions adapted to their needs.

Schinke et al. (2018) explain that developing an student-athlete's combination of sport and studies helps to achieve goals not only in these areas (sport and academics), but also in all other areas of their lives (e.g. psychological and social). However, their emotional well-being may be impaired when they try to cope with the challenges they present during their HDC (Brown et al., 2019). This could also increase the risk of dropping out of school and in the long run would not be conducive to their MH. Along the same lines as Kuettel and Larsen (2020), the participants explain that in order to be able to combine top-level sport with higher education, it is important that the club helps them to identify the challenges that may arise. Above all, they need to be provided with resources based on adapted and flexible organisation and planning. However, it must be emphasised that student-football players perceive that they have a demanding lifestyle and that it would be necessary for the club to provide them with more resources to be able to develop a more fulfilling HDC with the consideration of preserving their MH. For example, they suggest the incorporation of more study rooms, break rooms and training based on the management of attentional foci. As stated by Torregrossa et al. (2021), the adapted resources provided by the environment can act as a protective factor. Therefore, if student-football players are provided with support services and adapted

conditions (Storm et al., 2021; Brown et al., 2019) within this level of demand (McGuine et al., 2021) and, above all, for the age at which they are (Åkesdotter et al., 2020), they will be further away from presenting problems of emotional dysregulation (Kegelaers et al., 2022).

Considering the micro-level of the student-athlete (Henriksen et al., 2020), the results also suggest that people in the student-athletes' environment play a crucial role in the development of HDC (Defruyt et al., 2019). They need these people to have specific competences (e.g. competences in emotional validation, understanding and adaptation). At the same time, as suggested by Wylleman et al. (2017), the student-football players consider it important that, above all, psychologists help them to acquire the skills they need for a healthy combination (e.g. organisation and planning). They also believe that the relationship they have with families and partners is essential for the social support they need. These results are in line with those of Hurley et al. (2020), where they explain that the families and partners of student-athletes play a key role not only in helping them to combine sport with their studies, but also in their emotional well-being. As points to be strengthened, participants consider that receiving more individual sessions with the psychology specialists would help them with the management of their HDC. These results, which are in line with other research on student-athletes (Hong & Coffe, 2017; Orozco et al., 2018), lead us to believe that if the people around the student-athletes put certain skills into practice and transfer them, they can help to a large extent to safeguard the HDC of the student-athletes and, above all, to promote their MH (Defruyt et al., 2019).

In relation to the emotional well-being of the student-football players and the macro level of the student-athlete (Henriksen et al., 2020), the results also indicate that the talks and workshops organised by the club help them to acquire skills and values (e.g. self-awareness, self-regulation, compassion, commitment, and identity) that make it easier for them to cope with their demanding lifestyle (Jordana et al., 2022). However, participants felt that, above all, receiving individual sessions based on realistic goal setting and emotional regulation would help them to function better. Along the same lines as the results of Wylleman et al. (2020), we can interpret that the context, culture and ethical principles are substantial when working with projects that aim to promote the healthy development of a DC, and even more so if we are talking about a HDC. Furthermore, the results of our study suggest that the club promotes a series of actions that help student-football players to cope with the demands of the HDC that could be articulated in what is known as a "Career Assistance Programme"; specifically, of a holistic type (CAP; Torregrossa et al., 2020; Jordana et al., 2019). These results could also be taken into account for proposals for other prevention-oriented work carried out with athletes to achieve their optimal performance from a holistic perspective (Gómez et al., 2019). Furthermore, working on and considering these aspects in the results would help athletes to cope with any kind of transition that might occur during their career (e.g. a pandemic; Zamora-Solé et al., 2022).

Our research can help to reflect the idea of a club model that is dedicated not only to developing football players, but people from a vision beyond the sporting sphere. This model could be generalisable to other clubs, as it provides an insight into the resources that student-football players may need to combine professional football with higher education. Nevertheless, some limitations should be noted. Firstly, the sample we have chosen is a small population, as there are few football players who reach senior level by combining professional football and higher education. Therefore, future research could explore the reasons for dropping out of school for those football players who would like to go on to higher education but have not been able to do so. Secondly, in order to preserve the confidentiality of the participants, although there is complementary information that could be interesting to share, we have chosen not to do so. Future research could prove that these results help to meet the needs of student-football players to perform a HDC. We also encourage other clubs to implement this HDC based on the actions we have suggested in our study. Finally, we believe that more research is needed to examine how the demands of different areas, as well as the benefits and resources offered by a HDC affect the MH of student-football players.

Conclusions

This work shows that it is indeed possible to combine professional football with higher education, provided that the environment is conducive to this higher dual career (HDC). We consider that the environment has a responsibility not only in the development of HDC, but also in the prevention of mental health (MH) of student-football players. In this sense, in order for these individuals to be able to complement sport and higher education in a healthy way, it is important that: (a) at the individual level, the club identifies the challenges they present and advises them on the necessary skills and resources; (b) at the micro level, the most relevant people in their environment have a set of skills and offer them adapted support, conditions and means; and (c) at the macro level, the club fosters a

culture that facilitates HDC and, at the same time, supports their emotional wellbeing. Specifically, and in terms of practical application, any club would have to take the following actions: (a) establish a planning and organisation between the different professionals who are part of the context of this type of athletes based on flexibility and adaptation of their needs through realistic objectives; (b) have professionals who provide them with competences related to the organisation, planning and management of transitions and, in addition, offer training for the people in their environment (e.g. mothers, fathers and partners) so that they can help them with the accompaniment of their higher dual career; and (c) establish a methodology based on self-knowledge and self-regulation of the student-athlete through a methodology based on self-knowledge and self-regulation of the student-athlete through programmes providing psychological tools and resources. Thus, despite the lifestyle of student-football players who develop in such an environment, if these suggested guidelines are followed, the risk factors could be counteracted by preventive factors. In other words, the stress of having to cope with so many demands, and therefore the danger of abandoning a sporting career or studies due to lack of resources, can be counteracted by a HDC with the means to provide them with alternatives both throughout their sporting career and at the end of it. And, by extension, it will seek to promote a life free of MH problems.

References

Åkesdotter, C., Kenttä, G., Eloranta, S., & Franck, J. (2020). The prevalence of mental health problems in elite athletes. *Journal of Science and Medicine in Sport, 23*(4), 329-335. https://doi.org/10.1016/j.jsams.2019.10.022

Braun, V., & Clarke, V. (2022). Toward good practice in thematic analysis: Avoiding common problems and be(com)ing a *knowing* researcher. *International Journal of Transgender Health, 24:1,* 1-6. https://doi.org/10.1080/26895269.2022.2129597

Brown, C. J., Webb, T. L., Robinson, M. A., & Cotgreave, R. (2019). Athletes' retirement from elite sport: A qualitative study of parents and partners' experiences. *Psychology of Sport and Exercise, 40*, 51–60. http://dx.doi.org/10.1016/j.psychsport.2018.09.005

Chamorro, J. L., Torregrosa, M., Sánchez Oliva, D., García Calvo, T., & León, B. (2016). Future Achievements, Passion and Motivation in the Transition from Junior-to-Senior Sport in Spanish Young Elite Soccer Players. *The Spanish Journal of Psychology*, *19*(E69), 1-12. https://doi.org/10.1017/sjp.2016.71

Defruyt, S., Wylleman, P., Torregrossa, M., Schipper-van Veldhoven, N., Debois, N., Cecić Erpič, S., & De Brandt, K. (2019). The development and initial validation of the dual career competency questionnaire for support providers (DCCQ-SP). *International Journal of Sport and Exercise Psychology, 0*(0), 1-18. https://doi.org/10.1080/1612197X.2019.1581827

Dugdale, J. H., Sanders, D., Myers, T., Williams, A. M., & Hunter, A. M. (2021). Progression from youth to professional soccer: A longitudinal study of successful and unsuccessful academy graduates. *Scandinavian Journal of Medicine & Science in Sports, 31*, 73–84. https://doi.org/10.1111/sms.13701

Gómez, A., Roqueta, E., Tarragó, J. R., Seirul·lo, F., & Cos, F. (2019). Training in Team Sports: Coadjuvant Training in the FCB. *Apunts Educación Física y Deportes*, 138, 13-25. https://doi.org/10.5672/apunts.2014-0983.es.(2019/4).138.01

Henriksen, K., Storm, L. K., Kuettel, A., Linnér, L., & Stambulova, N. (2020). A holistic ecological approach to sport and study: The case of an athlete friendly university in Denmark. *Psychology of Sport and Exercise, 47*, 101637. https://doi.org/10.1016/j.psychsport.2019.101637

Hodge, K., Henry, G., & Smith, W. (2014). A case study of excellence in elite sport: Motivational climate in a world champion team. *The Sport Psychologist*, *28*(1), 60-74. https://doi.org/10.1123/tsp.2013-0037

Hong, H. J., & Coffee, P. (2017). A psycho-educational curriculum for sport career transition practitioners: Development and evaluation. *European Sport Management Quarterly, 18*, 287-306. http://dx.doi.org/10.1080/16184742.2017.1387925

Hurley, D., Swann, C., Allen, M. S., & Vella, S. A. (2020). A qualitative evaluation of a mental health literacy intervention for parents delivered through community sport clubs. *Psychology of Sport and Exercise, 47*, 101635. https://doi.org/10.1016/j.psychsport.2019.101635

Jordana, A., Pons, J., Borrueco, M., Pallarés, S. & Torregrossa, M. (2019). Implementation of a Dual Career Assistance Programme in a private multisport club. *Revista de Psicología Aplicada al Deporte y al Ejercicio Físico, 4,* pp. e9, 1-7. https://doi.org/10.5093/rpadef2019a8

Jordana, A., Ramis, Y., Chamorro, J. L., Pons, J., Borrueco, M., De Brandt, K., & Torregrossa, M. (2022). Ready for Failure? Irrational Beliefs, Perfectionism and Mental Health in Male Soccer Academy Players. *Journal of Rational-Emotive & Cognitive-Behavior Therapy*, 1-24. https://doi.org/10.1007/s10942-022-00491-x

Kegelaers, J., Wylleman, P., Defruyt, S., Praet, L., Stambulova, N., Torregrossa, M., Kenttä, G., & De Brandt, K. (2022). The mental health of student-athletes: a systematic scoping review. *International Review of Sport and Exercise Psychology*, 1-34. https://doi.org/10.1080/1750984X.2022.2095657

Kuettel, A., & Larsen, C. H. (2020). Risk and protective factors for mental health in elite athletes: A scoping review. *International Review of Sport and Exercise Psychology, 13*(1), 231–265. https://doi.org/10.1080/1750984X.2019.1689574

McGuine, T. A., Biese, K. M., Petrovska, L., Hetzel, S. J., Reardon, C., Kliethermes, S., Bell, D. R., Brooks, A., & Watson, A. M. (2021). Mental health, physical activity, and quality of life of US adolescent athletes during COVID-19-related school closures and sport cancellations: A study of 13 000 athletes. *Journal of Athletic Training, 56*(1), 11-19. https://doi.org/10.4085/1062-6050-0478.20

Mejías, J., Torregrossa, M., Jordana, A., Borrueco, M., Pons, J, & Ramis, Y. (2021). Taxonomía de Entornos Desarrolladores de Carrera Dual en España. *Cultura, Ciencia y Deporte 16*(47), 19-29. https://doi.org/10.12800/ccd.v16i47.1624

Morris, L. M., Twilley, D., Sidman, C. L., Adamczyk, H., Gasell, Z., & Plemmons, K. (2020). Student- Athletes: An exploration of subjective wellbeing. *The Sport Journal, 24(1)*, 1-11.

NCAA Sport Science Institute. (2016). Interassociation consensus document: Mental Health Best Practices. Understanding and Supporting Student-Athlete Mental Wellness. https://ncaaorg.s3.amazonaws.com/ssi/mental/SSI_MentalHealthBestPractices.pdf

Orozco, A. M., Pérez, A. A., & Sierra, F. S. (2018). U8 football training: Optimising educational potential. *Apunts Educación Física y Deportes*, (133), 68-84. https://doi.org/10.5672/apunts.2014-0983.es.(2018/3).133.05

Pallarés, S., Azócar, F., Torregrosa, M., Selva, C., & Ramis, Y. (2011). Athletic career models in water polo and their involvement in the transition to an alternative career. *Cultura, Ciencia y Deporte*, *6*(17), 93-103. https://doi.org/10.12800/ccd.v6i17.36

Patton, M. Q. (2002). Qualitative research and evaluation methods. Thousand Oaks (CA): *Sage Publications*. New York, New Delhi, London.

Perez-Rivases, A., Pons, J., Regüela, S., Viladrich, C., Pallarès, S., & Torregrossa, M. (2020). Spanish female student-athletes' perception of key competencies for successful dual career adjustment. *International Journal of Sport and Exercise Psychology*, 1-15. https://doi.org/10.1080/1612197X.2020.1717575

Prieto-Ayuso, A. (2008). La formación del talento en el ámbito deportivo: la transferencia de los procesos formativos en el ámbito educativo al joven jugador de fútbol. 2017 [The formation of talent in the sports field: the transfer of formative processes in the field of education to the young football (..)]. *Tesis doctorales*, (15). https://revista-apunts.com/la-formacion-del-talento-en-el-ambito-deportivo-transferencia-de-los-procesos-formativos-en-el-ambito-educativo-al-joven-jugador-de-futbol/

Samuel, RD, Galily, Y. y Tenenbaum, G. (2017). ¿Quién eres, árbitro? Definición del árbitro de fútbol carrera desde una perspectiva basada en el cambio.*Revista Internacional de Psicología del Deporte y el Ejercicio, 15*(2), 118–130. https://doi.org/10.1080/1612197X.2015.1079792

Schinke, R. J., Stambulova, N., Si, G., & Moore, Z. (2018). International society of sport psychology position stand: Athletes' mental health, performance, and development. *International Journal of Sport and Exercise Psychology, 16*(6), 622-639. https://doi.org/10.1080/1612197X.2017.1295557

Smith, B., & Sparkes, A. C. (2017). *Routledge Handbook of Qualitative Research in Sport and Exercise*. Routledge.

Stambulova, N., Engström, C., Franck, A., Linnér, L., & Lindahl, K. (2015). Searching for an optimal balance: Dual career experiences of Swedish adolescent athletes. *Psychology of Sport and Exercise, 21*, 4-14. https://doi.org/10.1016/j.psychsport.2014.08.009

Stambulova, N. B., Ryba, T. V., & Henriksen, K. (2020). Career development and transitions of athletes: the International Society of Sport Psychology Position Stand Revisited. *International Journal of Sport and Exercise Psychology, 0*(0), 1-27. https://doi.org/10.1080/1612197X.2020.1737836

Stambulova, N. B., & Wylleman, P. (2014). Athletes career development and transitions. In A. G. Papaioanu i D. Hackfort (Eds.), *Routledge companion to sport and exercise psychology: Global perspectives and fundamental concepts* (pp. 603-620). Routledge.

Stambulova, N., & Wylleman, P. (2019). Psychology of athletes' dual careers: A state of the art critical review of the European discourse. *Psychology of Sport and Exercise, 42*, 74-88. https://doi.org/10.1016/j.psychsport.2018.11.013

Storm, L. K., Henriksen, K., Stambulova, N. B., Cartigny, E., Ryba, T. V., De Brandt, K., Ramis, Y., & Cecić Erpič, S. (2021). Ten essential features of European dual career development environments: A multiple case study. *Psychology of Sport and Exercise, 54*, 101918. https://doi.org/10.1016/j.psychsport.2021.101918

Sullivan, M., Moore, M., Blom, L. C., & Slater, G. (2020). Relationship between social support and depressive symptoms in collegiate student athletes. *Journal for the Study of Sports and Athletes in Education, 14*(3), 192-209. https://doi.org/10.1080/19357397.2020.1768034

Torregrossa, M., Chamorro, J. L., Prato, L., & Ramis, Y. (2021). Grupos, Entornos y Carrera Deportiva. In T. García-Calvo, F. M. Leo, i E. Cervelló (Eds.), *Dirección de Equipos Deportivos* (pp. 355-374). Tirant Humanidades.

Torregrossa, M., Ramis, Y., Pallarés, S., Azócar, F., & Selva, C. (2015). Olympic athletes back to retirement: A qualitative longitudinal study. *Psychology of Sport and Exercise*, *21*, 50- 56. https://doi.org/10.1016/j.psychsport.2015.03.003

Torregrossa, M., Regüela, S., & Mateos, M. (2020). Career Assistance Programmes. In D. Hackfort i R. J. Schinke (Eds.), *The Routledge International Encyclopedia of Sport and Exercise Psychology* (pp. 73-88). Routledge.

World Medical Association (2013). World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. *JAMA, 310*(20), 2191–2194. https://doi.org/10.1001/jama.2013.281053

Wylleman, P., De Brandt, K., & Defruyt, S. (Eds.). (2017). GEES handbook for dual career support providers (DCSPs).

Wylleman, P., De Brandt, K., & De Knop, P. (2020). Career development. In D. Hackfort, & R. J. Schinke (Eds.), *The Routledge International encyclopedia of Sport and Exercise psychology. Volume 2: Applied and Practical measures* (pp. 714-731). Taylor & Francis Group.

Zamora-Solé, R., Alcaraz, S., Regüela, S., & Torregrossa, M. (2022). Experiences of Olympic Hopefuls of the Disruption of the Olympic Cycle at Tokyo 2020. *Apunts Educación Física y Deportes, 148*, 1-9. https://doi.org/10.5672/apunts.2014-0983.es.(2022/2).148.01

Conflict of Interests: No conflict of interest was reported by the authors.

apunts EDUCACIÓN FÍSICA Y DEPORTES

ISSUE 156

Published: April 1, 2024
https://doi.org/10.5672/apunts.2014-0983.es.(2024/1).156.02

Study on the motivations for the practice of speleology

Miquel Pans[1*], Laura Antón-González[1] & Maite Pellicer-Chenoll[1]

[1] Department of Physical and Sports Education. University of Valencia (Spain).

Cite this article
Pans, M., Antón-González, L. & Pellicer-Chenoll, M. (2024). Study on the motivations for the practice of speleology. *Apunts Educación Física y Deportes, 156*, 10-18. https://doi.org/10.5672/apunts.2014-0983.es.(2024/2).156.02

OPEN ACCESS

Editor:
© Generalitat de Catalunya
Departament de la Presidència
Institut Nacional d'Educació Física de Catalunya (INEFC)

ISSN: 2014-0983

***Corresponding author:**
Miquel Pans
miquel.pans@uv.es

Section:
Human and Social Sciences

Original language:
Spanish

Received:
September 1, 2023
Accepted:
December 12, 2023
Published:
April 1, 2024

Front cover:
Mountain biker enjoying nature and open air.
© Adobe Stock. Delcio F/ peopleimages.com

Abstract

This article studies the reasons that lead people to practise caving as a physical-sporting activity. To this end, the relationships between different motivations and variables of interest such as gender, academic studies, federation membership, caving level, and participation in "alpine" explorations were analysed. A cross-sectional study was carried out with 502 cavers (355 men, 146 women) aged 18-76 years (M = 45.38; SD = 11.32) and with caving experience between 1 and 73 years (M = 15.78; SD = 13.54). Participants completed an electronic survey on the reasons for caving and socio-demographic data. The results revealed that the main reasons for caving are intrinsic, such as being in contact with nature or gaining personal and life experience. Significant associations were also found for gender, level of education, federal affiliation, and participation in explorations. Future plans to promote caving should take these differences into account in their design.

Keywords: caves, caving, motivation, natural environment, physical activity.

Introduction

In recent decades, participation in extreme and adventure sports in the natural environment, such as climbing, alpine skiing, or caving, has grown exponentially (Pain & Pain, 2005). Outdoor adventure sports elicit a degree of perceived excitement for the practitioner and also involve moving in a wild and vast environment, taking risks, and dealing with the unexpected (Pike & Beames, 2013). These practices provide higher levels of health and well-being than physical activity in built or indoor environments (Shanahan et al., 2016), as regular contact with the natural environment offers a multitude of physical and mental benefits (Hartig et al., 2014).

Among the different outdoor sports practices, caving is a complex discipline that requires specific logistics, detailed planning, multidisciplinary knowledge, comprehensive safety protocols, and teamwork (White, 2019). The discipline has been defined as a "sport science" or a "citizen science" and practitioners as "underground astronauts" (Cant, 2006; Mattes, 2015; Mencarini et al., 2021). However, most of these definitions mainly include characteristics related to the nature or origin and formation of the caves. Thus, Cuenca-Rodríguez (2021) points out that caving is an exploratory activity with two key parts, sport and science, which are united by curiosity. On the other hand, Pans et al. (2023) define caving "as a physical and sporting activity that takes place in a natural space and consists of the exploration or exploration of an underground cavity, either for scientific or recreational purposes, through the use of specific physical skills" (p. 58). Even so, there are very few existing studies that analyse and study this discipline in depth from the perspective of physical activity and sport sciences. In fact, in this same journal (started in 1985), caving is only mentioned within the taxonomies of adventure physical activities in nature (Olivera & Olivera, 1995; Olivera & Olivera, 2016), and in another article that studies the current situation of physical activities in the natural environment in physical education (González-Melero et al., 2023). Likewise, in *Apunts Sport Medicine* it also appears in three physiological studies (Balcells et al., 1986; Yzaguirre i Maura et al., 2008; Yzaguirre Maura & Balcells Diaz, 1989).

However, previous studies in other countries show that caving offers several benefits, such as the development of spatial skills, improvement of mental rotation, or perspective-taking (Muffato et al., 2022). Thus, according to a study of Italian cavers, most of these athletes perform vigorous physical activity at least once a week, indicating that they are very physically active (Viviani & Tommaso, 2017). At the same time, caving practitioners have significantly lower levels of anxiety than the general population (De la Torre-Cruz et al., 2021). However, the practice of this type of activity also carries a number of risks to practitioners such as getting lost, inhaling polluted air, rockfall, or flooding (StartCaving.co.uk, 2017). In addition, qualitative studies focusing on the use of technology by cavers report the pleasure cavers take in exploring isolated places (Mencarini & Zambon, 2023).

As we have seen, the benefits and risks of caving have been studied, but the motivation to go caving has not yet been explored. In addition, one of the most common questions asked of caving enthusiasts is "why do you go caving?" This question, which triggers the need to know why people go into caves and chasms for physical activity, could be answered by George Leigh Mallory's reply in 1923 when he was about to make his third attempt at the summit of Everest and was asked why he was doing it: "Because it's there". However, apart from this anecdote, which serves to illustrate the need to know why the practice is being used, Ewert et al. (2013) went further and investigated the motivations that existed for the practice of adventure recreational activities. This study concluded that motivational factors can be social, sensation-seeking, and related to self-image. In addition, variables such as level of experience, gender, and type of activity showed different trends in these motivational factors. Dr. Alan W. Ewert has previously conducted several studies on motivation in outdoor activities, including specific disciplines such as climbing. In one of his studies, it was concluded that the most important motivational reasons for climbing, taking into account the level of experience of its practitioners, were challenge, gaining high mental concentration, and enjoyment of the natural environment (Ewert, 1985). Likewise, among the subsequent research carried out in Spain on motivation to climb, we find the study by López-Fernández et al. (2013). In this research, the reasons for climbing were classified into three main groups: one group whose main reasons for climbing were contact with nature, adventure, challenge, fun and physical fitness; another group, which reported personal experience, social relationship, peace, and health as motivations; and finally, the least numerous group, whose main reasons were image, competition, and social recognition. Furthermore, this study found differences in motivations according to the gender of the participants: female climbers showed a higher motivation towards climbing for fun and body image improvement than male climbers.

With the aim of expanding the scientific literature in

the field of caving, the purpose of this study is to find out the reasons for caving and whether there are differences in motivation according to gender, academic studies, federation membership, caving level or participation in "alpine" explorations.

Methodology

Procedure

The fieldwork was carried out between October 2022 and December 2022. Potential participants were contacted through the caving federations in Spain, some of which emailed a link to an online survey (administered by LimeSurvey, Version 5.4.13+) to their members. Participants were also contacted through social media posts (i.e. Twitter and Facebook). To access the full survey, participants had to click on a box explaining the conditions of participation (i.e. confidentiality, anonymity, and the right to refuse or drop out) and finally give their informed consent. Prior to fieldwork, all procedures and materials were reviewed and followed the guidelines of the Ethics Committee of the University of Valencia. Prior to analysis, all data were checked for outliers, and an experimental mortality of 26 subjects was obtained due to failure to complete the survey correctly.

Participants

The study involved 502 cavers (355 men, 146 women, and 1 non-binary) aged between 18 and 76 years (M = 45.38; SD = 11.32) and with caving experience between 1 and 73 years (M = 15.78; SD = 13.54). In addition, among the participants, the frequency of caving per month ranged from 0 to 23 days (M = 3.12; SD = 2.53). Table 1 presents the socio-demographic characteristics of the sample.

Table 1
*Sample characteristics according to variables of interest (*N = *502).*

Variable	*N*	% total
Gender		
Man	355	70.7
Woman	146	29.1
Missing	1	0.2
Academic studies		
School graduate	52	10.4
Higher Education	58	11.6
Vocational training	213	42.4
University students	150	29.9
PhD	29	5.8
Missing		
Federated		
Yes	474	94.4
No	28	5.6
Missing		
Caving level		
Beginner	59	11.8
Intermediate	221	44
Advanced	222	44.2
Missing		
Participation in "alpine" explorations		
Yes	186	37.1
No	316	62.9
Missing		

Table 2
Place of residence of the surveyed (N = 502).

Residence	*N*	% total
Andalusia	63	12.5
Aragon	9	1.8
Asturias	23	4.6
Balearic Islands	51	10.2
Basque Country	18	3.6
Canary Islands	5	1
Cantabria	25	5
Castilla-la Mancha	10	2
Castilla y León	8	1.6
Catalonia	51	10.2
Extremadura	1	0.2
Galicia	49	9.8
La Rioja	2	0.4
Madrid	42	8.4
Murcia	8	1.6
Navarre	22	4.4
Other (Andorra, Portugal, France, and Mexico)	14	2.8
Valencian Community	101	20.1
Total	502	100

As can be seen, the majority of participants were male (70.7%). In terms of educational level, the most numerous profile was that of people with vocational training (42.4%). The caving level was distributed as follows: beginners (11.8%), intermediate (44%), and advanced (44.2%). The majority of respondents were federated (94.4%), and more than half of the participants had not taken part in any "alpine" exploration campaign (62.9%).

On the other hand, the place of residence of the participants was obtained in terms of Spanish region. Likewise, 2.8% of the sample were people whose place of residence is outside Spain. Table 2 shows the origin of the participants.

Resources

A questionnaire was used to collect the reasons for caving by frequency of choice, developed by López et al. (2013). This questionnaire was previously used to collect reasons for rock climbing. In addition, this questionnaire was based on that which was designed by Ewert (1994). The questionnaire used is composed of 14 items with reasons for caving, including 13 reasons for caving and one "Other" item with an open-ended response. In this question, participants were asked to choose the reasons for practice that most represented them, and could indicate as many as they considered fit. In addition, socio-demographic data were collected (i.e. gender, level of education) and variables of interest in caving (i.e. membership of a federation, caving level, and participation in "alpine" explorations).

Statistical Analysis

Statistical analyses were performed using SPSS version 28.0 software (SPSS Inc., Chicago, IL, USA) Pearson's Chi-square test was used to analyse differences according to gender, and statistical significance was established at $p < .05$.

Results

Figure 1 shows the results of the questionnaire on reasons for caving in order of frequency of choice. On the basis of these, two reasons can be observed that exceed 70%, namely "being in contact with nature" and "personal and life experience". Two other reasons chosen by more than half of the sample were "enjoying myself and having a good time" and "adventure-seeking".

Figure 1
Reasons for caving, ordered by frequency of choice and expressed as a percentage.

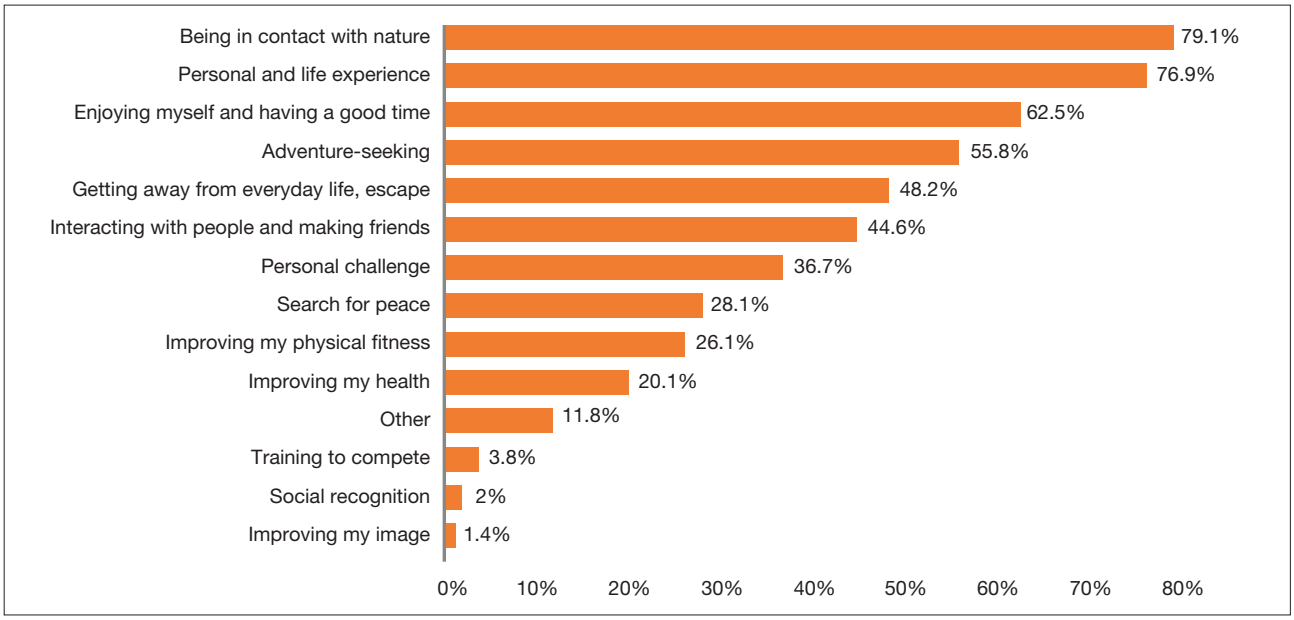
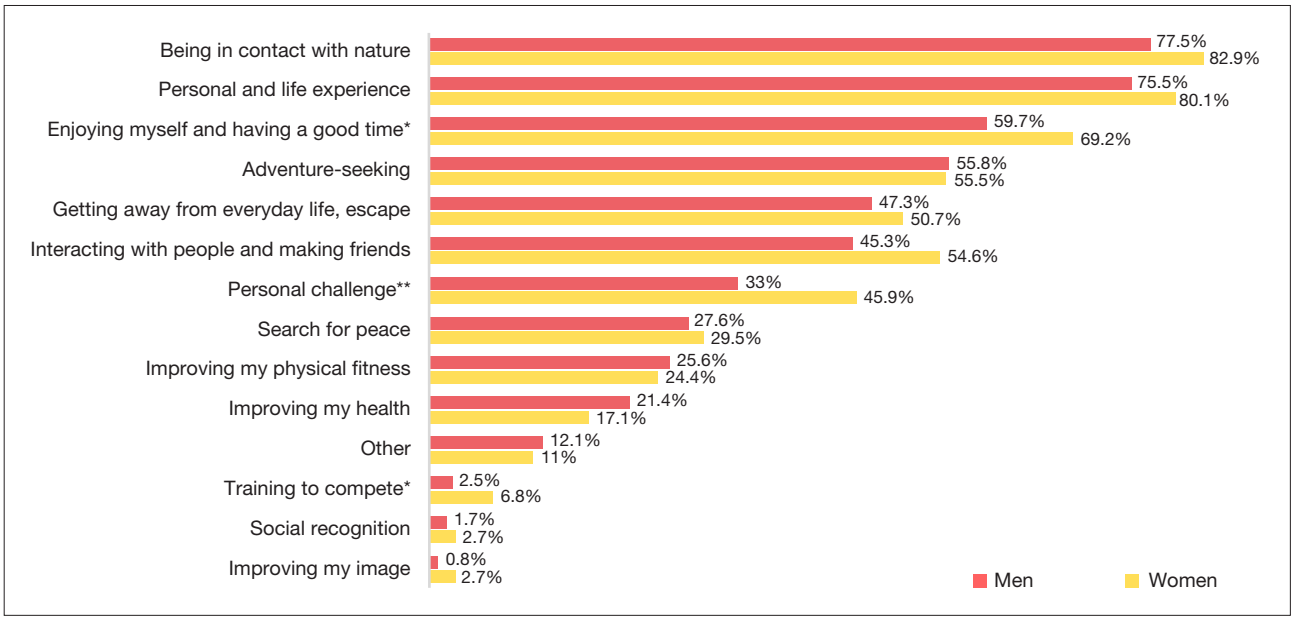


Figure 2
Frequency of choice of reasons for caving differentiated by gender.



**indicates significant differences p < .05; **indicates significant differences p < .01*

This would be followed by "escape", "making friends" and "personal challenge", which would be around 40-30%. Among the group of reasons, around 30-20% are "peace", "physical fitness", and "health". Among the least representative reasons were "training to compete", "social recognition" and "improving my image".

Also, the category "other" scored 11.8% and in the open answer section some people agreed and gave reasons for practice such as "exploration of new caves", "scientific discovery", "underground photography", "rescue" or "work".

Figure 2 shows the results differentiated by gender. Significant associations were found using the Chi-square test for three of the reasons for caving. The first of these was in the reason "enjoying myself and having a good time" (χ^2_1= 3.95; $p < .047$), where women scored 69.2% compared to 59.7% for men. The second, in "personal challenge" (c^2_1 = 7.45; $p < .01$), where women obtained a value of 45.9% compared to 33% for men. And the third, in "training to compete" (χ^2_1 = 5.28; $p < .022$), where women had 6.8% compared to 2.5% for men.

In addition, significant differences by level of academic studies were found for the reason "personal and life experience" ($\chi^2_4 = 12.04$; $p < .017$), where, of the total percentage of 76.9% answered, 65.4% corresponded to school graduates, 69.0% to high school graduates, 76.10% to vocational training, 85.3% to university graduates, and 75.9% to doctoral graduates. Also, by caving level in "adventure-seeking" ($\chi^2_1 = 4.03$; $p <. 045$), where beginners obtained 72.9%, intermediate 51.6%, and advanced 55.4%; and in "other" ($\chi^2_1 1 = 8.58$; $p < .047$) where beginners acquired 3.4%, intermediate 8.1%, and advanced 17.6%. Significant differences were also found in whether they were federated or not, in the reason of "social recognition" ($\chi^2_2 = 8.58$; $p < .014$), where the federated obtained 1.7% and the non-federated 7.1%; and in "Other" ($\chi^2_2 = 13.99$; $p < .01$), where the federated obtained 12.4% and the non-federated 0%. Finally, with respect to the variable of participation in "alpine" explorations, significant differences were only found for the reason "Other" ($\chi^2_1 = 6.87$; $p < .01$), where those who have participated in explorations obtained 16.7% and those who have not obtained 8.9%.

Discussion

To date, this is the first study on the motivations for caving among a large sample of cavers. The main results of the study show that the main reasons for caving are intrinsic motivations, such as being in contact with nature or gaining personal and life experience. This is evidence that caving is felt to be an intrinsically valuable practice in its own right and that it does not need external or social reinforcement for its motivation. Thus, in Mencarini's study (2021), expert cavers said they felt like astronauts exploring the last untouched corners of the Earth.

Caving as a practice in the natural environment, whose main purpose is the discovery and exploration of unexplored or little-known environments, is in line with other disciplines practised in the natural environment such as mountaineering or climbing (Olivera & Olivera, 2016). Since there are no previous studies on the motivations of people who go caving, the results presented here will be discussed with studies of other types of caving in the natural environment. One of the main studies related to the motivation to practice activities in the natural environment is that of López et al. (2013) carried out with climbers in Spain. In this study the most frequent reason for climbing was being in contact with nature at 58.2%; however in the present study, the results for being in contact with nature are 79.1%. In terms of personal and life experience, 76.9% of cavers chose it as a motivation, while 45.9% of climbers chose it as a motivation. In short, there is a discrepancy between climbers and cavers among the main reasons for caving and, although contact with nature is the main reason for both disciplines, it is not given the same importance, since 20.9% more cavers than climbers choose it as the motivation for their practice. This difference may be due to the fact that caving involves the discovery of nature. To give an objective example, at present, about 12 caving explorations are organised annually in the Picos de Europa National Park (Cantabrian mountain range), which report between 5 and 10 km of new galleries each year (Ballesteros, 2021). At the same time, it seems that after the health crisis, contact with natural areas has become more important for the general population (Tansil et al., 2022). On the other hand, it may also be due to the fact that there are more sports facilities such as climbing walls and very few caving walls.

Next, personal and life experience among male and female cavers is the second most chosen reason, however, among male and female climbers it was chosen in seventh place, with a difference with caving of 31% less than among male and female climbers. This discrepancy may be due to the sensations of entering a cave. As Mencarini and Zambon (2023) point out, despite the darkness, the narrowness, or the cold, cavers feel privileged and fascinated by their presence in this environment, as only a few can go and come back intact.

With regard to gender differences, results were obtained with significant differences in 3 items. From highest to lowest proportion, we found differences in "enjoying myself and having a good time", where men obtained lower values than women, namely 59.7% versus 69.2%, respectively. These results are at odds with most studies of motivation in physical activity and sport, in which women tend to report this motivation to a much lesser extent than men (Frömel et al., 2022; Kopcakova et al., 2015).

The second item in which we found significant differences is "personal challenge" and, in fact, it is the one that has shown the greatest difference, namely 12.9% difference, in favour of women over men. While it is true that there are studies that report that women have a greater need for motivations that provide them with self-improvement, or that in some way imply responsibility, such as the fact of associating it with a goal to be achieved, or feeling good about

themselves (Drummond et al., 2022). Expressing this type of motivation as a personal challenge may have to do with the type of sport, as caving has a strong exploration component, and achieving a complete exploration can be considered an achievement in itself, as there are no marks to compete for and no comparisons between caving practitioners. Finally, significantly different results were also found for "training to compete" where women again obtained higher values than men. This is contrary to the results of studies in sport in general, which have recurrently found a lower interest of women in competition (Budd et al., 2018; Frömel et al., 2022). It is worth noting that this item was only selected by 3.8% of the respondents, and furthermore, what is involved in competitive caving is very different from what is involved in other sports. However, this information may be useful to suggest that the promotion of caving or vertical progression technique (VPT) competitions would be positive for the attraction of women in this sport. This result is in line with the previously mentioned importance of personal achievement and the fact that "compulsory" motivation is needed for women to give sport an important place in their lives (Drummond et al., 2022). Even so, in disciplines such as climbing or caving, competition is not a relevant motivation for climbers. In outdoor and adventure sports, competition takes second place, with the enjoyment of nature, adventure-seeking, the personal challenge or self-improvement or mere fun being the most repeated motivations (Gürer & Kural, 2023; López Fernández et al., 2013).

With regard to the differences found depending on the level of studies with respect to the reason for practice that refers to personal and experiential experience, we observe that this reason is much more important for people with university studies, and then for those with vocational training and doctorate studies, than for people with a school-leaving certificate and baccalaureate. Possibly because the first groups are already immersed in the world of work and caving can provide an experience of social escape or relief from work and/or social burdens. In order to explore this reason further, one should look at age and its correspondence with the level of education, as it is usually the youngest people who have the lowest level of education, as they have not yet completed their education. In this sense, we can associate the differences found according to the level of education to differences in age, where higher motivation scores are usually obtained with increasing age (Gavin et al., 2014).

In addition, beginner cavers tended to value adventure-seeking motivation more highly than intermediate and advanced cavers. This can be related to studies by Ewert (1985), where differences were found in the reasons for practice in climbers according to the level of experience in the discipline. Beginner climbers climbed for extrinsic reasons such as social recognition, escape, or socialisation. However, more advanced climbers selected more intrinsic reasons, including excitement and personal challenge. Compared to our results, it can be seen that caving does not follow the same trend as climbing, as people with lower levels were the ones who valued intrinsic reasons the most. Also, advanced individuals have more specific motivations than beginners (i.e. rescue, exploration, research). Interestingly, there were also differences in social recognition for federation affiliation, with non-federated people having higher values. This could be because people seeking social recognition shy away from federative movements, which in principle are more about the collective rather than the individual. However, it should be kept in mind that this study compares 474 federated versus 28 non-federated individuals. In turn, members gave other reasons such as photography, caving, scientific discovery and explorations of new caves; these motivations should be taken into account for future studies of motivation in caving and included in future questionnaires or reasons for caving practice. Also, in the "Other" item, differences were seen among those who had participated in "alpine" explorations, with those who had participated also giving more reasons. Here standard knowledge in the caving discipline would reveal that people who are federated and involved in exploration tend to be the ones who are most involved in exploration of new caves, rescue (caving rescue), and photography.

Finally, regarding the limitations of the present study, there is one main limitation that deserves to be mentioned, and that is that in the field of speleology there is a large volume and dissemination of publications that are not included in scientific databases (i.e. WoS, Scopus, Google Scholar), and it is very difficult to access these other publications. However, there does seem to be a favourable trend in recent years in the publication of scientific articles on caving, not only related to Karst but also to other aspects of this discipline. It is therefore hoped that this research will add to and contribute to the broadening of scientific knowledge within the world of caving.

Future studies

In order to gain a deeper insight into the reasons why people go caving, qualitative research could be carried out, as was done in Ewert's study (Ewert et al., 2020). In this study, semi-structured interviews were conducted with mountain bikers, rock climbers, and whitewater rafters in which motivation to practise was addressed. Applying this methodology with caving practitioners would allow the scientific literature on caving as a sport to be expanded. It would also be advisable to work on the elaboration of a questionnaire specific to this physical-sporting practice that includes the different sensitivities and disciplines of caving and their motivations. Furthermore, caving has not yet been approached and studied in depth from the physical activity and sport sciences, perhaps due to its complexity when collecting data, so there are still many interesting studies that can contribute to its exploration from different disciplines.

Conclusions

This article has explored the reasons for caving among a large sample of male and female cavers. The results allow two conclusions to be drawn regarding the object of study. The first is that the motivations for caving are mainly to be in contact with nature and to gain personal and life experience, i.e. intrinsic motivations. In addition, fun and adventure-seeking are also reasons chosen by more than half of our survey. On the other hand, the results have shown that there are gender differences in reasons such as "enjoying myself and having a good time", "personal challenge" and "training to compete". Finally, the results described above are interesting for future plans to promote the practice of caving and its orientation.

Acknowledgements

The authors would like to thank the people who voluntarily participated and gave us their time, the caving clubs that are the basis of all the previous knowledge and its transmission, and some caving federations that have supported us with the dissemination. We would especially like to acknowledge the great involvement of the Federación de Espeleología de la Comunitat Valenciana and our colleagues from the Picos de Europa campaign.

References

Balcells, M., Prat, J. A., & Yzaguirre, I. (1986). Perfil fisiològic i càrregues de treball en Espeleologia. *Apunts Sports Medicine*, *23*(90), 217–224. http://apunts.org/es-perfil-fisioiogic-i-carregues-treball-articulo-X0213371786049400

Ballesteros, D. (2021). Espeleología y ciencia en las cuevas de los Picos de Europa. *Congreso Colombiano de Espeleología*. https://www.academia.edu/53316686/Memorias_II_Congreso_Colombiano_de_Espeleología_2021

Budd, E. L., McQueen, A., Eyler, A. A., Haire-Joshu, D., Auslander, W. F., & Brownson, R. C. (2018). The role of physical activity enjoyment in the pathways from the social and physical environments to physical activity of early adolescent girls. *Preventive Medicine*, *111*, 6–13. https://doi.org/10.1016/j.ypmed.2018.02.015

Cant, S. G. (2006). British speleologies: Geographies of science, personality and practice, 1935–1953. *Journal of Historical Geography*, *32*(4), 775–795. https://doi.org/10.1016/j.jhg.2005.10.002

Cuenca-Rodríguez, J. (2021). El camino del espeleólogo: Enfoque multidisciplinar en la formación de un espeleólogo. *Congreso Colombiano de Espeleología*. https://www.academia.edu/53316686/Memorias_II_Congreso_Colombiano_de_Espeleología_2021

De la Torre-Cruz, T., Luis-Rico, I., di Giusto-Valle, C., Escolar-Llamazares, M.-C., Hortigüela-Alcalá, D., Palmero-Cámara, C., & Jiménez, A. (2021). A Mediation Model between Self-Esteem, Anxiety, and Depression in Sport: The Role of Gender Differences in Speleologists. *International Journal of Environmental Research and Public Health*, *18*(16), 8765. https://doi.org/10.3390/ijerph18168765

Drummond, M., Drummond, C., Elliott, S., Prichard, I., Pennesi, J.-L., Lewis, L. K., Bailey, C., & Bevan, N. (2022). Girls and Young Women in Community Sport: A South Australian Perspective. *Frontiers in Sports and Active Living*, *3*. https://doi.org/10.3389/fspor.2021.803487

Ewert, A. (1985). Why people climb: The relationship of participant motives and experience level to mountaineering. *Journal of Leisure Research*, *17*(3), 241–250. https://doi.org/10.1080/00222216.1985.11969634

Ewert, A., Gilbertson, K., Luo, Y.-C., & Voight, A. (2013). Beyond "Because It's There": Motivations for Pursuing Adventure Recreational Activities. *Journal of Leisure Research*, *45*(1), 91–111. https://doi.org/10.18666/jlr-2013-v45-i1-2944

Ewert, A. W. (1994). Playing the edge: Motivation and risk taking in a high-altitude wilderness like environment. *Environment and Behavior*, *26*(1), 3–24. http://dx.doi.org/10.7771/2327-2937.1016

Ewert, A., Zwart, R., & Davidson, C. (2020). Underlying Motives for Selected Adventure Recreation Activities: The Case for Eudaimonics and Hedonics. *Behavioral Sciences*, *10*(12), 185. https://doi.org/10.3390/bs10120185

Frömel, K., Groffik, D., Šafář, M., & Mitáš, J. (2022). Differences and Associations between Physical Activity Motives and Types of Physical Activity among Adolescent Boys and Girls. *BioMed Research International*, *2022*, 6305204. https://doi.org/10.1155/2022/6305204

Gavin, J., Keough, M., Abravanel, M., Moudrakovski, T., & Mcbrearty, M. (2014). Motivations for participation in physical activity across the lifespan. *International Journal of Wellbeing*, *4*(1). https://doi.org/10.5502/ijw.v4i1.3

González-Melero, E., Baena-Extremera, A. & Baños, R. (2023). Current situation of Physical Activity in the Natural Environment in Physical Education in Spain. *Apunts Educación Física y Deportes, 153,* 9-26. https://doi.org/10.5672/apunts.2014-0983.es.(2023/3).153.02

Gürer, B., & Kural, B. (2023). Push and Pull Motivations of Sport Climbers Within the Scope of Outdoor and Adventure Tourism. *Journal of Quality Assurance in Hospitality & Tourism*, *0*(0), Article 0. https://doi.org/10.1080/1528008X.2023.2211787

Hartig, T., Mitchell, R., de Vries, S., & Frumkin, H. (2014). Annual Review of Public Health. *Nature and Health*, *35*, 207–228. https://doi.org/10.1146/annurev-publhealth-032013-182443

Kopcakova, J., Veselska, Z. D., Geckova, A. M., Kalman, M., van Dijk, J. P., & Reijneveld, S. A. (2015). Do Motives to Undertake Physical Activity Relate to Physical Activity in Adolescent Boys and Girls? *International Journal of Environmental Research and Public Health*, *12*(7), Article 7. https://doi.org/10.3390/ijerph120707656

López Fernández, I., García Bravo, L., & Garrido González, F. J. (2013). Study about the Motivations for Going Rock Climbing. *Apunts Educación Física y Deportes*, *113*, 23–29. http://dx.doi.org/10.5672/apunts.2014-0983.es.(2013/3).113.01

Mattes, J. (2015). Disciplinary identities and crossing boundaries: The academization of speleology in the first half of the twentieth century. *Earth Sciences History*, *34*(2), 275–295. https://doi.org/10.17704/1944-6187-34.2.275

Mencarini, E., Rapp, A., & Zancanaro, M. (2021). Underground astronauts: Understanding the sporting science of speleology and its implications for HCI. *International Journal of Human-Computer Studies*, *151*, 102621. https://doi.org/10.1016/j.ijhcs.2021.102621

Mencarini, E., & Zambon, T. (2023). Becoming a Speleologist: Design Implications for Coordination in Wild Outdoor Environments. *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems*, 1–12. https://doi.org/10.1145/3544548.3581545

Muffato, V., Zavagnin, M., & Meneghetti, C. (2022). The practice of speleology: What is its relationship with spatial abilities? *Cognitive Processing*, *23*(2), 217–233. https://doi.org/10.1007/s10339-022-01075-4

Olivera Betrán, A., & Olivera Betrán, J. (1995). Propuesta de una clasificación taxonómica de las actividades físicas de aventura en la naturaleza. Marco conceptual y análisis de los criterios elegidos. *Apunts Educación Física y Deportes, 3*(41), 108-123. https://revista-apunts.com/propuesta-de-una-clasificacion-taxonomica-de-las-actividades-fisicas-de-aventura-en-la-naturaleza-marco-conceptual-y-analisis-de-los-criterios-elegidos/

Olivera, J., & Olivera, A. (2016). Adventure Physical Activities in Nature (APAN): Review of the Taxonomy (1995-2015) and Tables for Classification and Identification of Practices. *Apunts Educación Física y Deportes*, *32*(124), 71–88. https://doi.org/10.5672/apunts.2014-0983.es.(2016/2).124.06

Pain, M. T., & Pain, M. A. (2005). Essay: Risk taking in sport. *The Lancet*, *366*, S33–S34. https://doi.org/10.1016/S0140-6736(05)67838-5

Pans, M., Antón-González, L., & Pellicer-Chenoll, M. (2023). The physical activity of Spanish speleologists: Accomplishment of recommendations and differences by sociodemographic variables. *International Journal of Speleology*, *52*(1). https://doi.org/10.5038/1827-806X.52.1.2460

Pike, E. C. J., & Beames, S. (Eds.). (2013). *Outdoor Adventure and Social Theory*. Routledge. https://doi.org/10.4324/9780203114773

Shanahan, D. F., Franco, L., Lin, B. B., Gaston, K. J., & Fuller, R. A. (2016). The Benefits of Natural Environments for Physical Activity. *Sports Medicine*, *46*(7), 989–995. https://doi.org/10.1007/s40279-016-0502-4

StartCaving.co.uk. (2017). *Caving Hazards and Staying Safe*. StartCaving.Co.Uk. http://www.startcaving.co.uk/staying-safe/

Tansil, D., Plecak, C., Taczanowska, K., & Jiricka-Pürrer, A. (2022). Experience Them, Love Them, Protect Them—Has the COVID-19 Pandemic Changed People's Perception of Urban and Suburban Green Spaces and Their Conservation Targets? *Environmental Management*, *70*(6), 1004–1022. https://doi.org/10.1007/s00267-022-01721-9

Viviani, F., & Tommaso, D. (2017). Aspects Of The Self-Referent Thought In Italian Speleologists. *Antrocom Journal of Anthropology*, *13*(2), 89–97. http://www.antrocom.net/archives/2017/130217/03-Antrocom.pdf

White, W. B. (2019). Chapter 47—Exploration of caves—General. In W. B. White, D. C. Culver, & T. Pipan (Eds.), *Encyclopedia of Caves (Third Edition)* (pp. 407–413). Academic Press. https://doi.org/10.1016/B978-0-12-814124-3.00047-9

Yzaguirre i Maura, I. de, Escoda i Mora, J., Bosch Cornet, J., Gutiérrez Rincón, J. A., Dulanto Zabala, D., & Segura Cardona, R. (2008). Adaptació a l'aire enrarit als avencs i coves. Estudi de laboratori. *Apunts Sports Medicine*, *43*(159), 135–141. https://apunts.org/en-pdf-XX886658108263709

Yzaguirre Maura, I., & Balcells Diaz, M. (1989). Perfil fisiològic dels practicants d'espeleologia (i sol-licitacions). *Apunts Sports Medicine*, *26*(102), 233–246. http://apunts.org/en-perfil-fisiologic-dels-practicants-d39espeleologia-articulo-XX886658189050887

Conflict of Interests: No conflict of interest was reported by the authors.

apunts EDUCACIÓN FÍSICA Y DEPORTES

ISSUE 156

Published: April 1, 2024
https://doi.org/10.5672/apunts.2014-0983.es.(2024/2).156.03

OPEN ACCESS

Psychological characteristics related to sport: differences between disabled and able-bodied athletes

Sergio Barbosa-Granados[1], Haney Aguirre-Loaiza[2*], Jaime Arenas-Granada[3], Ángela Urrea-Cuéllar[4], Ricardo Hernández Roldán[5], Jhon Quiñonez[5], Jeison Parra-Tijaro[7], Laura Herrera-Agudelo[7] & Jonathan Nanez[2]

[1] Cooperative University of Colombia, Pereira (Colombia).
[2] Catholic University of Pereira, Pereira (Colombia).
[3] Jaime Isaza Cadavid Colombian Polytechnic, Medellín (Colombia).
[4] San Buenaventura University, Cali (Colombia).
[5] University Institution of Envigado, Envigado (Colombia).
[6] University of Barcelona, Barcelona (Spain).
[7] University of Manizales, Manizales (Colombia).

Cite this article
Barbosa-Granados, S., Aguirre-Loaiza, H., Arenas-Granada, J., Urrea-Cuéllar, Á., Hernández Roldán, R., Quiñonez, J., Parra-Tijaro, J., Herrera-Agudelo, L., & Nanez, J. (2024). Psychological characteristics related to sport: differences between disabled and able-bodied athletes. *Apunts Educación Física y Deportes, 156*, 19-29. https://doi.org/10.5672/apunts.2014-0983.es.(2024/2).156.03

Editor:

ISSN: 2014-0983

***Corresponding author:**
Haney Aguirre-Loaiza
haney.aguirre@gmail.com

Section:
Physical Activity and Health

Original language:
English

Received:
August 21, 2023
Accepted:
January 16, 2024
Published:
April 1, 2024

Front cover:
Mountain biker enjoying nature and open air.
© Adobe Stock. Delcio F/ peopleimages.com

Abstract

The study of adapted sports and sport psychology has gained increasing insight for both the general public and the scientific community. However, there is a limited number of studies that compare the psychological characteristics of Athletes with Disabilities (AWD) and Able-Bodied Athletes (ABA). The objectives of this study were: (1) to compare the psychological characteristics between AWD and ABA; (2) to analyze sports expertise (inexperienced vs. experts) and the type of sport (individual vs. team). A quantitative study with an associative-comparative design was conducted, involving 200 athletes of both sexes (M_{age} = 28.6 ± 10.2). Out of the total participants, 88 were AWD (M_{age} = 34.7 ± 10.7) and 114 were ABA (M_{age} = 23.8 ± 6.6). The results, obtained through factorial ANOVA, revealed that AWD are more motivated and exhibit better team cohesion compared to ABA. These findings remained consistent even when considering expertise and type of sport. These results contribute to raising awareness about biased or stereotypical views and promoting increased sports participation within the AWD community. In conclusion, there are differences in motivation and team cohesion favoring AWD.

Keywords: expertise, motivation, multiple disabilities, sport psychology, team cohesion.

Introduction

Although the Paralympic Games have received greater media coverage compared to previous years, there are still gaps that hinder the participation of people with disabilities in physical and sports activities (Burns et al., 2019; Smith et al., 2016). Relative to the body of research conducted on athletes without disability, there has been limited research conducted across various scientific disciplines regarding the interaction of people with disabilities in the context of physical activity and sports. Sports psychology is one such area that has received relatively little attention (Burns et al., 2019; Martin et al., 2020; Smith et al., 2016). While there exist pioneering studies on the psychology of sports and individuals with disability (Henschen et al., 1992; Sherrill, 1990; Sherrill & Rainbolt, 1988), the current landscape is marked by a promising trend. Presently, there is an encouraging outlook as research dedicated to the intersection of sports and individuals with disabilities is gaining momentum (Marín-Suelves & Ramon-Llin, 2021).

People with disabilities often engage in sports to foster social bonds and promote socialization opportunities (Aitchison et al., 2022). Previous studies have indicated that participation in adapted sports is associated with improved quality of life and athletic identity (Groff et al., 2009), which helps combat negative stereotypes associated with their disability (Kittson et al., 2013). Additionally, the sports environment facilitates social connections and integration, leading to a sense of freedom and a shift in paradigms regarding stereotypes (Aitchison et al., 2022; McVeigh et al., 2009). Other notable benefits are improved general health and well-being (Aitchison et al., 2022). For instance, individuals with disabilities who engage in sports, regardless of their competitive level, report a higher quality of life compared to those who do not participate (Groff et al., 2009). Additionally, sports involvement is associated with reduced symptoms of mood changes, anxiety, and depression when compared to non-participants with disabilities (Tasiemski & Brewer, 2011). Sport plays a role in fostering self-confidence, self-esteem, and competence development (Smith & Sparkes, 2012), and promotes coping strategies and resilience (Lins et al., 2019).

To date, numerous benefits of sports participation have been identified. However, there is a significantly lower rate of sports engagement among people with disabilities compared to those without disabilities (Zhang et al., 2021). The limited participation of individuals with disabilities in sports can be attributed to various barriers they face. These barriers include factors such as time constraints, lack of motivation, unfavorable weather conditions, inadequate peer support, negative societal attitudes, limited access to information about sports opportunities, secondary problems related to physical pain and health impairments, structural environmental obstacles, non-adapted sports equipment and facilities, transportation issues, inaccessible housing, and a lack of qualified support from professionals in sports science, among others (Jaarsma et al., 2014).

Various theoretical models provide explanatory frameworks for understanding levels of participation and the barriers faced by people with disabilities in sports (Martin et al., 2020). For instance, the medical model focuses on the individual and views disability as a "disease" or medical condition. Conversely, social models emphasize the role of the environment. These models recognize multiple social determinants while downplaying personal factors. Within this context, the social-relational model proposes that both medical (individual) and social factors can coexist and influence participation in physical or sports activities among people with disabilities (Thomas, 2004). Thus, the social-relational model suggests that a combination of factors from both medical and social models shapes and integrates real-life situations (Martin et al., 2020).

Given the aforementioned considerations, sport serves as a reference model for society and holds significant importance for individuals with disabilities. Consequently, sport psychology emerges as a relevant field for conducting research within a comprehensive social-relational model (Martin et al., 2020). In this regard, an intriguing avenue of research involves investigating the psychological characteristics that impact individual factors of Athletes with Disability (AWD) in the context of sport, competition, sports experience, and various forms of association (environmental factors). Of particular interest is whether there exist differences in performance-related psychological characteristics between AWD and Able-Bodied Athletes (ABA) (Hernández et al., 2021).

Psychological characteristics related to sport in ABA have been extensively studied using various methodological approaches (Arias et al., 2016). Furthermore, there is a current interest in examining the distinguishing psychological characteristics between elite and non-elite athletes (Mitić et al., 2021). It is believed that the implementation of specific psychological strategies within training plans enables the attainment of high-performance levels during competitive sports events.

Therefore, one might assume that the existing body of knowledge and research on the psychological characteristics exhibited by ABA can also be applied to AWD. However, this approach raises two main concerns. Firstly, this assumption might be plausible because sports competitions require the engagement of demanding psychological skills and traits. Consequently, it can be hypothesized that, on average, ABA and AWD share similar physical, technical, tactical, and

psychological demands, albeit within different modalities. AWD participate in demanding Olympic cycles and experience competitive schedules comparable to the physical and psychological demands encountered by ABA. On the other hand, the second approach proposes that there are differences in psychological characteristics between AWD and ABA. It suggests that there are certain hormonal and behavior variations in Paralympic athletes (Paulo-Pereira-Rosa et al., 2020). This could be attributed to the unique experiences of AWD (Smith et al., 2016). Building on this perspective, AWD not only face the demands of sports competition but also encounter distinctive challenges that extend beyond performance enhancement (Blumenstein & Orbach, 2015). Additionally, the reviewed studies have not considered participants' sports experience and type of sport. In the present study, experience is operationalized as the number of years dedicated specifically to competitive sports participation within a particular discipline.

As a result, the practical implications of interventions made by sports psychologists need to be adapted to suit the context of AWDs (Hanrahan, 2015). However, there is a scarcity of studies in sport psychology that compare psychological characteristics and attitudes to sports in samples of AWD relative to ABA, despite their significant importance in shaping future research and informing professional practice (Gomez-Marcos & Sanchez-Sanchez, 2019; Szájer et al., 2019). Therefore, there is a pressing need to investigate the behavior of AWD, as this exploration can provide valuable insights into sports initiation, as well as the identification and selection of new talents.

Based on our literature review and recognizing the significance of further exploring research on AWD, our study has two primary objectives: 1. To compare psychological characteristics (such as stress control, influence of performance, motivation, mental ability, and team cohesion) between AWD and ABA; 2. To analyze the relationship between sports expertise (inexperienced vs. experts) and type of sport (individual vs. team) relative to psychological characteristics in AWD and ABA.

Method

Design and participants

A quantitative, non-experimental study was conducted. 202 athletes participated: $n = 88$ AWD and $n = 114$ ABA. Sample selection was intentionally carried out in different cities of Colombia (Medellín, Armenia, Manizales, and Cali). Volunteers are representative of 19 sports disciplines. Information on sociodemographic variables, type of disability, and sports variables is found in Table 1 and 2, respectively.

Table 1
Descriptive information regarding sociodemographic variables and disability type.

Sociodemographic variables	AWD $n = 88$ (43.5 %)	ABA $n = 114$ (56.4 %)	All $n = 202$
$Age_{(M\pm SD)}$	34.7 ± 10.7	23.8 ± 6.6	28.6 ± 10.2
Sex			
Female	16 (18.1)	29 (25.4)	45 (22.2)
Male	72 (81.8)	85 (74-5)	157 (77.7)
Type of injury			
Spinal cord injury	42 (48.3)		
Amputation	21 (24.1)		
Spina bifida	7 (8.0)		
Short height	4 (4.6)		
Right hemiplegia	1 (1.1)		
Balance disorders	1 (1.1)		
Hip dysplasia	1 (1.1)		
Musculoskeletal injury	1 (1.1)		
Polio	2 (2.3)		
Left hemiplegia	1 (1.1)		
Phocomelia	2 (2.3)		
Spastic paraplegia	1 (1.1)		
Left arm paralysis	1 (1.1)		
Amyotrophic Lateral Sclerosis	1 (1.1)		
No answer	2 (2.3)		

Note: AWD = Athletes with Disability, ABA = Able-Bodied Athletes, age = mean (M) and standard deviation (±). Other variables are reported as frequencies and percentages (%)

Table 2
Sports characteristics in Athletes with Disability (AWD) and Able-Bodied Athletes (ABA).

Sports-related variables	AWD *n* = 88 (43.5 %)	ABA *n* = 114 (56.4 %)	All *n* = 202
Sports experience$_{(years)}$			
< 1	7 (7.9)	0 (0.0)	7 (3.4)
1-2	18 (20.4)	18 (15.7)	36 (17.8)
3-4	21 (23.8)	35 (30.7)	56 (27.7)
5-6	7 (7.9)	14 (12.2)	21 (10.3)
7-8	11 (12.5)	16 (14.0)	27 (13.3)
> 9	24 (27.2)	31 (27.1)	55 (27.2)
Expertise			
Non-experts $_{(< 4 years)}$	46 (52.2)	53 (46.4)	99 (49.0)
Experts $_{(> 5 years)}$	42 (47.0)	61 (53.5)	103 (51.0)
Sport			
Chess	4 (4.4)	0 (0.0)	4 (1.9)
Athletics	21 (23.8)	24 (21.0)	45 (22.7)
Basketball	7 (7.9)	0 (0.0)	7 (3.4)
Handball	0 (0.0)	7 (6.1)	7 (3.4)
BMX	0 (0.0)	4 (4.3)	3 (2.3)
Bowling	0 (0.0)	2 (1.7)	2 (0.9)
Futsal	0 (0.0)	36 (31.5)	36 (17.8)
Hapkido	0 (0.0)	24 (21.0)	24 (11.8)
Swimming	11 (12.5)	0 (0.0)	11 (5.4)
Skating	0 (0.0)	2 (1.7)	2 (0.9)
Weightlifting	4 (4.5)	9 (7.8)	13 (6.4)
Rugby	9 (10.2)	0 (0.0)	9 (4.4)
Tennis	4 (4.4)	0 (0.0)	4 (1.2)
Table Tennis	4 (4.4)	5 (4.3)	9 (4.4)
Archery	4 (4.5)	0 (0.0)	4 (1.9)
Shooting	8 (9.0)	0 (0.0)	8 (3.9)
Volleyball	12 (13.6)	0 (0.0)	12 (5.9)
Type of sport			
Individual	61 (69.3)	71 (62.2)	132 (65.3)
Team	27 (30.6)	43 (37.7)	70 (34.6)

Note: AWD = Athletes with Disability, ABA = Able-Bodied Athletes

Instruments and measures

Psychological characteristics: The *Psychological characteristics of the sports performance Questionnaire* (CPRD by Spanish acronym) was used (Gimeno & Pérez-Llantada, 2010). CPRD has evidence of construct validity with an explained variance of 63% derived from five factors (55 items): Stress Control (SC = 20 items), Influence of Performance Evaluation (IPE = 12 items), Motivation (M = 8 items), Mental Ability (MA = 9 items) and Team Cohesion (TC = 8 items). It has been shown that the reliability coefficient of the entire scale is satisfactory. The CPRD has a Likert-type response format that evaluates the degree of agreement from 0 = "totally disagree" to 5 = "totally agree". For this study, the CPRD showed adequate total internal consistency (ω = .87, 95% *CI* [.85, .90]).

CPRD factors are characterized as follows: i) SC: is the response related to the demands of training-competition and potentially stressful situations; ii) IPE: is the response to situations in which athletes evaluate their own performance or think that significant people are evaluating them; iii) M: is the interest in improving each day, the relationship between effort and reward, the acknowledgement by other people;

iv) MS: is the ability to self-assess and self-regulate the level of activation, visualization, attentional focus, control of dysfunctional cognition, goal setting and objective evaluation of one's own performance; v) TC: is the integration with their own sports group, including the interpersonal relationship with other team members, the level of satisfaction training along other athletes, the individualistic attitude in relation to the rest of the group and the importance of "team spirit".

Sociodemographic and sport variables: Through an Ad-hoc questionnaire, we explored: (i) sex; (ii) age; (iii) sport experience (classified as 2-year intervals); (iv) expertise, which was computed in two groups: "inexperienced" (≤ 4 sport experience years) and "expert" (≥ 5 sport experience years); (v) sport discipline; (vi) sport type, which was classified as either individual or team sport, and (vii) injury type for AWD.

Data Analysis

Data processing was performed by JASP®. Dependent variables were performance-related psychological characteristics (see instruments and measures section). The independent variables of this analysis were sports expertise and sport type (individual vs. team). Expertise was classified in two groups according to median experience of sport years: inexperienced ($Mdn_{years} < 4.0$) and expert ($Mdn_{years} > 4.0$). Exploratory data analysis did not yield any missing data. Extreme data and outliers were kept. The inferential analysis was performed with the direct scores of the dependent variables. The descriptive analysis estimated measures of frequency and percentages of sociodemographic characteristics (see Table 1 and 2). The assumptions were verified in each of the groups (AWD and ABA) for normal distribution through Shapiro-Wilk, and homogeneity with Levene's. Hypothesis testing was performed in two stages. First, the means of the two groups were compared through t-Student for independent samples and Cohen's *d* effect size was estimated. Second, two 2 x 2 factorial ANOVA models were run, one model for condition*experience, and for condition*type of sport. The effect size used for the ANOVA models was Eta squared (η^2). Post-hoc analysis of mean comparisons was corrected by Tukey's test. The mean difference (M_{diff}) and its confidence interval (95% CI) were reported. McDonalds Omega (ω) coefficients for internal consistency of CPRD scores were also considered.

Procedure and ethical considerations

AWD and ABA participants were contacted through sports leagues, coaches, and sports administrators. Data collection consisted of group-administered instruments and procedures and took place in various cities in Colombia (Medellín, Armenia, Cali, and Manizales). Ethical considerations were observed during the data processing phase, following the guidelines outlined in the Declaration of Helsinki. These provisions were implemented to protect the autonomy and anonymity of all participants while ensuring the integrity of the study. The bioethical committee of the Politécnico Colombiano Jaime Isaza Cadavid approved this research (Code: 20610801-202201007863 - Acta 11-2022).

Results

The comparison of the psychological characteristics between AWD and ABA (see table 3) showed differences in Motivation, $t(185) = 5.24$ $p < .001$, $d = 71.$, CI 95% [0.43, 1.00]), as AWD were significantly more motivated. Additionally, Team Cohesion had significantly higher means for AWD, $t(185) = 2.71$ $p = .007$, $d = 69.$, 95% CI [0.09, 0.65]).

Table 3
Comparison of psychological characteristics between Athletes with Disability (AWD) and Able-Bodied Athletes (ABA).

Psychological Characteristics	AWD *n* = 88	ABA *n* = 114	*t*	*p*	*d*
	M(SD)	*M(SD)*			
Stress Control	55.1 (12.3)	55.4 (12.5)	-0.196	.845	.02
Influence of Performance Eval.	29.9 (8.2)	29.7 (7.9)	0.210	.834	.03
Motivation	26.7 (3.5)	23.0 (6.3)	5.245[a]	< .001*	.71
Mental Skills	25.2 (3.8)	24.6 (5.2)	0.802	.423	.11
Cohesion team	18.8 (3.0)	17.4 (4.4)	2.713[a]	.007*	.37

Note: a = Welch's test, *t* = Student's t test, *d* = Cohen's d (effect size). *significance

Analysis of psychological characteristics by expertise

The interaction between Condition*Expertise did not show significant differences in stress control, influence on performance evaluation, motivation, and mental ability (see table 4). On the contrary, Team Cohesion did yield differences from this interaction $F(1,198) = 4.62$, $p = .033$, $\eta^2 = 0.022$. Also, a main effect was demonstrated in the expertise $F(1,198) = 11.05$, $p = .001$. Post-hoc analysis of mean comparisons indicated differences between "expert" AWD ($M_{TC} = 19.3$) vs. "expert" ABA ($M_{TC} = 16.7$) $M_{diff} = 2.60$, 95% CI [0.57, 64.63], $p = .006$ (see Figure 1). These results indicated that expert AWD had more Team Cohesion than expert ABA.

Regarding the Motivation variable, main effects were observed in the "inexperienced" group $F(1,198) = 6.94$, $p = .009$, and the "experts" group $F(1,198) = 17.4$, $p = .009$. Post-hoc analysis indicated significant differences (see figure 1): between "inexperienced" AWD ($M_M = 26.3$) vs. "inexperienced" ABA ($M_M = 23.7$), $M_{diff} = 2.81$, CI 95% [0.05, 5.58], $p = .044$. Namely, inexperienced AWD were significantly more motivated that inexperienced ABA.

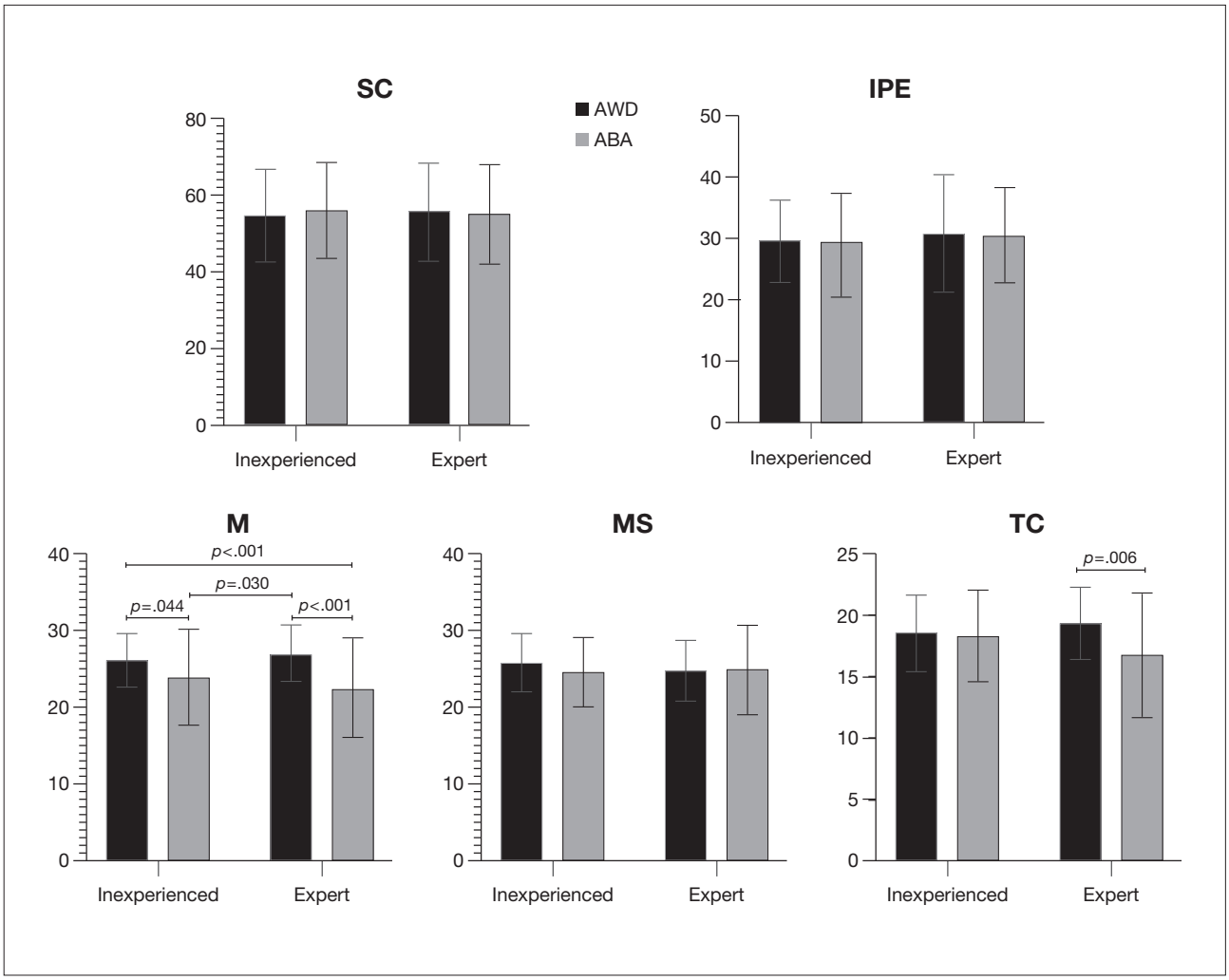
Likewise, inexperienced AWD were more motivated than expert ABA. We observed significant differences between inexperienced AWD ($M_M = 26.3$) vs. expert ABA ($M_M = 22.3$), $M_{diff} = 4.24$, CI 95% [1.56, 6.92], $p < .001$. "Expert" AWD ($M_M = 26.8$) obtained higher scores than the "inexperienced" ABA ($M_M = 23.7$), $M_{diff} = -3.04$, CI 95% [-5.87, -0.20], $p = 030$; and finally, the "expert" AWD ($M_M = 26.8$) also outperformed the "expert" ABA ($M_M = 22.3$), $M_{diff} = 4.47$, CI 95% [1.72, 7.22], $p < .001$.

Table 4
Psychological Characteristics comparison between condition (AWD vs. ABA) and expertise.

Characteristics	Condition	Inexperienced *n* = 99	Expert *n* = 103	Condition*Expertise			
		M(SD)	*M(SD)*	*MS*	*F*	*p*	η^2
Stress Control	AWD	54.7 (12.0)	55.5 (12.8)	31.2	0.19	.656	0.001
	ABA	55.8 (12.3)	55.1 (12.7)				
Influence of Performance Eval.	AWD	29.2 (6.7)	30.8 (9.5)	0.52	0.01	.925	0.001
	ABA	29.0 (8.2)	30.3 (7.5)				
Motivation	AWD	26.6 (3.5)	26.8 (3.6)	33.9	1.21	.273	0.001
	ABA	23.7 (6.1)	22.3 (6.4)				
Mental Skills	AWD	25.6 (3.7)	24.6 (3.8)	19.6	0.89	.344	0.004
	ABA	24.5 (4.5)	24.8 (5.8)				
Team Cohesion	AWD	18.5 (3.1)	19.3 (2.9)	70.5	4.62	.033	0.022
	ABA	18.2 (3.6)	16.7 (5.0)				

Note: AWD = Athletes with Disability, ABA = Able-Bodied Athletes. MS = Mean of Squares. Inexperienced (AWD, *n* = 46; ABA, *n* = 53), Expert (AWD, *n* = 42; ABA, *n* = 61). *$p < .01$

Figure 1
Post-hoc analysis of the psychological characteristics according to expertise (corrected by Tukey's test).



Note: AWD = Athletes with Disability, ABA = Able-Bodied Athletes. Psychological Characteristics: SC = Stress Control, IPE = Influence of Performances Evaluation, M = Motivation, MS = Mental Skills, TC = Team.

Analysis of psychological characteristics by type of sport

The interaction between Condition*Type of Sport (see table 5) showed an effect on Motivation, $F(1,198) = 6.00$, $p = .015$, $\eta^2 = 0.025$, as well as on Team Cohesion $F(1,198) = 4.37$, $p = .038$, $\eta^2 = 0.018$. The variables of Stress Control, Influence of Performance Evaluation and Mental Ability did not show any interaction nor main effects.

Regarding the Motivation variable, a main effect was observed for individual sports $F(1,198) = 11.05$, $p = .001$. Post-hoc analysis indicated significant differences in individual AWD sports ($M_M = 26.2$) vs. ABA ($M_M = 21.0$) $M_{diff} = 5.17$, 95% *CI* [2.93, 7.40], $p < .001$. Another significant mean comparison was between AWD team sports ($M_M = 27.7$) vs. ABA individual sports ABAs ($M_M = 21.0$) $M_{diff} = 6.70$, 95% *CI* [9.60, 3.80], $p < .001$ (see figure 2).

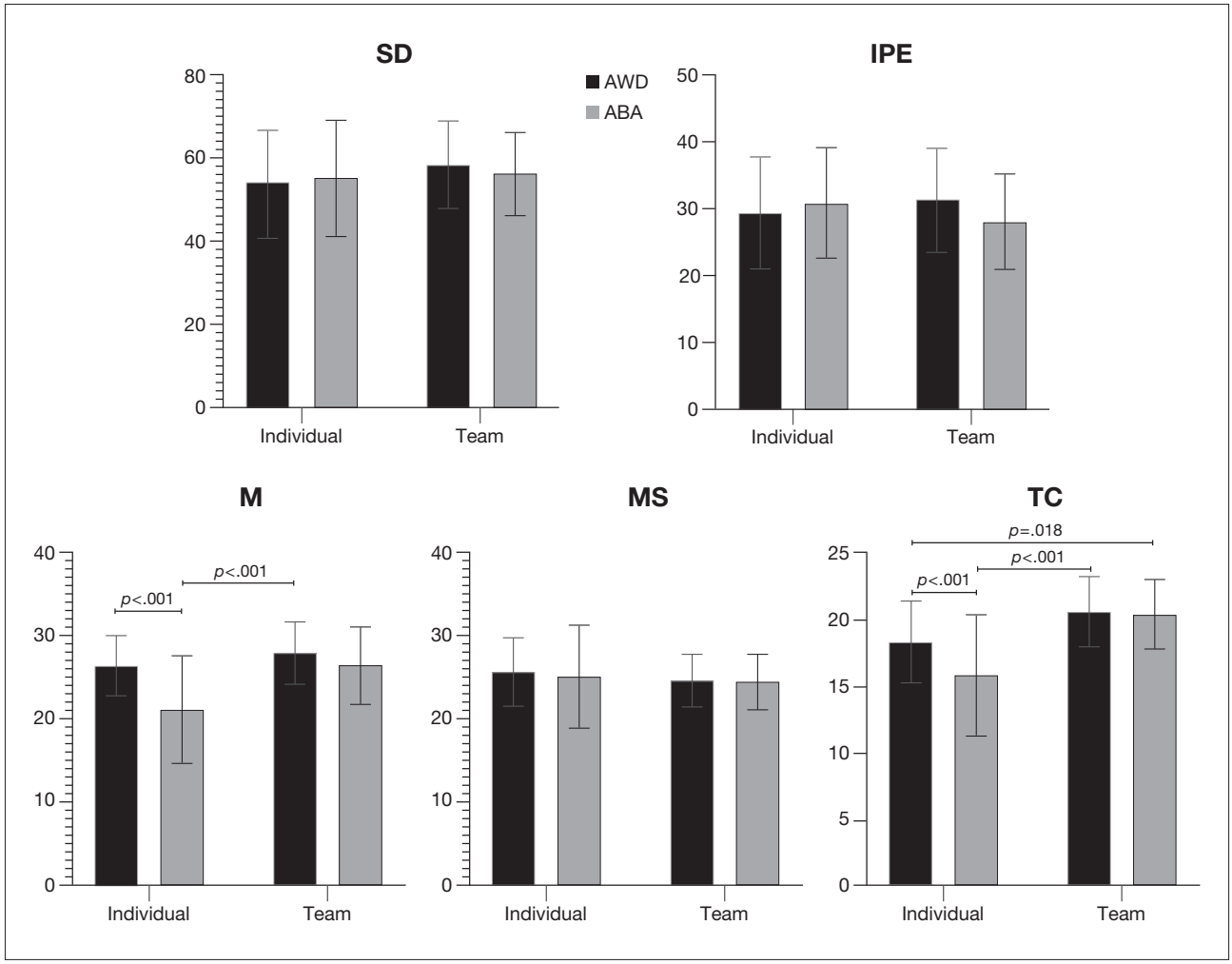
In terms of Team Cohesion, a main effect was found for individual sports $F(1,198) = 15.8$, $p = .001$. Post-hoc analysis showed differences, indicating that AWD in individual sports ($M_{TC} = 18.1$) outperformed ABA ($M_{TC} = 15.7$) $M_{diff} = 2.44$, *CI* 95% [0.85, 4.04], $p < .001$. Likewise, differences were also found in AWD individual sports ($M_{TC} = 18.1$) vs. Team ABA ($M_{TC} = 20.2$) $M_{diff} = -2.07$, CI 95% [-3.89, -0.25], $p = .018$. There were also differences in AWD team sports ($M_{TC} = 20.4$) relative to ABA individual sports ($M_{CHE} = 15.7$) $M_{diff} = 4.74$, CI 95% [6.81, 2.68], $p < .001$ (see Figure 2).

Table 5
Psychological Characteristics compared between condition (AWD vs. ABA) and type of sport.

Psychological Characteristics	Condition	Individual *n* = 132	Team *n* = 70	Condition*Type of sport			
		M(SD)	*M(SD)*	*MS*	*F*	*p*	η^2
Stress Control	AWD	53.8 (12.9)	58.1∫(10.4)	141.8	0.91	.340	0.005
	ABA	55.1 (13.7)	55.9 (10.2)				
Influence of Performance Eval.	AWD	29.3 (8.3)	31.2 (7.8)	242.4	3.78	.053	0.019
	ABA	30.7 (8.2)	28.0 (7.1)				
Motivation	AWD	26.2 (3.5)	27.7 (3.5)	147.0	6.00	.015*	0.025
	ABA	21.0 (6.4)	26.2 (4.6)				
Mental Skills	AWD	25.5 (4.0)	24.4 (3.1)	1.84	1.84	.772	0.000
	ABA	24.9 (6.1)	24.2 (3.3)				
Team Cohesion	AWD	18.1 (3.0)	20.4 (2.6)	54.4	4.37	.038	0.018
	ABA	15.7 (4.5)	20.2 (2.5)				

Note: AWD = Athletes with Disability, ABA = Able-Bodied Athletes. Individual sports (AWD, *n* = 61; ABA, *n* = 71), Team sports (AWD, *n* = 27; ABA, *n* = 43). **significance*

Figure 2
Post-hoc analysis of the psychological characteristics according to type sport.



Note: AWD = Athletes with Disability, ABA = Able-Bodied Athletes. Psychological Characteristics: SC = Stress Control, IPE = Influence of Performances Evaluation, M = Motivation, MS = Mental Skills, TC = Team Cohesion.

Discussion

The objective of this study was twofold: firstly, to compare the psychological characteristics (Stress Control, Performance Influence, Motivation, Mental Ability, and Team Cohesion) between AWD and ABA; and secondly, to analyze possible differences in relation to expertise (inexperienced vs. experts) and type of sport (individual vs. team).

Our findings indicated that AWD exhibited higher scores of motivation and better team cohesion compared to ABA. Notably, this pattern persisted even when accounting for expertise and type of sport. However, there was a difference in team cohesion for type of sport, with AWD averaging lower scores relative to ABA in team sports.

Few studies have directly compared the psychological characteristics between AWD and ABA (Hernández et al., 2021), and as a result, this line of research is still in its early stages and has yielded inconsistent results thus far (Gomez-Marcos & Sanchez-Sanchez, 2019; Szájer et al., 2019).

Differences between AWD and ABA have been observed in somatic anxiety, self-confidence, and achievement motivation in swimmers (Szájer et al., 2019). However, other studies have shown no significant differences in psychological characteristics, such as in the case of triathlon athletes (Gomez-Marcos & Sanchez-Sanchez, 2019). Given the wide variety of measures, types of sports, and other modulating variables, no definitive conclusions can be drawn regarding these inconsistencies in results.

Our results partially support the perspective that there are differences in psychological characteristics between AWD and ABA. Participation in sports is a rewarding experience for individuals with disabilities (Aitchison et al., 2022). Sport serves as both a means and an end for AWD, enabling them to surpass stereotypical and imaginary constraints associated with disability (Rees et al., 2019; Swartz et al., 2016). Consequently, sports competition provides a platform to reinforce positive narratives surrounding disability and personal transformation (Bantjes et al., 2019; Lins et al., 2019). Involvement in sports positively affects personal factors such as health, individual skills, and social participation, as well as environmental factors, including perceived support from the surroundings (Côté-Leclerc et al., 2017). Furthermore, sports enable individuals to overcome disability and enhance personal commitment towards goal achievement (Garci & Mandich, 2011).

AWD exhibit significantly higher sports motivation compared to ABA. This motivational trend persists even when considering expertise level (beginners vs. experts) and type of sport (individual vs. team). Numerous studies have identified various reasons that prompt individuals to initiate and maintain engagement in sports, including motivational profiles. Motivation, as a unique element within each athlete's psychological profile, generates positive responses in sports participation (Tracey et al., 2021). For instance, wheelchair tennis athletes have been found to promote well-being within their community and challenge negative societal perceptions of disability (Falcão et al., 2015; Richardson et al., 2015). Personal and social factors related to sports play a role in determining motivation in AWD participating in wheelchair sports and goalball (Palencia & Gallón, 2022). Satisfaction of basic psychological needs and motivation predict higher levels of life satisfaction, reflecting a positive attachment to sports (Martins et al., 2022). In general, the literature suggests that AWD exhibit higher motivation levels compared to ABA.

Our data also revealed that team cohesion was significantly higher in AWD compared to ABA. This finding aligns with the consistent trend observed in previous studies (Hernández et al., 2021), indicating that AWD, through their engagement in sports, report greater peer support, team dedication, and a sense of camaraderie, which manifests as a cohesive sports family (Stieler et al., 2022) and promotes psychosocial well-being (Richardson et al., 2015). Sports practice fosters team spirit by cultivating strong bonds and unconditional acceptance in pursuit of common goals (Garci & Mandich, 2011). Additionally, AWD have been shown to integrate more effectively within their sports teams and develop stronger interpersonal relationships with fellow team members (Aitchison et al., 2022; Bantjes et al., 2019; Burns et al., 2019). It is worth noting the crucial role of coaches in promoting team cohesion. The coach's experience and academic training are instrumental in their interaction with athletes (Ayala-Zuluaga et al., 2015). Therefore, it is essential for coaches to possess adequate knowledge about existing barriers and coping mechanisms, enabling them to enhance athletes' performance. Consequently, sport psychologists can play a vital role in supporting both coaches and athletes. Goal setting and regular communication between the coach and AWD underscore the importance of the Paralympic coach in the athletes' training process (Falcão et al., 2015).

The differences observed in our results suggest that AWD may have sports experiences that differ from those of ABA (Smith et al., 2016). It is plausible to consider that the competitive demands, including psychological demands, placed on AWD may be more challenging than those encountered in standard ABA competitions. However, it is important to acknowledge that the social environment presents barriers that extend beyond sports performance and necessitate additional coping strategies for AWD (Blumenstein & Orbach, 2015).

In terms of other psychological characteristics examined in our study: Stress Control, Performance Influence, and Mental Ability, no significant differences were found between the two groups of athletes, indicating homogeneity in these variables.

Nevertheless, it is essential to exercise caution when interpreting these results. Several limitations should be considered for future research. Methodologically, the intentional selection of our sample precludes generalizations, and comprehensive representation of all sports disciplines was not a primary criterion during participant recruitment. Future studies employing experimental designs are necessary to draw more robust conclusions. Additionally, given the observational nature of our study, causal inferences cannot be made. On a theoretical level, exploring precompetitive paradigms and other psychological variables, such as anxiety, should be pursued in future projects. Furthermore, comparing AWD and ABA while considering other variables and psychological abilities will generate knowledge with practical implications. AWD sample size is rather small, future projects should aim to include bigger and more representative sample sizes, refining the inclusion criteria for the AWD group (e.g., disability grading and score). Lastly, it is imperative to consider other processes, such as the identification and selection of athletes in adapted sports, as well as the involvement of different stakeholders, including referees (Aguirre-Loaiza et al., 2020).

After considering these limitations, this study has important implications. Firstly, it contributes to the existing body of knowledge in sport psychology for adapted sports. The number of studies comparing psychological characteristics between AWD and ABA is limited, with only a few explorations available (Gomez-Marcos & Sanchez-Sanchez, 2019; Szájer et al., 2019). Additionally, this study is the first to examine not only the comparison between AWD and ABA but also the role of sports experience and type of sport as potential contributing variables to the observed differences. Secondly, applying psychological knowledge to sport psychology and adapted sports enables evidence-based decision-making (Hanrahan, 2015). For instance, psychological interventions or programs by discipline and sport type as well as interventions specifically targeting training and competence stages.

Significantly, our study contributes to the implementation of professional practice in sport psychology by addressing the unique role and needs of AWD (Martin, 2017). These findings deepen our understanding of the challenges and stereotypes faced by AWD compared to ABA. Moreover, they have the potential to enhance sports engagement and participation within the AWD community. Sport psychology can play a vital role in facilitating AWD participation and dispelling community perceptions that equate disability with reduced ability. Consequently, raising awareness through these findings can foster confidence, independence, and a sense of acceptance among AWD (Ballas et al., 2020).

In conclusion, our data suggest the presence of differences between AWD and ABA. Specifically, our results indicate that AWD exhibit higher levels of motivation and better team cohesion compared to ABA. These differences persist regardless of sports experience and type of sport.

Acknowledgements

We would like to thank all the participating athletes for their time and kindness.

References

Aguirre-Loaiza, H., Holguín, J., Arenas, J., Núñez, C., Barbosa-Granados, S., & García-Mas, A. (2020). Psychological characteristics of sports performance: Analysis of professional and semiprofessional football referees. *Journal of Physical Education and Sport*, *20*(4), 1861–1868. https://doi.org/10.7752/jpes.2020.04252

Aitchison, B., Rushton, A., Martin, P., Barr, M., Soundy, A., & Heneghan, N. (2022). The experiences and perceived health benefits of individuals with a disability participating in sport: A systematic review and narrative synthesis. *Disability and Health Journal*, *15*(1), 101164. https://doi.org/10.1016/j.dhjo.2021.101164

Arias, I., Cardoso, T., Aguirre-Loaiza, H., & Arenas, J. (2016). Características psicológicas de rendimiento deportivo en deportes de conjunto: diferencias entre modalidad y género. *Revista Psicogente*, *19*(35), 25–36. https://doi.org/10.17081/psico.19.35.1206

Ayala-Zuluaga, C., Aguirre-Loaiza, H., & Ramos-Bermúdez, S. (2015). Formación académica y experiencia deportiva de los entrenadores suramericanos. *Revista Brasileira de Ciencias Do Esporte*, *37*(4), 367–375. https://doi.org/10.1016/j.rbce.2015.09.001

Ballas, J., Buultjens, M., Murphy, G., & Jackson, M. (2020). Elite-level athletes with physical impairments: Barriers and facilitators to sport participation. *Disability & Society, 37(*6), 1018-1037. https://doi.org/10.1080/09687599.2020.1862642

Bantjes, J., Swartz, L., & Botha, J. (2019). Troubling stereotypes: South African elite disability athletes and the paradox of (self-) representation. *Journal of Community Psychology*, *47*(4), 819–832. https://doi.org/10.1002/JCOP.22155

Blumenstein, B., & Orbach, I. (2015). Psychological preparation for paralympic athletes: A preliminary study. *Adapted Physical Activity Quarterly*, *32*(3), 241–255. https://doi.org/10.1123/APAQ.2014-0235

Burns, L., Weissensteiner, J., & Cohen, M. (2019). Lifestyles and mindsets of Olympic, Paralympic and world champions: is an integrated approach the key to elite performance? *British Journal of Sports Medicine*, *53*(13), 818–824. https://doi.org/10.1136/BJSPORTS-2018-099217

Côté-Leclerc, F., Boileau, G., Bolduc, P., Gélinas-Lafrenière, A., Santerre, C., Desrosiers, J., & Levasseur, M. (2017). How does playing adapted sports affect quality of life of people with mobility limitations? Results from a mixed-method sequential explanatory study. *Health and Quality of Life Outcomes*, *15*(1), 1–8. https://doi.org/10.1186/S12955-017-0597-9

Falcão, W., Bloom, G., & Loughead, T. (2015). Coaches' Perceptions of Team Cohesion in Paralympic Sports. *Adapted Physical Activity Quarterly: APAQ*, *32*(3), 206–222. https://doi.org/10.1123/APAQ.2014-0122

Garci, H., & Mandich, A. (2011). Going for Gold: Understanding Occupational Engagement in Elite-Level Wheelchair Basketball Athletes. *Journal of Occupational Science, 12*(3), 170–175. https://doi.org/10.1080/14427591.2005.9686560

Gimeno, F., & Pérez-Llantada, M. (2010). Características psicométricas del cuestionario CPRD. In F. Gimeno & J. Buceta (Eds.), *Evaluación psicológica en el deporte: el cuestionario de Características Psicológicas Relacionadas con el Rendimiento Deportivo (CPRD)* (pp. 81–123). Dykinson.

Gomez-Marcos, G., & Sanchez-Sanchez, M. (2019). Descripción y diferencias en las variables psicológicas relacionadas con el rendimiento deportivo de triatletas y para-triatletas. *Retos*, *36*, 22–25.

Groff, D., Lundberg, N., & Zabriskie, R. (2009). Influence of adapted sport on quality of life: perceptions of athletes with cerebral palsy. *Disability and Rehabilitation*, *31*(4), 318–326. https://doi.org/10.1080/09638280801976233

Hanrahan, S. (2015). Psychological Skills Training for Athletes With Disabilities. *Australian Psychologist*, *50*(2), 102–105. https://doi.org/10.1111/AP.12083

Henschen, K. P., Horvat, M., & Roswal, G. (1992). Psychological profiles of the United States wheelchair basketball team. *International Journal of Sport Psychology*, *23*(2), 128–137.

Hernández, R., Quiñonez, J., Arenas, J., Urrea, A., Barbosa-Granados, S., & Aguirre-Loaiza, H. (2021). Características Psicológicas en Deportistas con Discapacidad Física. *Retos*, *40*(1), 351–358. https://doi.org/10.47197/retos.v1i40.83079

Jaarsma, E., Dijkstra, P., Geertzen, J., & Dekker, R. (2014). Barriers to and facilitators of sports participation for people with physical disabilities: a systematic review. *Scandinavian Journal of Medicine & Science in Sports*, *24*(6), 871–881. https://doi.org/10.1111/SMS.12218

Kittson, K., Gainforth, H., Edwards, J., Bolkowy, R., & Latimer-Cheung, A. (2013). The effect of video observation on warmth and competence ratings of individuals with a disability. *Psychology of Sport and Exercise*, *14*(6), 847–851. https://doi.org/10.1016/J.PSYCHSPORT.2013.07.003

Lins, S., Melo, C., Alves, S., & Silva, R. (2019). "Our Voices, Our Meaning": The Social Representations of Sports for Brazilian Athletes With Disabilities. *Adapted Physical Activity Quarterly : APAQ*, *36*(1), 42–60. https://doi.org/10.1123/APAQ.2017-0206

Marín-Suelves, D., & Ramon-Llin, J. (2021). Educación física e inclusión: un estudio bibliométrico. *Apunts Educación Física y Deportes*, *143*. https://doi.org/10.5672/apunts.2014-0983.es.(2021/1).143.03

Martin, J. (2017). Handbook of disability sport and exercise psychology. In Oxford University Press (Ed.), *Handbook of Disability Sport and Exercise Psychology*. https://doi.org/10.1093/oso/9780190638054.001.0001

Martin, J., Guerrero, M., & Snapp, E. (2020). Disability and Sport Psychology. In *Handbook of Sport Psychology* (pp. 1152–1168). John Wiley & Sons, Ltd. https://doi.org/10.1002/9781119568124.ch56

Martins, A., Folgado, J., Matos, J. J., Batista, M., & Duarte, J. (2022). Gender Differences in Self-Determined Motivation and Subjective Well-Being of Adapted Sport Athletes Members of the Special with Intellectual and Developmental Difficulties Members. *Retos*, *44*, 328–334. https://doi.org/10.47197/RETOS.V44I0.88827

McVeigh, S., Hitzig, S., & Craven, C. (2009). Influence of sport participation on community integration and quality of life: a comparison between sport participants and non-sport participants with spinal cord injury. *The Journal of Spinal Cord Medicine*, *32*(2), 115–124. https://doi.org/10.1080/10790268.2009.11760762

Mitić, P., Nedeljković, J., Bojanić, Ž., Franceško, M., Milovanović, I., Bianco, A., & Drid, P. (2021). Differences in the Psychological Profiles of Elite and Non-elite Athletes. *Frontiers in Psychology*, *12*, 635651. https://doi.org/10.3389/fpsyg.2021.635651

Palencia, M., & Gallón, O. (2022). Facilitadores en el deporte paralímpico: motivos de práctica deportiva en jugadores con discapacidad física y visual. *Retos*, *44*, 27–33. https://doi.org/10.47197/RETOS.V44I0.90277

Paulo-Pereira-Rosa, J., Silva, A., Ferreira-Rodrigues, D., Stieler, E., & Tulio-De-Mello, M. (2020). The potential influence of cortisol and testosterone on psychobiological aspects in paralympic athletes. *Apunts Educación Física y Deportes*, *142*. https://doi.org/10.5672/apunts.2014-0983.es.(2020/4).142.09

Rees, L., Robinson, P., & Shields, N. (2019). Media portrayal of elite athletes with disability–a systematic review. In *Disability and Rehabilitation* (Vol. 41, Issue 4, pp. 374–381). Taylor and Francis Ltd. https://doi.org/10.1080/09638288.2017.1397775

Richardson, E., Papathomas, A., Smith, B., & Goosey-Tolfrey, V. (2015). The psychosocial impact of wheelchair tennis on participants from developing countries. *Disability and Rehabilitation, 372*, *39*(2), 193–200. https://doi.org/10.3109/09638288.2015.1073372

Sherrill, C. (1990). Psychosocial Status of Disabled Athletes. *Advances in Psychology*, *74*(C). https://doi.org/10.1016/S0166-4115(08)61187-5

Sherrill, C., & Rainbolt, W. (1988). Self-actualization profiles of male able-bodied and elite cerebral palsied athletes. *Adapted Physical Activity Quarterly*, *5*(2). https://doi.org/10.1123/apaq.5.2.108

Smith, B., Perrier, M., & Perrier, M. (2016). Disability sport: a partial overview and some thoughts about the future. In R. Schinke, K. McGannon, & B. Smith (Eds.), *Routledge International Handbook of Sport Psychology* (pp. 236–333). Routledge.

Smith, B., & Sparkes, A. (2012). Disability, Sport and Physical Activity. *Routledge Handbook of Disability Studies*. https://doi.org/10.4324/9780203144114.CH25

Stieler, E., da Costa, V., Silva Cruz, A., Bastos Lôbo, I., Noce, F., Maculano, A., de Mello, M., & Silva, A. (2022). Training load, stress, recovery, mood, and motivation of athletes with spinal cord injury in wheelchair rugby during a competitive preseason. *Motriz: Revista de Educação Física*, *28*. https://doi.org/10.1590/S1980-657420220006821

Swartz, L., Bantjes, J., Knight, B., Wilmot, G., & Derman, W. (2016). "They don't understand that we also exist": South African participants in competitive disability sport and the politics of identity. *Disability and Rehabilitation, 40*(1), 35–41. https://doi.org/10.1080/09638288.2016.1242171

Szájer, P., Tóth, L., Szemes, Á., Nagy, N., Zala, B., Köteles, F., & Szabo, A. (2019). A comparative analysis of national olympic swimming team members' and para-swimming team members' psychological profiles. *Cognition, Brain, Behavior. An Interdisciplinary Journal* , *23*(4), 299–311. https://doi.org/10.24193/cbb.2019.23.17

Tasiemski, T., & Brewer, Britton. (2011). Athletic identity, sport participation, and psychological adjustment in people with spinal cord injury. *Adapted Physical Activity Quarterly : APAQ*, *28*(3), 233–250. https://doi.org/10.1123/APAQ.28.3.233

Thomas, C. (2004). Rescuing a social relational understanding of disability. *Scandinavian Journal of Disability Research*, *6*(1), 22–36. https://doi.org/10.1080/15017410409512637

Tracey, D., Maïano, C., Gagnon, C., Craven, R., McCune, V., & Morin, A. (2021). The Task and Ego Orientation in Sport Questionnaire adapted for youth with intellectual disabilities (TEOSQ-ID). *Psychology of Sport and Exercise*, *56*, 102006. https://doi.org/10.1016/J.PSYCHSPORT.2021.102006

Zhang, L., Zhu, X., Haegele, J. A., Wang, D., & Wu, X. (2021). Effects of a one-year physical activity intervention on fundamental movement skills of boys with severe intellectual disabilities. *Research in Developmental Disabilities*, *114*, 103980. https://doi.org/10.1016/j.ridd.2021.103980

Conflict of Interests: No conflict of interest was reported by the authors.

apunts EDUCACIÓN FÍSICA Y DEPORTES

ISSUE 156

Published: April 1, 2024
https://doi.org/10.5672/apunts.2014-0983.es.(2024/2).156.04

How many Physical Education hours do students desire? It depends on the (de-)motivating teaching style perceived

Javier García-Cazorla[1], Sergio Diloy-Peña[1*], Carlos Mayo-Rota[1], Luis García-González[1] & Ángel Abós[1]

[1] Faculty of Health and Sport Sciences. Physical Education and Physical Activity Promotion Research Group (EFYPAF), University of Zaragoza, Huesca (Spain).

OPEN ACCESS

Cite this article
García-Cazorla, J., Diloy-Peña, S., Mayo-Rota, C., García-González, L. & Abós, A. (2024). How many Physical Education hours do students desire? It depends on the (de-)motivating teaching style perceived. *Apunts Educación Física y Deportes, 156*, 30-38. https://doi.org/10.5672/apunts.2014-0983.es.(2024/2).156.04

Editor:
© Generalitat de Catalunya
Departament de la Presidència
Institut Nacional d'Educació Física de Catalunya (INEFC)

ISSN: 2014-0983

***Corresponding author:**
Sergio Diloy-Peña
sdiloy@unizar.es

Section:
Physical Education

Original language:
English

Received:
July 10, 2023
Accepted:
October 27, 2023
Published:
April 1, 2024

Front cover:
Mountain biker enjoying nature and open air.
© Adobe Stock. Delcio F/ peopleimages.com

Abstract

A more integrative and fine-grained model called circumplex approach, which classifies (de-)motivating teaching style into eight (de-)motivating approaches based on the degree of need support/thwarting and directiveness, has recently been proposed in the educational context. However, the evidence so far on how each of (de-)motivating teaching approaches may be related to different (mal-)adaptive outcomes is scarce in the PE context. Grounded in this circumplex model, the present study aims to examine differences in the number of PE hours desired by students in terms of students' perceptions of (de-)motivating teaching approaches. An intentional sample of 669 secondary students (M_{age} = 14.65; *SD* = 1.47; 52 % girls), aged between 12 and 17 years participated in this cross-sectional study. The results show that students who would like to have more and the same desired PE hours as usual reported perceived significantly higher values in participative, attuning, guiding, clarifying, and demanding approaches from their PE teachers than those who desired fewer PE hours than usual. In addition, students who reported fewer desired PE hours than usual perceived significantly higher values in the abandoning approach from their PE teachers in comparison with students who desired more and the same PE hours. Results highlighted the importance of PE teachers developing autonomy-supportive and structuring approaches (i.e., participative, attuning, guiding, and clarifying) and avoiding chaotic approaches (i.e., abandoning) to foster adaptive students' affective outcomes.

Keywords: circumplex model, desired PE hours, self-determination theory, teaching approaches.

Introduction

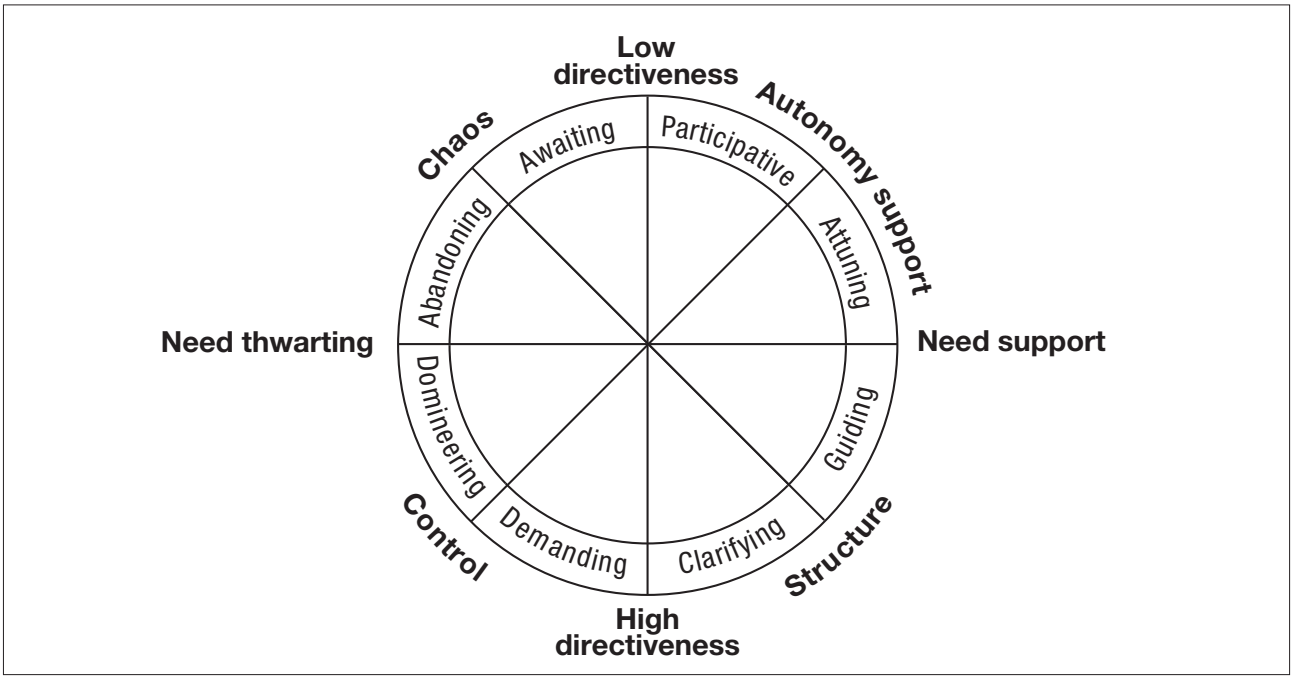
Increasing the number of Physical Education (PE) lessons may contribute, among other purposes, to increasing the amount of physical activity (PA) that pupils engage in each week. According to data from a 2016 global study, more than 80 % of adolescents aged 11-17 years did not meet current daily PA recommendations, compromising their current and future health (Guthold et al., 2020). So, by increasing the number of PE hours and therefore PA per week the students would develop physical, psychological, and cognitive benefits (Biddle et al., 2019; Poitras et al., 2016; Ramires et al., 2023). Previous research has highlighted the role of PE teachers, via their (de-)motivating teaching style, as one of the most important factors for the development of positive experiences, knowledge, and values necessary to facilitate a healthy lifestyle in their students (Diloy-Peña et al., 2021; Vasconcellos et al., 2020).

Recently, within the Self Determination Theory framework (SDT; Ryan & Deci, 2017) a more integrative and detailed conceptualization of (de-)motivating teaching styles called circumplex model has been proposed (Aelterman et al., 2019), which differentiates among eight teaching approaches that draw a circular structure in terms of the level of directiveness, and support or thwarting of basic psychological needs (BPN). Aelterman et al. (2019) argued that this circular structure more accurately captures the complexity and interaction between different (de-)motivating styles. This circular structure also allows for the identification and analysis of teaching approaches that may have been overlooked or underestimated in more unidimensional classification systems. Although the circumplex approach represents a relevant advance in the study of (de-)motivating teaching style, little, if any, is still known about how the eight (de-)motivating teaching approaches may impact a set of students' outcomes (Aelterman et al., 2019; Burgueño et al., 2023; Escriva-Boulley et al., 2021). For example, there is no previous research that has explored the student's desired PE hours and if this could differ according to eight teachers' (de-)motivating approaches. To overcome this existing gap and to extend previous evidence on (de-)motivating teaching style on the circumplex approach in PE, the present study aims to examine differences in the number of PE hours desired by students concerning students' perception of (de-)motivating teaching approaches.

(De-)motivating teaching styles based on the circumplex approach

Building upon SDT (Ryan & Deci, 2017), Aelterman et al. (2019) in the educational context, and, specifically in PE context (Burgueño et al., 2023; Escriva-Boulley et al., 2021) forwarded a more integrative and fine-grained circumplex approach in which four (de-)motivating teaching styles (i.e., autonomy support, structure, control, and chaos) and eight (de-)motivating teaching approaches (i.e., participative, attuning, guiding, clarifying, demanding, domineering, abandoning, and awaiting) can be distinguished depending on the level of directiveness (i.e., high or low) and support or thwarting of BPN used by teachers to interact with students (see Figure 1).

Figure 1
Circumplex approach to (de-)motivating styles by Aelterman et al. (2019).



The first (de-)motivating teaching style, characterized by a low level of directiveness and a high level of need-support is autonomy support (i.e., PE teacher understands students' interests, feelings, and preferences), which is composed of participative and attuning approaches. Particularly, a participative PE teacher wants to identify the personal interests of his or her students, listen to their suggestions, and try to provide meaningful dialogue so that students can develop their learning. An attuning PE teacher tries to find and offer options to make tasks more interesting and enjoyable, thus increasing students' interest and providing a meaningful rationale for each task performed (Aelterman et al., 2019; Escriva-Boulley et al., 2021). The second (de-)motivating teaching style, characterized by a high level of directiveness and a high level of need-support, is structure (i.e., PE teacher knows the capabilities and abilities of their students and assist them in their learning), which is composed of guiding and clarifying teaching approaches. A guiding PE teacher helps students to progress in their learning through constructive, clear, and valuable feedback as well as by guiding them to complete tasks in different steps. A clarifying PE teacher reports an overview of the student's expectations and communicates guidelines clearly and transparently (Aelterman et al., 2019; Escriva-Boulley et al., 2021).

The third (de-)motivating teaching style, characterized by a high level of directiveness and a high level of need-thwarting, is control (i.e., teacher pressures and forces students to think, feel, and behave in a certain way), which is composed by demanding and domineering approaches. A demanding PE teacher requires discipline from students by using controlling language to make clear what students must do, for instance, the PE teacher does not tolerate any contradiction and threatens punishments or sanctions if the students do not comply. A domineering PE teacher pressures students to comply with these requests by inducing feelings of guilt, inferiority, disappointment, and shame (Aelterman et al., 2019; Escriva-Boulley et al., 2021). The last (de-)motivating teaching style, characterized by a low level of directiveness and a high level of need-thwarting, is chaos (i.e., the teacher allows the students to learn independently with no clear guidelines), which is composed of abandoning and awaiting approaches. An abandoning teacher disengages with students after several attempts, moving on to the next task without respecting the individual needs of each student, because he or she understands that they must learn to take responsibility. An awaiting PE teacher gives full initiative for action to the students, setting vague and diffuse goals and tasks (Aelterman et al., 2019; Escriva-Boulley et al., 2021).

(De-)motivating teaching styles and students' outcomes in PE

A substantial body of SDT-based research in PE has shown how teachers' (de-)motivating teaching styles are related to a wide range of students' (mal-)adaptive outcomes (Vasconcellos et al., 2020; White et al., 2021). For example, a meta-analysis study conducted by Vasconcellos et al. (2020) showed that both autonomy-supportive and structuring styles of PE teachers have been positively related to a range of positive affective (e.g., PE experiences), cognitive (e.g., learning-related outcomes), and behavioral (e.g., intention to be physically active) outcomes and negatively, to a lesser extent, to maladaptive outcomes. Likewise, another review about the impact of SDT on students' outcomes in PE lessons by Sun et al. (2017) showed that students who perceived motivating teaching styles of their PE teachers revealed positive motivational outcomes, such as interest, effort, enjoyment, satisfaction, engagement, high participation, and intention to future PE enrollment. However, past and recent SDT-related evidence in PE has shown that both controlling and chaotic styles are related to a long set of maladaptive outcomes, such as students' disaffection in PE (Curran & Standage, 2017) and need frustration (Burgueño et al., 2022; Burgueño & Medina-Casaubón, 2021).

The Present Study

Even though an increasing body of research is focusing on these four (de-)motivating teaching styles in different contexts (Aelterman et al., 2019; Delrue et al., 2019; Escriva-Boulley et al., 2021), very little attention, so far, has been paid to identifying possible outcomes of the different teaching approaches (i.e., participative, attuning, guiding, clarifying, demanding, domineering, abandoning, and awaiting) that encompass each teaching style in PE context, knowing in more detail how each of the eight (de-)motivating teaching approaches is associated with positive outcomes, as the desired PE hours, which, to the best of our knowledge, is still unexplored. Thus, this could provide more refined evidence about how teachers' behavior impacts on students' PE predisposition and PA intentions. Therefore, grounded in SDT (Ryan & Deci, 2017), and the circumplex model (Burgueño et al., 2023; Escriva-Boulley et al., 2021), the present study aims to examine differences in students' perceptions of different (de-)motivating teaching approaches in terms of students' desired PE hours. In line with previous SDT-based research in PE (Vasconcellos et al., 2020; White et al., 2021) and the circumplex model (Burgueño et al., 2023; Escriva-Boulley et al., 2021), students who report more desired PE hours are expected to show higher scores

of participative, attuning, guiding, and clarifying approaches of their PE teachers, and fewer demanding, domineering, abandoning, and awaiting approaches, compared to students who report a desire of having less PE hours than usual.

Material and Methods

Design and Participants

The present study was based on a cross-sectional design. An intentional, non-probability sample of 669 students (M_{age} = 14.65; *SD* = 1.47; 52 % girls; divided in Year 8 = 198; Year 9 = 161; Year 10 = 141; Year 11 = 102; Year 12 = 68), from different secondary schools in north-eastern Spain, more specifically in the Community of Aragon, was used after removing invalid data. The criteria for inclusion were to belong to the schools where the study was developed, to have the informed parental consent form signed, and to fill in the corresponding questionnaires correctly. Participants were taught by a total of 10 PE teachers (M_{age} = 38.56; *SD* = 7.18; 20 % female) who had an average of teaching experience of 10.77 ± 7.01 years. While PE teachers involved in this research did not receive any specific training about (de-)motivating teaching practices, they previously obtained at least a Bachelor of Science in Physical Activity and Sport Sciences and a Professional Master's program in Education. Besides, in the Spanish educational context, more specifically in secondary education, PE is a compulsory subject, in which students receive two lessons of approximately 50 minutes per week.

Instruments and Variables

(De-)motivating teaching style

Students' perceptions of PE teachers' (de-)motivating approaches were assessed using the student Spanish version of the School Situations Questionnaire in PE (SIS-PE; Burgueño et al., 2023). The SIS-PE presents 12 situations with four distinct items (i.e., 48 items in total) for each one that usually takes place in PE lessons. Each one of the 48 items corresponds to one of the eight (de-)motivating teaching approaches that the circumplex model encompasses. More precisely, four items refer to participative, eight to attuning, seven to guiding, five to clarifying, seven to demanding, five to domineering, eight to abandoning, and four to awaiting approaches (for further information on each item, please see the SIS-PE questionnaire in Burgueño et al., 2023. Responses were given on a Likert scale from 1 ("does not describe my PE teacher at all") to 7 ("describes my PE teacher extremely well"). In the present study, confirmatory factor analysis (CFA) showed a good fit to the data: χ^2 (3.673, n = 669) = 3945.463, $p < .001$; CFI = 0.906; TLI = 0.901; RMSEA = 0.064; 90 % CI = 0.061-0.066.

Desired PE hours

Students' perceptions of the desired number of PE hours were assessed using the question: "How many hours of PE would you like to have per week?". Because the Spanish Educational Legislation states that secondary students must have at least 2 hours of PE per week, we decided to categorize the answers into 3 options: "less than usual (i.e., < 2 h/week)", "the same hours (i.e., 2 h/week)", or "more hours than usual (i.e., > 2 h/week)".

Procedure

Before starting the study, the main researcher contacted the schools' boards and PE teachers to inform them about the objectives and request their participation. Next, families or legal guardians were asked to sign the informed consent form to agree to their children's participation. The questionnaires were completed in a paper-pencil format in approximately 15 minutes, in a quiet environment with a suitable temperature. During the development of the questionnaires, the main researcher was available to answer any questions, while the PE teachers were not present so as not to distort their answers. In addition, with the aim of reducing the potential bias of social desirability in responses, students were reminded that the data were confidential and anonymous and would only be used for research purposes, remarking the importance of honesty in their responses. Before starting the questionnaire, participants, who did not receive any remuneration for their participation, were informed that participation was voluntary and that, if they wished, they could leave the research at any time. Ethical clearance for this research was secured through the Institutional Research Ethics Committee of the first author's affiliated university (CEICA; PI15/0283).

Data Analysis

In preliminary analyses, descriptive statistics (means and standard deviations), composite reliability (via McDonald's omega coefficient), and bivariate correlations (Pearson's for continuous variables and Spearman's Rho for PE desired hours) were calculated for all study variables. Regarding composite reliability, scores above 0.80 could be needed when comparing among groups (Viladrich et al., 2017), although there are also other references that lower Omega's threshold to 0.70 (Nunnally, 1978). Prior to the MANOVA test, the normality of the data was assessed through the values of

skewness and kurtosis. Then, homoscedasticity was checked by Levene's test ($p > .05$). Also, we have controlled the data independence by Pearson's chi-square test ($p > .05$), so the data were independent from each other (Field, 2017). In the main analyses, we performed a multivariate analysis of variance (MANOVA) of students' perceptions of PE teachers' (de-)motivating teaching approaches according to the number of desired PE hours. In all analyses, if significant differences were found, *post hoc* tests were performed using the Bonferroni method, which is useful to control Type I error when making multiple simultaneous comparisons (Field, 2017). The level of statistical significance was set at $p < .05$. Effect sizes (η^2p) of .01 were considered low, above .06 moderate, and.14 high. All analyses were conducted using SPSS v25 software.

Results

Means, standard deviations, reliability, and correlations between study variables are presented in Table 1. As observed, students reported higher mean scores than the midpoint of the scale in six of the eight (de-)motivating teaching approaches of their PE teachers, only except for abandoning and awaiting approaches, which showed lower mean scores than the midpoint. Correlations revealed that most of the (de-)motivating teaching approaches correlated significantly with each other, ranging from $r = -.33$ (i.e., guiding with abandoning) to $r = .76$ (i.e., attuning with guiding). Participative, attuning, guiding, clarifying, and demanding approaches were related positively and significantly to the number of PE hours desired by students.

More related to the main aim of this research, differences in students' perceptions of PE teaching approaches regarding desired PE hours are reported in Table 2. The multivariate effect of the students' desired PE hours on (de-)motivating teaching approaches (Wilks' $\lambda = 0.942$, F (16.132) = 2.51, $p < .001$, $\eta^2_p = .030$) was significant. Students who would like to have more (i.e., > 2 h/week) and the same PE hours as usual (i.e., 2 h/week) perceived significantly higher values of participative, attuning, guiding, clarifying, and demanding approaches compared to students who reported fewer desired PE hours than usual (i.e., < 2 h/week). On the other hand, students who revealed fewer desired PE hours (i.e., < 2 h/week) perceived significantly higher values of abandoning approach from their PE teachers, compared to those who would like to have more (i.e., > 2 h/week) and the same PE hours than usual (i.e., 2 h/week).

Table 1
Descriptive statistics, reliability, and correlations among study variables.

Variables	*Range*	*M (SD)*	Omega (ω)	1	2	*3*	4	5	6	7	8	9
1. Participative	1-7	4.01 (1.50)	.72	-	.73**	.61**	.52**	.42**	.21**	-.06	.01	.12**
2. Attuning	1-7	4.60 (1.27)	.83		-	.77**	.70**	.51**	.18**	-.24**	-.07	.15**
3. Guiding	1-7	5.18 (1.22)	.84			-	.70**	.55**	.12**	-.33**	-.16**	.13**
4. Clarifying	1-7	5.22 (1.08)	.67				-	.59**	.22**	-.22**	-.11**	.09**
5. Demanding	1-7	4.75 (0.97)	.59					-	.44**	-.01	.04	.12**
6. Domineering	1-7	3.77 (1.19)	.57						-	.43**	.27**	.07
7. Abandoning	1-7	2.56 (1.24)	.82							-	.57**	-.02
8. Awaiting	1-7	2.63 (1.29)	.67								-	-.04
9. PE desired hours[a]	1-3	2.65 (1.31)	-									-

Nota. *$p < .05$; **$p < .01$; a = Spearman's rho correlation.

Table 2
Differences in students' perceptions of PE teaching approaches in terms of the desired PE hours.

	Number of desired PE hours						*Contrast between groups*					
	< 2 h/week (i) (*n* = 51)		2 h/week (j) (*n* = 130)		> 2 h/week (k) (*n* = 488)		*Mean difference*		*Standard error*	*p*	*F-value* $^{(2,487)}$	η^2p
	M	*SD*	*M*	*SD*	*M*	*SD*						
							i-j	-.656	.247	**.025**		
Participative	3.304	.210	3.960	.131	4.108	.068	i-k	-.804	.220	**.001**	6.782	.020
							j-k	-.148	.148	.950		
							i-j	-.853	.206	**< .001**		
Attuning	3.710	.174	4.563	.109	4.712	.056	i-k	-.1002	.183	**< .001**	15.039	.043
							j-k	-.149	.123	.681		
							i-j	-.757	.198	**< .001**		
Guiding	4.364	.168	5.121	.105	5.284	.054	i-k	-.920	.176	**< .001**	13.840	.040
							j-k	-.163	.118	.503		
							i-j	-.464	.177	**.027**		
Clarifying	4.718	.150	5.182	.094	5.289	.049	i-k	-.572	.158	**.001**	6.693	.020
							j-k	-.108	.106	.926		
							i-j	-.431	.160	**.022**		
Demanding	4.297	.136	4.727	.085	4.810	.044	i-k	-.513	.143	**.001**	6.527	.019
							j-k	-.083	.096	1.000		
							i-j	.101	.198	1.000		
Domineering	3.788	.168	3.688	.106	3.789	.054	i-k	-.001	.176	1.000	0.376	.001
							j-k	-.102	.118	1.000		
							i-j	.513	.204	**.037**		
Abandoning	3.078	.173	2.565	.108	2.516	.056	i-k	.563	.182	**.006**	4.790	.014
							j-k	.050	.122	1.000		
							i-j	.374	.213	.240		
Awaiting	2.897	.181	2.523	.113	2.641	.058	i-k	.256	.190	.533	1.543	.005
							j-k	-.118	.127	1.000		

Discussion

Although recent research in different contexts has shown that different (de-)motivating teaching styles can trigger a wide range of students' outcomes (Vasconcellos et al., 2020), research in PE is still scarce so far. This is the first research to date that focuses on the differences in students' desired PE hours about the students' perception of eight (de-)motivating teaching approaches, getting a more detailed view of the circumplex approach in PE. The present study, therefore, expands prior evidence in SDT-based research in PE by displaying two main findings: (1) students who desire more PE hours perceive their PE teachers as more need-supportive and directive (i.e., participative, attuning, guiding, clarifying, and demanding); (2) students who desire fewer PE hours perceive their PE teachers to be chaotic, especially with more traits of an abandoning approach.

Consistent with our research hypothesis, our results displayed that those students who desired more (i.e., > 2 h/week) or the same (i.e., 2 h/week) PE hours perceived significantly higher values for participative, attuning, guiding, and clarifying approaches from their PE teachers. These results are in line with previous SDT-based research (Burgueño et al., 2022; Curran & Standage, 2017; Vasconcellos et al., 2020) which showed that students' perceptions of autonomy-supportive (i.e., participative and attuning) and structuring (i.e., guiding and clarifying) styles were positively related to a wide range of motivational and behavioral adaptive outcomes (e.g., PA levels, engagement, among others). These results suggest that those PE teachers who offer students the opportunity for choice in the organization and delivery of the lessons (i.e., participative), explaining the usefulness of the tasks and adjusting them according to the students' wishes and preferences (i.e., attuning) may be more likely to arouse in their students a higher predisposition towards PE (Vasconcellos et al., 2020). Likewise, PE teachers who structure tasks in different steps and provide constructive, clear, and valuable feedback, addressing personal students' characteristics (i.e., guiding), and communicating learning objectives and goals (i.e., clarifying), also tend to report students' adaptive outcomes (Aelterman et al., 2019; Vasconcellos et al., 2020), triggering a greater desire to do and participate among students in the PE classes.

Regarding PE teachers' controlling style, our results showed that students who desired more (i.e., > 2 h/week) or the same (i.e., 2 h/week) PE hours perceived significantly higher values for the demanding approach. The results found are not totally in line with our hypothesis and previous SDT-related research in PE (Curran & Standage, 2017), which, overall, has shown how PE teachers' controlling style tends to trigger maladaptive outcomes, such as students' disaffection. A potential explanation for this result is that the demanding approach (i.e., controlling style) from PE teachers could be perceived by students as very close to clarifying approach (i.e., structuring style), as it is small nuances that differentiate both approaches characterized by a high directiveness (Aelterman et al., 2019). The results of the correlation analysis, as occurs in other studies based on the circumplex approach (Aelterman et al., 2019) show a significant and positive relationship between demanding and clarifying approaches. This could mean that, at least for some positive outcomes such as the predisposition towards PE, some nuances of teacher control (i.e., demanding approach) closer to the structure style (i.e., clarifying approach) may work as fuel to trigger adaptive outcomes. However, a recent study in PE has shown how the demanding approach from PE teachers, in parallel, can facilitate students' need-frustration (Burgueño et al., 2023). In this sense, it seems important that if PE teachers are characterized by conducting their lessons with high directiveness, it is characterized by traits of clarifying rather than demanding approach (Burgueño et al., 2023). Therefore, these results should be to increase the interest to investigate more about the relationship between the controlling style, specifically the demanding approach, with (mal-)adaptive students' outcomes.

Finally, the results of the present study also revealed that students who desired fewer PE hours (i.e., < 2 h/week) perceived higher values of abandoning approach (i.e., chaos) from their PE teachers. These results are in line with previous studies based on the circumplex approach in the sport context (Delrue et al., 2019) in which chaos from coaches was related to youth athletes' need for frustration. Similarly, our results are aligned with another recent SDT-based study which showed that students' perception of chaotic style was negatively related to behavioral and emotional engagement (Leo et al., 2022). In this vein, our results seem to point out that when PE teachers give up and leave students in their classroom (i.e., abandoning approach), students' desire to do PE decreases, probably because they do not know what to do, how they should act, and how they can develop their abilities and capabilities. Yet, it is important to note that students who wanted fewer PE hours did not perceive a higher level of awaiting approach from their PE teacher. Although both chaos approaches are highly detrimental (Burgueño et al., 2023; Delrue et al., 2019) this would mean that students would be likely to feel less desire to do PE, when they perceive that their PE teacher adopts a chaotic tone characterized by higher levels of need-thwarting (i.e., abandoning approach) than when that chaos moves towards a tone relied more on *laissez-faire* with low levels of directiveness (i.e., awaiting approach).

Implications for teaching practice

The results suggest the need to develop specialized training programs for pre- and in-service PE teachers. These programs should focus on equipping PE teachers with the necessary skills and knowledge to employ depending on several factors (e.g., students' age, content, class size, among others), need-supportive approaches with distinct levels of directiveness. Specifically, if PE teachers desire that their students have a high PE predisposition, they should be encouraged to adopt autonomy-supportive teaching methods (Pérez-González et al., 2019). More precisely, this involves providing students with choices and involving them in decision-making (i.e., participative), as well as recognizing their perspectives and preferences and trying to provide a meaningful rationale for each task performed (i.e., attuning) (Aelterman et al., 2019). Likewise, there is ample evidence that shows how structuring approaches could trigger an adaptive motivational process in students, including having a desire for more PE (Vasconcellos et al., 2020). More specifically, PE teachers should also seek to orient and guide their students in the teaching process (i.e., guiding), as well as to define the objectives clearly and in detail (i.e., clarifying) (Escriva-Boulley et al., 2021). Teachers can be trained to strike a balance between providing structure and allowing students to have a say in their PE lesson activities, which can boost their participation, effort, and engagement, among others (Burgueño et al., 2023). Furthermore, it seems that some control traits such as using a certain tone of power with students (i.e., demanding), could have a positive PE predisposition effect among students, at least in the short term. However, given the numerous negative evidence on teachers' control behavior, we prefer not to make recommendations in this regard for the moment and encourage continuing to examine the effects of the demanding and specially domineering approaches separately. Finally, training programs should highlight the negative impact of disorganized teaching approaches on students' adaptive outcomes in PE lessons, especially the abandoning approach.

Limitations and Future Directions

Although our findings expand previous evidence of the circumplex approach in PE, it is also important to indicate limitations and future directions. First, the design of this study is cross-sectional, so no causal relationships between the study variables can be inferred. Future longitudinal and/or experimental research is, thus, required to shed more light on the associations of (de-)motivating approaches with students' outcomes over time. Second, the sampling of this study was non-probabilistic (i.e., intentional sample), so the results should be interpreted with caution. Future studies based on the circumplex model in PE should use a probability sampling method to increase external validity. Third, the reliability of some (de-)motivating approaches was slightly under the threshold, so it is important to be cautious when interpreting results. Fourth, PE teachers' (de-)motivating teaching styles were measured based on students' perceptions, which may imply self-report bias and social desirability in their measurement. Future studies should use other sources of information (e.g., observation, teacher perceptions, etc.), for a triangulation of data. Finally, the present study only considered one outcome (i.e., the number of PE hours desired by students). Moreover, this variable was evaluated with a single item and therefore, reliability cannot be analyzed, so results should be interpreted with caution. Future research may include another type of outcome (e.g., affective, cognitive, or behavioral) and use instruments that capture better the meaning of the variable to draw a more complete picture of the relationship between the eight (de-)motivating teaching approaches proposed by the circumplex approach and the students' motivational process.

Conclusions

The present study expands previous PE research based on the circumplex model by displaying how some (de-)motivating approaches may be associated with a greater desire to do PE among students. More precisely, the present study indicates that PE teachers should make more use of motivating teaching approaches that support students' needs (i.e., participative, attuning, guiding, and clarifying). Besides, given the positive results of the demanding approach associated with this desire for more PE hours, there is a need to examine which could be the optimal amount, if any, of controlling style to achieve adaptive outcomes in the PE classes. Finally, this study indicates the need for PE teachers to avoid the chaotic style, and more specifically abandoning approaches, as these are the worst performers in terms of the number of hours of PE desired by students.

References

Aelterman, N., Vansteenkiste, M., Haerens, L., Soenens, B., Fontaine, J. R. J., & Reeve, J. (2019). Toward an integrative and fine-grained insight in motivating and demotivating teaching styles: The merits of a circumplex approach. *Journal of Educational Psychology*, *111*(3), 497-521. https://doi.org/10.1037/edu0000293

Biddle, S. J. H., Ciaccioni, S., Thomas, G., & Vergeer, I. (2019). Physical activity and mental health in children and adolescents: An updated review of reviews and an analysis of causality. *Psychology of Sport and Exercise*, *42*, 146-155. https://doi.org/10.1016/j.psychsport.2018.08.011

Burgueño, R., Abós, Á., Sevil-Serrano, J., Haerens, L., De Cocker, K., & García-González, L. (2023). A Circumplex Approach to (de)motivating Styles in Physical Education: Situations-In-School–Physical Education Questionnaire in Spanish Students, Pre-Service, and In-Service Teachers. *Measurement in Physical Education and Exercise Science*, 1-23. https://doi.org/10.1080/1091367X.2023.2248098

Burgueño, R., García-González, L., Abós, Á., & Sevil-Serrano, J. (2022). Students' motivational experiences across profiles of perceived need-supportive and need-thwarting teaching behaviors in physical education. *Physical Education and Sport Pedagogy*, 1-15. https://doi.org/10.1080/17408989.2022.2028757

Burgueño, R., & Medina-Casaubón, J. (2021). Validity and reliability of the interpersonal behaviors questionnaire in physical education with spanish secondary school students. *Perceptual and Motor Skills*, *128*(1), 522-545. https://doi.org/10.1177/0031512520948286

Curran, T., & Standage, M. (2017). Psychological Needs and the Quality of Student Engagement in Physical Education: Teachers as Key Facilitators. *Journal of Teaching in Physical Education*, *36*(3), 262-276. https://doi.org/10.1123/jtpe.2017-0065

Delrue, J., Reynders, B., Broek, G. V., Aelterman, N., De Backer, M., Decroos, S., De Muynck, G. J., Fontaine, J., Fransen, K., van Puyenbroeck, S., Haerens, L., & Vansteenkiste, M. (2019). Adopting a helicopter-perspective towards motivating and demotivating coaching: A circumplex approach. *Psychology of Sport and Exercise*, *40*, 110-126. https://doi.org/10.1016/j.psychsport.2018.08.008

Diloy-Peña, S., García-González, L., Sevil-Serrano,J., Sanz-Remacha, M. & Abós, A. (2021). Motivating teaching style in Physical Education: how does it affect the experiences of students? *Apunts Educación Física y Deportes, 144*, 44-51. https://doi.org/10.5672/apunts.2014-0983.es.(2021/2).144.06

Escriva-Boulley, G., Guillet-Descas, E., Aelterman, N., Vansteenkiste, M., Van Doren, N., Lentillon-Kaestner, V., & Haerens, L. (2021). Adopting the situation in school questionnaire to examine Physical Education teachers' motivating and demotivating styles using a circumplex approach. *International Journal of Environmental Research and Public Health*, *18*(14), 7342. https://doi.org/10.3390/ijerph18147342

Field, A. (2017). *Discovering Statistics Using IBM SPSS Statistics*. SAGE Publications.

Guthold, R., Stevens, G. A., Riley, L. M., & Bull, F. C. (2020). Global trends in insufficient physical activity among adolescents: a pooled analysis of 298 population-based surveys with 1·6 million participants. *The Lancet Child & Adolescent Health*, *4*(1), 23-35. https://doi.org/10.1016/S2352-4642(19)30323-2

Leo, F. M., Pulido, J. J., Sánchez-Oliva, D., López-Gajardo, M. A., & Mouratidis, A. (2022). See the forest by looking at the trees: Physical education teachers' interpersonal style profiles and students' engagement. *European Physical Education Review*, *28*(3), 720-738. https://doi.org/10.1177/1356336X221075501

Nunnally, J. C. (1978). *An Overview of Psychological Measurement. In Clinical Diagnosis of Mental Disorders* (pp. 97-146). Springer US. https://doi.org/10.1007/978-1-4684-2490-4_4

Pérez-González, A. M., Valero-Valenzuela, A., Moreno-Murcia, J. A., & Sánchez-Alcaraz, B. J. (2019). Revisión sistemática del apoyo a la autonomía en educación física. *Apunts Educación Física y Deportes*, 138, 51-61. https://doi.org/10.5672/apunts.2014-0983.es.(2019/4).138.04

Poitras, V. J., Gray, C. E., Borghese, M. M., Carson, V., Chaput, J.-P., Janssen, I., Katzmarzyk, P. T., Pate, R. R., Connor Gorber, S., Kho, M. E., Sampson, M., & Tremblay, M. S. (2016). Systematic review of the relationships between objectively measured physical activity and health indicators in school-aged children and youth. *Applied Physiology, Nutrition, and Metabolism*, *41*(6 (Suppl. 3)), S197-S239. https://doi.org/10.1139/apnm-2015-0663

Ramires, V. V., dos Santos, P. C., Barbosa Filho, V. C., Bandeira, A. S., Marinho Tenório, M. C., de Camargo, E. M., Ravagnani, F. C. P., Sandreschi, P., de Oliveira, V. J. M., Hallal, P. C., & Silva, K. S. (2023). Physical Education for Health Among School-Aged Children and Adolescents: A Scoping Review of Reviews. *Journal of Physical Activity and Health*, 1-14. https://doi.org/10.1123/jpah.2022-0395

Ryan, R. M., & Deci, E. L. (2017). *Self-Determination Theory: Basic Psychological Needs in Motivation, Development, and Wellness* R. M. Ryan & E. L. Deci (eds.). Guilford Press. https://doi.org/10.1521/978.14625/28806

Sun, H., Li, W., & Shen, B. (2017). Learning in Physical Education: A Self-Determination Theory Perspective. J*ournal of Teaching in Physical Education, 36*(3), 277-291. https://doi.org/10.1123/jtpe.2017-0067

Vasconcellos, D., Parker, P. D., Hilland, T., Cinelli, R., Owen, K. B., Kapsal, N., Lee, J., Antczak, D., Ntoumanis, N., Ryan, R. M., & Lonsdale, C. (2020). Self-determination theory applied to physical education: A systematic review and meta-analysis. *Journal of Educational Psychology*, *112*(7), 1444-1469. https://doi.org/10.1037/edu0000420

Viladrich, C., Angulo-Brunet, A., & Doval, E. (2017). A journey around alpha and omega to estimate internal consistency reliability. *Anales de Psicología/Annals of Psychology*, *33*(3), 755-782. https://doi.org/10.6018/analesps.33.3.268401

White, R. L., Bennie, A., Vasconcellos, D., Cinelli, R., Hilland, T., Owen, K. B., & Lonsdale, C. (2021). Self-determination theory in physical education: A systematic review of qualitative studies. *Teaching and Teacher Education*, *99*, 103247. https://doi.org/10.1016/j.tate.2020.103247

Conflict of Interests: No conflict of interest was reported by the authors.

apunts EDUCACIÓN FÍSICA Y DEPORTES

ISSUE 156

Published: April 1, 2024
https://doi.org/10.5672/apunts.2014-0983.es.(2024/2).156.05

OPEN ACCESS

Does the type of flexibility used before a Physical Education class have an influence?

Josep M. Serrano-Ramon[1,2*], Rodrigo Cubillo León[2] & Marco A. García-Luna[3]

[1] Secondary school teacher, Regional Government of Valencia, Department of Education, Valencia (Spain).
[2] Faculty of Humanities and Social Sciences, Isabel I University, Burgos (Spain).
[3] Department of General Didactics and Specific Didactics, Faculty of Education, University of Alicante, Alicante (Spain).

Cite this article
Serrano-Ramon, J. M., Cubillo León, R. & García-Luna, M. A. (2024). Does the type of flexibility used before a Physical Education class have any influence? *Apunts Educación Física y Deportes, 156*, 39-46. https://doi.org/10.5672/apunts.2014-0983.es.(2024/2).156.05

Editor:
© Generalitat de Catalunya
Departament de la Presidència
Institut Nacional d'Educació Física de Catalunya (INEFC)

ISSN: 2014-0983

***Corresponding author:**
Josep M. Serrano-Ramon
jm.serranoramon@edu.gva.es

Section:
Physical Education

Original language:
Catalan

Received:
July 19, 2023
Accepted:
November 8, 2023
Published:
April 1, 2024

Front cover:
Mountain biker enjoying nature and open air.
© Adobe Stock. Delcio F/ peopleimages.com

Abstract

The use of muscle stretching techniques has long been practised prior to physical activities to increase activation, increase joint amplitude or as part of warm-up techniques. In recent years, there has been discrepancy in the use of static stretching (STA), dynamic or intermittent stretching (DYN), or no stretching (CON) before starting the Physical Education session. The aim of this study was to find out which type of flexibility work would obtain better results in the countermovement jump (CMJ) with the variables: relative strength index (RSI), jump height (HGT) and contact time (CT) with a contact platform. 86 participants aged 16.74 ± 0.19 years, 65.17 ± 30.03 kg and 1.71 ± 0.09 m took part in this research. All participants were randomised to the 3 protocols, 2 stretching protocols (STA and DYN) for 30 seconds and 1 control without any stretching (CON). The results showed significant increases in the RSI and HGT ($p < .001$) in the DYN condition vs. CON and STA. On the other hand, CT showed significant increases in STA with respect to CON ($p < .01$) and DYN. From the results obtained, it could be affirmed that an acute programme of dynamic stretching could produce improvements on countermovement jumping (CMJ) compared to no stretching or a 30 s maintenance of muscle elongation.

Keywords: CMJ, dynamic flexibility, Physical Education, RSI.

Introduction

Flexibility is considered one of the four physical-motor skills along with speed, strength and endurance (Castañer & Camerino, 2022; Monguillot Hernando et al., 2015). This concept is understood as the property of a body to deform under an applied force and return to its initial state once removed (Porta, 1987). Multiple methodologies for their conditioning, maintenance, and improvement have been available for years (Castañer & Camerino, 2022; Monguillot Hernando et al., 2015). These procedures have shown several changes, from a static work with the maintenance of a muscle stretching position in a certain time (Castañer & Camerino, 2022; Jiménez-Parra et al., 2022), to a dynamic work with stretching and relaxation intervals (Lin et al., 2020). Within this type of dynamic flexibility, several methods have been implemented, such as performing it at maximum speed or ballistic, at controlled or dynamic speed or at resisted speed, known as "proprioceptive neuromuscular facilitation" (Merino-Marban, et al. 2021). The application of these procedures in sports has been debated over the last few years, as well as the order in which each one should be worked on during the training session (Donti et al., 2014).

In another field of application such as education, there has also been much controversy about the use of any of the methods in Physical Education classes at school age (Becerra Fernández et al., 2020; Castañer & Camerino, 2022). Their use and duration of stimulus or muscle stretching has also been discussed for decades in numerous researches (Ayala et al., 2012), and it has been concluded that it is preferable to use intervals of approximately 30 seconds (s) per muscle or muscle group, maintaining them in static stretching (STA), interspersed with intervals of 2 s of elongation and 1 s of relaxation for dynamic stretching (DYN) (Lin et al., 2020; Reid et al., 2018). The influence on the type of muscle elongation used and its reactive capacity has been investigated in recent years (Kirmizigil et al., 2014). In addition, it has been related to the strength and power produced in isoinertial exercises and variables related to the high jump or long jump (Kirmizigil et al., 2014). According to multiple research studies, the most suitable movement to measure lower limb power is the high jump compared to other types (Toumi et al., 2004). Within this, the countermovement jump or CMJ has shown a high relationship with performance in maximum, explosive or sprint strength tests (Markovic et al., 2004).

As devices to record the kinematic variables of these exercises have been used from linear transducers or encoders to measure force (N) and velocity (m/s) in exercises with external load (Morales-Artacho et al., 2018) to contact platforms to measure CMJ-related variables such as flight time (FT) and contact (CT) (s), jump height (HGT) in centimetres (cm), power in watts (W), and reactive strength index (RSI) (De Blas & González-Gómez, 2005). This variable is obtained from the quotient between the height (cm) and the CT (s) of the jump (Flanagan & Comyns, 2008). Its interpretation has been considered an indicator of optimal neuromuscular readiness to perform a jump (McBride et al., 2008), as a result of a rapid transition between concentric-eccentric phases of muscle contraction (Turner & Jeffreys, 2010) triggered by instantaneous nerve stimulation, which activates the locking of muscle fibre stretching organs such as the Golgi apparatus (Toumi et al., 2004). In this sense, the aim of the present research was to verify the possible differences in the variables obtained with the CMJ in students before starting Physical Education class using various flexibility methods.

Methodology

Participants

In this study, 105 participants from the three years (A, B, and C) of the first level of baccalaureate (1BAC) of the Secondary School IES Haygón in Sant Vicent del Raspeig were recruited. Of the 100% (105) participants, 86 (81.9%) took part in the study with an age of 16.74 ± 0.19 years, a mass of 65.17 ± 30.03 kg, a height of 1.71 ± 0.09 m and a body mass index (BMI) of 22.31 ± 8.61 kg/m^2. This group of participants consisted of 41 boys (16.74 ± 0.20 years, 75.72 ± 38.37 kg, 1.71 ± 0.06 m and a BMI of 23.60 ± 11.23 kg/m^2) and 45 girls (16.76 ± 0.20 years, 56.48 ± 9.48 kg, 1.63 ± 0.04 m and a BMI of 21.21 ± 3.92 kg/m^2).

The 86 participants who took part in the study met the following inclusion criteria: 1. participate in all the sessions of study design; 2. not have any cardiac, musculoskeletal, orthopaedic, or congenital disability that would prevent them from performing the jumps; and 3. have signed the informed consent permission of their legal guardians regarding the objectives, procedure, and risks of the study. The 19 participants who did not take part in the study did not meet any of the above criteria. This study was approved by the centre's management and the legal guardians of the participants, who signed the above-mentioned informed consent form. In addition, it complied with the current protocols of the Declaration of Helsinki on Ethical Principles for Human Research (World Medical Association, 2022). The intervention was carried out in the same time slot (10:00 - 12:00 AM UTC + 1) and with the same environmental conditions (15-19 °C) in the indoor gymnasium of IES Haygón.

This sample size was determined *a priori* using the G*Power software version 3.1.9.6 for Mac OS X 13. An ANOVA for repeated measures between factors and an analytical power type was estimated with the F-test family *a priori*. This test determined that, for a median effect size F of 0.25 ($\eta_p^2 = .06$), an alpha(α) < .05, statistical power($\beta-1$) > .95, 3 groups, 3 measures (1 each participant and condition) and an option specification for SPSS, a minimum total sample of 168 participants (56 per condition) was required.

Study design

This research was based on a quasi-experimental intrasubject design (repeated measures) with a control condition. In order to evaluate the effect of dynamic muscle stretching interventions vs. static on countermovement jumping (CMJ) performance, each participant was subjected to the 3 intervention conditions: 1. without any application of stretch (CON), 2. static flexibility (STA) and 3. dynamic flexibility (DYN). These were assigned to each group-class with the following arrangement: 1BAC-A started the intervention with CON, followed by STA, and ending with DYN. For group 1BAC-B, the order was DYN, CON, and STA, respectively. Finally, for the third group (1BAC-C), the organisation was set up in: STA, DYN, and CON. In this sense, in each session, the starting order of the intervention was mixed up by its number on the PE teacher's list. This was done using the random sorting function of the Microsoft Excel (v. 11.0) spreadsheet programme developed by Microsoft (USA) for MacOS.

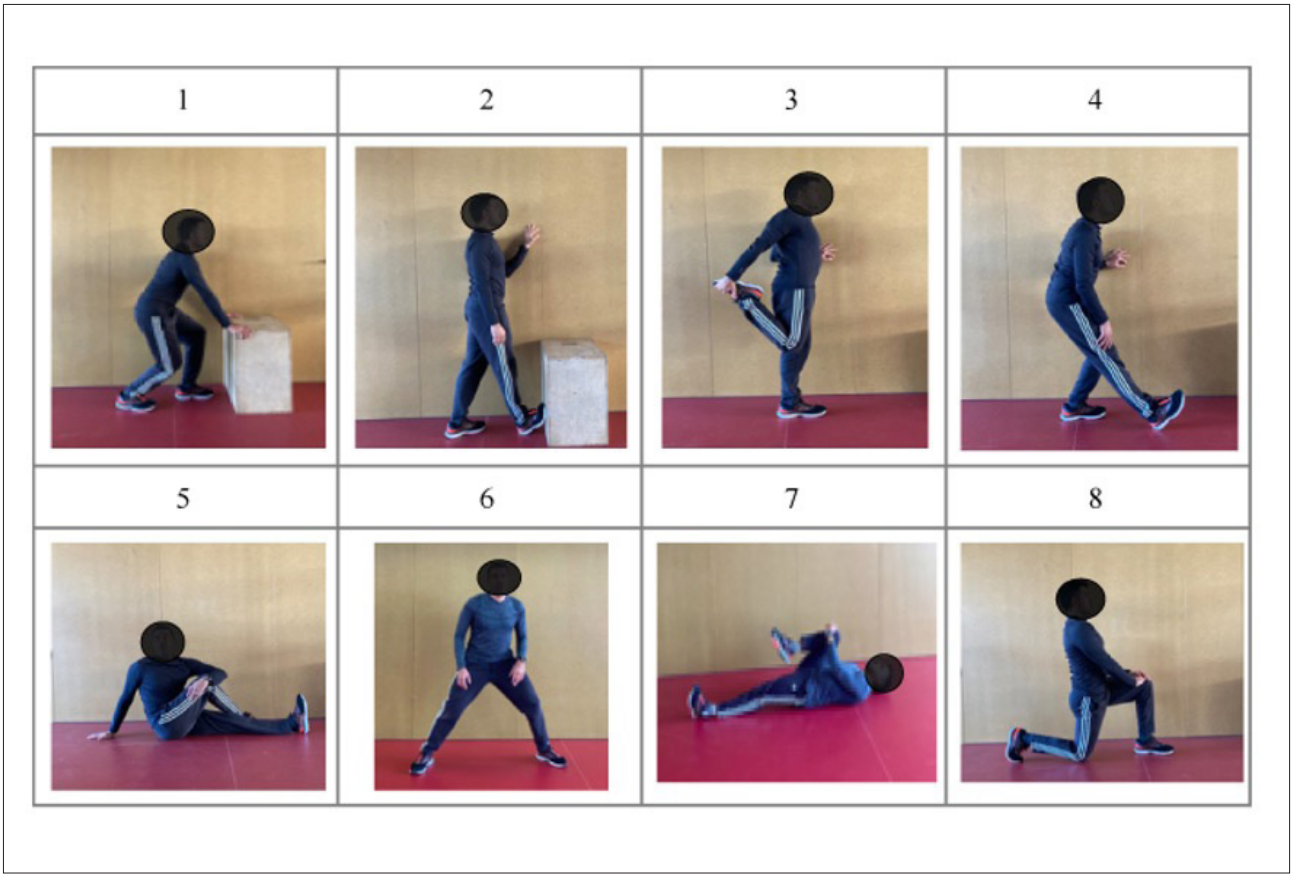
Procedure

The timing of this intervention consisted of 5 sessions separated by a minimum of 48 hours for each group (1BAC-A, B, or C). In session 1 (S1), the protocol of this research was explained and the informed consent form that had previously been distributed by the teacher to the students, together with the authorisation of the legal guardians, was signed and collected. S2 was used for familiarisation of the intervention protocol, where 5 attempts of the CMJ jump were practised with control from the sagittal plane by 2 observers (Blazevich, et al. 2018) (PE teacher of the group and the researcher of the present study) and feedback was provided to the students to try to get as high as possible with as little contact time as possible with the (deactivated) platform on each jump. The CMJ was initiated from an upright position with hands on hips, knees at shoulder width and heels in contact with the platform (Blazevich, et al. 2018). Immediately, participants performed a self-selected eccentric downward countermovement until their thighs were no lower than parallel to the ground, and then immediately performed the two-footed vertical jump (Samson et al., 2012). In this session (S2), the positions for the posterior stretches (DYN and STA) were also practised. In addition, the self-perception of walking at 50% (5 on a scale of 10) of the maximum perceived exertion for the activity prior to the application of the 3 conditions was internalised. From here, the intervention sessions began in randomised order (see Study Design).

Sessions of the CON, STA, and DYN conditions

All intervention sessions (CON, STA, and DYN) were composed of an activation performed by walking clockwise around the indoor volleyball court in the gym (18 x 9 metres) for 3 minutes at 50% of maximum perceived exertion (Blazevich et al., 2018). Then, in the CON condition, they remained seated for 10 minutes on a Swedish bench with both feet in contact with the floor and their shoulder blades in contact with the wall. In the STA condition session, 8 static muscle stretches were performed for the lower limbs as shown in figure 1 (Taylor, et al. 2009). These positions were held for 30 s of effective stretch at each point and 1 minute at both limbs (8 minutes of total stretch time) and, to change to the next, 20 s of transition was used (a total of 10:20 minutes of stretch plus transition time) (Taylor et al., 2009). However, in the DYN condition, the 8 positions shown in figure 1 were made in effective stretching sequences of 2 s with the same feeling of tightness as in the STA condition and 1 s of cessation of stretching. To achieve the same effective stretching time in each position (30 s), limbs (1 minute) and total time (8 minutes) as in the STA session. Simultaneously, 20 s of transition was also used to change to the next position, with 14:20 minutes of elongation plus transition (Lin et al., 2020). The start, end and transition time of the stretches was monitored with the iCountTimer application (RhythmicWorks Software LLP) for the Iphone 6 IOS 16.0 smartphone (Apple, Inc., Cupertino, California, United States). To intensify the acoustic control of the speaking time, the smartphone was connected via Bluetooth signal (Bluetooth Special Interest Group, Inc.) to a 2.4 GHz radio frequency, to an external wireless speaker Sony SRS-XE300 (Sony Group Corporation, Tokyo, Japan). Following (< 1 minute) the intervention procedures described in the CON, STA, and DYN sessions, they completed 5 CMJs on the contact platform (Chronojump, Bosco System, Barcelona, Spain) with a temporal resolution of 1 millisecond (ms) at a data collection rate of 1,000 Hz to record the dependent variables (see introduction). For the treatment of the data from the 5 CMJs, 4 jumps were selected, discarding the first or starting jump (Serrano-Ramon et al., 2023).

Figure 1
Static and dynamic stretching positions.



1. Stretching of the Achilles tendon. 2. Stretching of the calf. 3. Stretching of the quadriceps. 4. Stretching of the biceps femoris. 5. Stretching of the gluteus maximus. 6. Stretching of the groin. 7. Stretching of the lower back. 8. Stretching of the psoas.

Statistical Analysis

All data are expressed as mean (*M*) and standard deviation (*SD*). Before statistical analysis, the dependent variables (RSI, CT, HGT, and PO) were subjected to the Shapiro-Wilk test to check that they met the assumption of normality. The influence of CON, STA and DYN conditions on RSI, CT, HGT, and PO was then analysed with a repeated measures analysis of variance (RM ANOVA) with a total of 3 levels (i.e. CON, STA, and DYN). In this sense, Mauchly's test for sphericity was assumed; if this assumption was not met, the degrees of freedom and error were corrected using the Greenhouse-Geisser or Huynh-Feldt approximations, respectively. In addition, the observed power was calculated as β -1, and the effect size (ES) was expressed by partial eta squared (η_p^2), and was set at: .01 as a small effect, .06 medium and .14 or higher as a large effect size. To analyse the comparisons for each of the 3 levels, a *post hoc* Bonferroni test was performed, and the significance level was set at $p < .05$, as well as reflecting the upper and lower limits of the 95% confidence interval [CI]. The analyses described above were carried out using statistical analysis software (SPSS Inc., Chicago, Illinois, USA).

Results

The results showed statistically significant increases in the RSI (see figure 2) with a median effect size $F_{(1.52)} = 20.21$, $p < .001$, $\eta_p^2 = .06$, β -1 = 1. In the capacity of DYN ($M = 0.66$, $SD = 0.52$) scores were higher than CON ($M = 0.51$, $SD = 0.26$, $p < .001$, [95% CI 0.07, 0.23]) and STA ($M = 0.51$, $SD = 0.27$, $p < .001$, [CI 95% 0.08, 0.23]). On the other hand, the CT (see figure 3) showed a significant increase in the STA condition ($M = 0.45$, $SD = 0.19$) with respect to CON ($M = 0.41$, $SD = 0.15$, $p < .01$, [95% CI 0.01, 0.07]) and DYN

($M = 0.39$, $SD = 0.16$, $p < .001$, [95% CI 0.02, 0.08]) with a small effect size $F_{(2.0)} = 8.58$, $p < .001$, $\eta_p^2 = .02$, β -1 = .97. In contrast, HGT (see figure 4) showed significant increases with a median effect size $F_{(1.97)} = 24.84$, $p < .001$, $\eta_p^2 = .07$, β -1 = 1, in the DYN condition ($M = 22.29$, $SD = 7.71$) with respect to STA ($M = 19.82$, $SD = 6.34$, $p < .001$, [95% CI 1.21, 3.72]) and CON ($M = 18.67$, $SD = 6.52$, $p < .001$, [CI 95% 2.28, 4.96]).

Figure 2
RSI values.

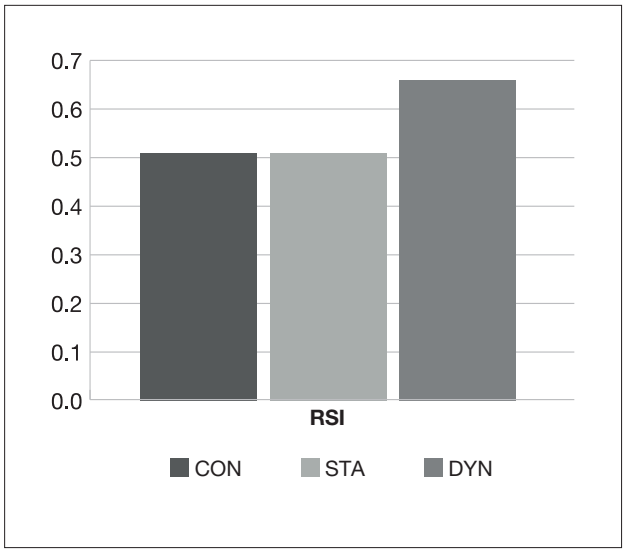


Figure 3
CT values.

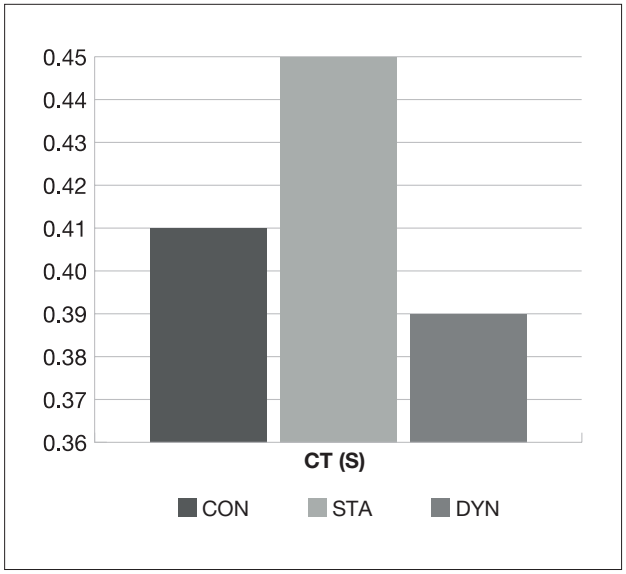
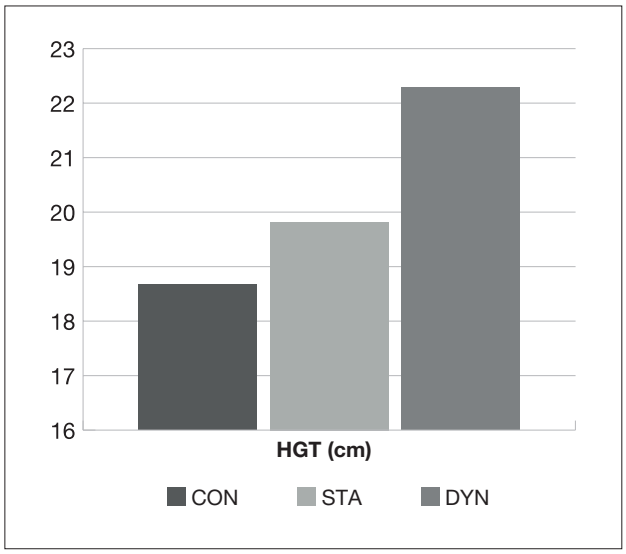


Figure 4
HGT values.



Discussion

The aim of this research was to test the acute effect of 2 muscle stretching procedures (static vs. dynamic) in comparison with the resting state (control), on the performance of the CMJ test among Physical Education students in the stage of their first year of baccalaureate. The results of the present study showed significant improvements in relation to CMJ performance on the dependent variables (RSI, CT, HGT) with the dynamic elongation condition, versus static and at rest. Procedures similar to this intervention have been investigated in a large number of papers over the past decades (Lin et al., 2020; Reid et al., 2018; Taylor et al., 2009). However, the RSI variable has been analysed in fewer studies compared to the other variables (CT, HGT, and PO) and treatments (STA vs. DYN) (Montalvo & Dorgo, 2019; Warneke et al., 2022; Werstein & Lund, 2012). In this sense, the RSI has shown increases in the research of Werstein and Lund (2012) in line with our results, although with differences in the methodological procedure. Starting with the fact that the participants in Werstein and Lund's (2012) research performed the RSI measurement using the drop jump from a 45cm box (Ruffieux et al., 2020), as well as significantly exceeding the pre-treatment activation time (10 vs. 5 minutes) and cycling on a cycleergometer rather than walking (Lopez-Samanes et al., 2021). In reference to the treatment, Werstein and Lund (2012) used the same elongation time in the STA condition as ours (30 s vs. 30 s), but in half as many positions as in this one (4 vs. 8). In contrast, in the DYN condition they did 3 sets of 10 repetitions without indicating the total duration time (Pinto et al., 2014). Interestingly, despite the methodological differences between the two studies, the significant increases in RSI coincided in the CON vs. DYN and STA vs. DYN. According to Stewart et al. (2003)

and Werstein and Lund (2012), the improvement of RSI could be due to the increase in conduction velocity and activation of the muscle fibres involved in the jumping action (Lopez-Samanes et al., 2021), as a consequence of the increase in muscle temperature caused by the dynamic activity. Interestingly, this hypothesis put forward by numerous investigations (Kirmizigil et al., 2014; Lin et al., 2020; Merino-Marban et al., 2021; Werstein & Lund, 2012) partially coincides with our results although the RSI is lower in the work of Werstein and Lund (2012) relative to the present (10.70 vs. 22.70%) in CON vs. DYN, since in this study no displacement was performed in the DYN condition (Wilczyńskiet al., 2021) and the activation time was shorter (10 vs. 5 minutes) (Lopez-Samanes et al., 2021) and would be more in line with Young's (1995) theory. This hypothesis is based on the interaction of the internal contractile and non-contractile structures of skeletal muscle in the stretch-shortening cycle (Turner & Jeffreys, 2010), which could be slowed down by the action of prolonged (≥ 30 s) muscle elongation (Takeuchi et al., 2021; Warneke et al., 2022). However, research by Montalvo and Dorgo (2019) and Warneke et al. (2022) registered no significant improvement in the RSI variable. This difference in results with the work of Montalvo and Dorgo (2019) could be due in the first place to the difference in the type of jump (in depth from a height of 30 cm vs. CMJ) (Ruffieux et al., 2020), to the lower number of CMJ compared to the present (2 vs. 5) (He et al., 2022) and to the performance of the jumps after the warm-up in a time of 3-5 minutes, much longer than ours (<1 minute) (Tsurubami et al., 2020). Since the total number of exercises targeting the lower limbs and the time spent on muscle stretching for each condition (STA and DYN) would be identical. In this regard, the research by Warneke et al. (2022) also had some methodological differences compared to this one, such as doing the stretching exercises on the plantar flexors and extensors and not on the rest of the muscle groups of the lower limbs. Since the number of jumps was the same, 1-minute pauses were incorporated between each attempt that could have conditioned the RSI result (He et al., 2022).

With regard to the variable CT, a significant increase in the STA condition was recorded in this study compared to CON and DYN. These results differ from those obtained by Werstein and Lund (2012), in which no differences were obtained in any condition, possibly justified by the relationship with the previous methodological differences provided in the RSI variable. This statement could be justified by the fact that CT is a component of RSI and the negative influence of STA condition with CMJ performance (Takeuchi et al., 2021; Warneke et al., 2022). Likewise, Young and Behm (2003) supported the rationale put forward by Werstein and Lund (2012), showing no differences in the CT score in any condition, although they had some distinctions such as jumping in depth (30 cm), activation performed by running and not walking and fewer muscle stretching exercises than in the present work (4 vs. 8). In line with our result, Lima et al. (2018) obtained significant decreases in CT with the STA condition compared to CON (8.55% vs. 10.97%), using the same static stretching time (30 s), number of CMJs, but with fewer positions (6 vs. 8).

Another variable related to CMJ and associated with multiple investigations comparing CON, STA and DYN conditions is HGT. Our results have shown significant increases in DYN compared to the rest (CON and STA). In this regard, the work of Montalvo and Dorgo (2019) also found significant improvements with HGT in DYN vs. STA (8.24%) lower than ours (11.08%). Despite some methodological differences, such as a reduced number of CMJs (2 vs. 5), which could lead to this difference in results between studies (He et al., 2022). Regarding the differences between CON and STA, our results do not coincide with those shown by Pinto et al. (2014). Specifically, because they found no difference between CON and STA with an elongation of 30 s, as it was established in the STA condition with a stretching time of 60 s, showing a reduction of -3.40%. This is in contrast to our research, which recorded increases of 5.80% in the STA condition vs. CON. The reduction in HGT between STA 60 s vs. CON was -3.40%, taking into account that in the study by Pinto et al. (2014) made fewer CMJs compared to ours (3 vs. 5); in addition, 10 s were recovered between each CMJ, fewer exercises were performed (4 vs. 8) and a different warm-up in the CMJ (5 minutes seated vs. 5 minutes walking). The performance of a lower number of CMJs and interspersed pauses could be one of the factors causing the difference in results between studies (He et al., 2022), together with the static activation procedure that could impair subsequent performance in the CMJ (Tsurubami et al., 2020), by not achieving an optimal temperature for muscle contraction (Lopez-Samanes et al., 2021).

In this regard, the results of Yildiz et al. (2020) also found improvements in HGT between CON vs. STA different from ours (10.38% vs. -5.80%). Although these studies showed procedural differences compared to this one, such as higher activation before the intervention (5 minutes of running plus 2 minutes of walking vs. 5 minutes), less stretching exercises (5 vs. 8) and number of CMJ (3 vs. 5 The causes of lower HGT in the CON condition vs. STA of our work could be due to the superior CT of the STA condition vs. CON needed to achieve more HGT (Takeuchi et al., 2021; Warneke et al., 2022), since the levels of the variable CT in the two conditions (STA and CON) are identical. In line with our results, the present study follows in many methodological aspects Taylor et al. (2009), such as the same exercises (8), the duration of stretching (30 s) and the total time in the STA condition. Despite some differences, such as pre-activation with a 300 m run at an underwater intensity and different and more numerous stretches in the DYN treatment (16 vs. 8). In addition to running or jogging for 20-30 m, use a time similar to the present time (15 vs. 14 minutes), without specifying the elongation-relaxation

time and only performing 1 CMJ, as the work of Taylor et al. (2009) found lower results than ours between STA vs. DYN (4.20% vs. 11.08%). The causes of these differences could be due to the submaximal running activation prior to the CMJ (Tsurubami et al., 2020), the higher number of exercises in the DYN treatment (Young & Behm, 2003), or the single CMJ performed (He et al., 2022).

Consequently, the results of the present work have shown improvements in the variables that determine performance in the CMJ in the DYN condition, compared to the rest (STA and CON). In this sense, one of the reasons that could explain this positive influence of DYN treatment without displacement in comparison with the rest of the studies consulted would be the stretch theory of Turner and Jeffreys (2010), in which the maintenance of elongation of a muscle structure momentarily delays the effectiveness of the subsequent contraction, caused by the movement of the cross-bridges away from the sarcomere (Turner & Jeffreys, 2010). Related to this theory, Ettema et al. (1992) proposed the hypothesis of inhibition of muscle spindles and reduction of the contractile properties of muscle tissue as a consequence of the locking reflex of these structures (Ettema et al., 1992). However, it is not possible to conclude the theory responsible for the improvement of CMJ in the DYN condition, although in the other conditions it could be stated that a muscle elongation of ≥ 30 s or its absence decreases the performance in the CMJ test.

Conclusion

From the results obtained, it can be concluded that an acute programme of dynamic stretching appears to produce beneficial effects on countermovement jumping (CMJ) compared to no stretching or a 30 s maintenance of muscle elongation. This improvement occurred in all the variables analysed and showed significant differences. Thus, in the RSI variable, the DYN condition showed significant increases that were a representative value of the reactive jumping ability coupled with contact time (CT), which was significantly lower, and jump height, which was significantly higher in DYN. According to the literature consulted, it is the set of the above variables that provides valuable information on the reactive capacity of the lower limbs in countermovement jumping.

Acknowledgement

The authors would like to thank all the participants in the study and the Physical Education teacher of IES Haygón, Paco Carlos, for his altruistic help in recruiting the participants and controlling the procedure and any other needs that might arise.

References

Ayala, F., Sainz de Baranda, P., & Cejudo, A. (2012). El entrenamiento de la flexibilidad: técnicas de estiramiento. *Revista Andaluza de Medicina del Deporte*, *5*(3), 105–112. https://www.elsevier.es/es-revista-revista-andaluza-medicina-del-deporte-284-articulo-el-entrenamiento-flexibilidad-tecnicas-estiramiento-X1888754612647166

Becerra Fernández, C. A., Mayorga Vega, D., & Merino Marban, R. (2020). Effect of Physical Education-based stretching programs on hamstring extensibility in high school students: A systematic review. *Cultura_Ciencia_Deporte [CCD]*, *15*(43), 63–73.

Blazevich, A. J., Gill, N. D., Kvorning, T., Kay, A. D., Goh, A. G., Hilton, B., Drinkwater, E. J., & Behm, D. G. (2018). No Effect of Muscle Stretching within a Full, Dynamic Warm-up on Athletic Performance. *Medicine and Science in Sports and Exercise*, *50*(6), 1258–1266. https://doi.org/10.1249/MSS.0000000000001539

Castañer, M., & Camerino, O. (2022). *Enfoque Dinámico e Integrado de la Motricidad (EDIM).* Colección Motriu Actual. INEFC-UdL.

De Blas, X., & González-Gómez, J. (2005). Proyecto Chronojump: Sistema de Medida de la Capacidad de Salto usando Software y Hardware Libres. *Actas I Congreso de Tecnologías del Software Libre*, *223*.

Donti, O., Tsolakis, C., & Bogdanis, G. C. (2014). Effects of baseline levels of flexibility and vertical jump ability on performance following different volumes of static stretching and potentiating exercises in elite gymnasts. *Journal of Sports Science & Medicine*, *13*(1), 105–113.

Ettema, G. J. C., Huijing, P. A., & De Haan, A. (1992). The Potentiating Effect of Prestretch on the Contractile Performance of Rat Gastrocnemius Medialis Muscle During Subsequent Shortening and Isometric Contractions. *Journal of Experimental Biology*, *165*(1), 121–136. https://doi.org/10.1242/jeb.165.1.121

Flanagan, E. P., & Comyns, T. M. (2008). The Use of Contact Time and the Reactive Strength Index to Optimize Fast Stretch-Shortening Cycle Training. *Strength & Conditioning Journal*, *30*(5). https://journals.lww.com/nsca-scj/Fulltext/2008/10000/The_Use_of_Contact_Time_and_the_Reactive_Strength.5.aspx

He, L., Li, Y.-G., Wu, C., Yao, S., Su, Y., Ma, G.-D., & Wang, I.-L. (2022). The Influence of Repeated Drop Jump Training on Countermovement Jump Performance. *Applied Bionics and Biomechanics*, *2022*, 9609588. https://doi.org/10.1155/2022/9609588

Jiménez-Parra, J. F., Manzano-Sánchez, D., Camerino, O., Castañer, M., & Valero-Valenzuela, A. (2022). Enhancing Physical Activity in the Classroom with Active Breaks: A Mixed Methods Study. *Apunts Educación Física y Deportes*, *147*, 84–94. https://doi.org/10.5672/apunts.2014-0983.es.(2022/1).147.09

Kirmizigil, B., Ozcaldiran, B., & Colakoglu, M. (2014). Effects of three different stretching techniques on vertical jumping performance. *Journal of Strength and Conditioning Research*, *28*(5), 1263–1271. https://doi.org/10.1519/JSC.0000000000000268

Lima, C. D., Brown, L. E., Ruas, C. V, & Behm, D. G. (2018). Effects of Static Versus Ballistic Stretching on Hamstring: Quadriceps Strength Ratio and Jump Performance in Ballet Dancers and Resistance Trained Women. *Journal of Dance Medicine & Science: Official Publication of the International Association for Dance Medicine & Science*, *22*(3), 160–167. https://doi.org/10.12678/1089-313X.22.3.160

Lin, W.-C., Lee, C.-L., & Chang, N.-J. (2020). Acute Effects of Dynamic Stretching Followed by Vibration Foam Rolling on Sports Performance of Badminton Athletes. *Journal of Sports Science & Medicine*, *19*(2), 420–428.

Lopez-Samanes, A., Del Coso, J., Hernández-Davó, J. L., Moreno-Pérez, D., Romero-Rodriguez, D., Madruga-Parera, M., Muñoz, A., & Moreno-Pérez, V. (2021). Acute effects of dynamic versus foam rolling warm-up strategies on physical performance in elite tennis players. *Biology of Sport*, *38*(4), 595–601. https://doi.org/10.5114/biolsport.2021.101604

Markovic, G., Dizdar, D., Jukic, I., & Cardinale, M. (2004). Reliability and factorial validity of squat and countermovement jump tests. *Journal of Strength and Conditioning Research*, *18*(3), 551–555. https://doi.org/10.1519/1533-4287(2004)18<551:RAFVOS>2.0.CO;2

McBride, J. M., McCaulley, G. O., & Cormie, P. (2008). Influence of Preactivity and Eccentric Muscle Activity on Concentric Performance during Vertical Jumping. *The Journal of Strength & Conditioning Research*, *22*(3). https://journals.lww.com/nsca-jscr/Fulltext/2008/05000/Influence_of_Preactivity_and_Eccentric_Muscle.15.aspx

Merino-Marban, R., Fuentes, V., Torres, M., & Mayorga-Vega, D. (2021). Acute effect of a static- and dynamic-based stretching warm-up on standing long jump performance in primary schoolchildren. *Biology of Sport*, *38*(3), 333–339. https://doi.org/10.5114/biolsport.2021.99703

Monguillot Hernando, M., González Arévalo, C., Zurita Mon, C., Almirall Batet, L., & Guitert Catasús, M. (2015). Play the Game: gamification and healthy habits in physical education. *Apunts Educación Física y Deportes*, *119*, 71–79. https://doi.org/10.5672/apunts.2014-0983.es.(2015/1).119.04

Montalvo, S., & Dorgo, S. (2019). The effect of different stretching protocols on vertical jump measures in college age gymnasts. *The Journal of Sports Medicine and Physical Fitness*, *59*(12), 1956–1962. https://doi.org/10.23736/S0022-4707.19.09561-6

Morales-Artacho, A. J., Padial, P., García-Ramos, A., Pérez-Castilla, A., Argüelles-Cienfuegos, J., De la Fuente, B., & Feriche, B. (2018). Intermittent Resistance Training at Moderate Altitude: Effects on the Force-Velocity Relationship, Isometric Strength and Muscle Architecture. *Frontiers in Physiology*, *9*, 594. https://doi.org/10.3389/fphys.2018.00594

Pinto, M. D., Wilhelm, E. N., Tricoli, V., Pinto, R. S., & Blazevich, A. J. (2014). Differential effects of 30- vs. 60-second static muscle stretching on vertical jump performance. *Journal of Strength and Conditioning Research*, *28*(12), 3440–3446. https://doi.org/10.1519/JSC.0000000000000569

Porta, J. (1987). El desarrollo de las capacidades físicas. La flexibilidad. *Apunts Educación Física y Deportes*, *07*(08), 10–19.

Reid, J. C., Greene, R., Young, J. D., Hodgson, D. D., Blazevich, A. J., & Behm, D. G. (2018). The effects of different durations of static stretching within a comprehensive warm-up on voluntary and evoked contractile properties. *European Journal of Applied Physiology*, *118*(7), 1427–1445. https://doi.org/10.1007/s00421-018-3874-3

Ruffieux, J., Wälchli, M., Kim, K.-M., & Taube, W. (2020). Countermovement Jump Training Is More Effective Than Drop Jump Training in Enhancing Jump Height in Non-professional Female Volleyball Players. *Frontiers in Physiology*, *11*, 231. https://doi.org/10.3389/fphys.2020.00231

Samson, M., Button, D. C., Chaouachi, A., & Behm, D. G. (2012). Effects of dynamic and static stretching within general and activity specific warm-up protocols. *Journal of Sports Science & Medicine*, *11*(2), 279–285.

Serrano-Ramon, J., Cortell-Tormo, J., Bautista, I., García Jaén, M., & Chulvi-Medrano, I. (2023). Acute effects of different external compression with blood flow restriction on force-velocity profile during squat and bench press exercises. *Biology of Sport*, *40*(1), 209–216. https://doi.org/10.5114/biolsport.2023.112093

Stewart, D., Macaluso, A., & De Vito, G. (2003). The effect of an active warm-up on surface EMG and muscle performance in healthy humans. *European Journal of Applied Physiology*, *89*(6), 509–513. https://doi.org/10.1007/s00421-003-0798-2

Takeuchi, K., Akizuki, K., & Nakamura, M. (2021). Time course of changes in the range of motion and muscle-tendon unit stiffness of the hamstrings after two different intensities of static stretching. *PloS One*, *16*(9), e0257367. https://doi.org/10.1371/journal.pone.0257367

Taylor, K.-L., Sheppard, J. M., Lee, H., & Plummer, N. (2009). Negative effect of static stretching restored when combined with a sport specific warm-up component. *Journal of Science and Medicine in Sport*, *12*(6), 657–661. https://doi.org/10.1016/j.jsams.2008.04.004

Toumi, H., Best, T. M., Martin, A., & Poumarat, G. (2004). Muscle plasticity after weight and combined (weight + jump) training. *Medicine and Science in Sports and Exercise*, *36*(9), 1580–1588. https://doi.org/10.1249/01.mss.0000139896.73157.21

Tsurubami, R., Oba, K., Samukawa, M., Takizawa, K., Chiba, I., Yamanaka, M., & Tohyama, H. (2020). Warm-Up Intensity and Time Course Effects on Jump Performance. *Journal of Sports Science & Medicine*, *19*(4), 714–720.

Turner, A. N., & Jeffreys, I. (2010). The Stretch-Shortening Cycle: Proposed Mechanisms and Methods for Enhancement. *Strength & Conditioning Journal*, *32*(4). https://journals.lww.com/nsca-scj/Fulltext/2010/08000/The_Stretch_Shortening_Cycle__Proposed_Mechanisms.10.aspx

Warneke, K., Konrad, A., Keiner, M., Zech, A., Nakamura, M., Hillebrecht, M., & Behm, D. G. (2022). Using Daily Stretching to Counteract Performance Decreases as a Result of Reduced Physical Activity-A Controlled Trial. *International Journal of Environmental Research and Public Health*, *19*(23). https://doi.org/10.3390/ijerph192315571

Werstein, K. M., & Lund, R. J. (2012). The effects of two stretching protocols on the reactive strength index in female soccer and rugby players. *Journal of Strength and Conditioning Research*, *26*(6), 1564–1567. https://doi.org/10.1519/JSC.0b013e318231ac09

Wilczyński, B., Hinca, J., Ślęzak, D., & Zorena, K. (2021). The Relationship between Dynamic Balance and Jumping Tests among Adolescent Amateur Rugby Players. A Preliminary Study. *International Journal of Environmental Research and Public Health*, *18*(1). https://doi.org/10.3390/ijerph18010312

World Medical Association. (2022). *WMA Declaration Of Helsinki – Ethical Principles For Medical Research Involving Human Subjects*. 6th September. https://www.wma.net/policies-post/wma-declaration-of-helsinki-ethical-principles-for-medical-research-involving-human-subjects/

Yildiz, S., Gelen, E., Çilli, M., Karaca, H., Kayihan, G., Ozkan, A., & Sayaca, C. (2020). Acute effects of static stretching and massage on flexibility and jumping performance. *Journal of Musculoskeletal & Neuronal Interactions*, *20*(4), 498–504.

Young, W. (1995). Laboratory strength assessment of athletes. *New Studies in Athletics*, *10*, 89.

Young, W. B., & Behm, D. G. (2003). Effects of running, static stretching and practice jumps on explosive force production and jumping performance. *The Journal of Sports Medicine and Physical Fitness*, *43*(1), 21–27.

Conflict of Interests: No conflict of interest was reported by the authors.

apunts EDUCACIÓN FÍSICA Y DEPORTES

ISSUE 156

Published: April 1, 2024
https://doi.org/10.5672/apunts.2014-0983.es.(2024/2).156.06

OPEN ACCESS

Novelty, emotions and intention to be physically active in Physical Education students

Sebastián Fierro-Suero[1*], David González-Cutre[2], Luis Murta[3], Bartolomé J. Almagro[1] & Pedro Sáenz-López[1]

[1] Faculty of Education, Psychology and Sport Sciences, University of Huelva (Spain).
[2] Department of Sports Sciences, Sports Research Centre, Miguel Hernández University of Elche (Spain).
[3] Departamento de Artes, Humanidades e Desporto, Instituto Politécnico de Beja (Portugal). Quality of Life Research Center (CIEQV), Santarém (Portugal).

Cite this article
Fierro-Suero, S., González-Cutre, D., Murta, L., Almagro, B.J. & Sáenz-López, P. (2024). Novelty, emotions and intention to be physically active in Physical Education students. *Apunts Educación Física y Deportes, 156*, 47-56. https://doi.org/10.5672/apunts.2014-0983.es.(2024/2).156.06

Editor:
© Generalitat de Catalunya
Departament de la Presidència
Institut Nacional d'Educació Física de Catalunya (INEFC)

ISSN: 2014-0983

***Corresponding author:**
Sebastián Fierro-Suero
fierro.suero@ddi.uhu.es

Section:
Physical Education

Original language:
Spanish

Received:
July 14, 2023
Accepted:
November 21, 2023
Published:
April 1, 2024

Front cover:
Mountain biker enjoying nature and open air.
© Adobe Stock. Delcio F/ peopleimages.com

Abstract

In recent years, the importance of students' emotions in Physical Education classes has been highlighted. Novelty has also recently been proposed as a candidate for basic psychological need. To date, no study has specifically focused on analysing the relationships between these two constructs, which is the main objective of this paper. For this purpose, a structural equation model was tested with 799 Physical Education students with a mean age of 13.16 years (*SD* = 1.17). The results showed that students' perception of their teachers' novelty support strategies predicted the satisfaction of this need (ß = .81; $p < .01$). In turn, novelty satisfaction positively predicted positive emotions and negatively predicted negative emotions, with the explained variances of enjoyment (52%), pride (41%), and boredom (37%) standing out. Finally, the emotions enjoyment (ß = .45; $p < .01$) and hopelessness (ß = -.16; $p < .01$) predicted intention to be physically active in the future. These results show the importance of novelty in making PE a positive emotional experience and its effect on the creation of healthy habits.

Keywords: basic psychological need, boredom, enjoyment, interpersonal style, novelty support.

Introduction

The promotion of active lifestyles is a priority goal of modern societies, as around three quarters of adolescents do not get enough physical activity (Guthold et al., 2020). In this sense, the role of schools in general and in particular Physical Education in promoting healthy lifestyles has been highlighted (Ferriz et al., 2016). Physical Education is the only period of structured, compulsory, and regular physical activity in the educational curriculum (Grao-Cruces et al., 2019). However, the number of hours devoted to this subject is limited and differs from country to country (De Meester et al., 2014). For this reason, although Physical Education provides an opportunity to directly increase hours of physical activity (Hollis et al., 2017), it is equally important to make this motor experience psychologically positive (Diloy-Peña et al., 2021) in order to encourage students to engage in extracurricular physical activity (Castillo et al., 2020; Fierro-Suero et al., 2022). At a psychological level, students' motivation towards Physical Education has been one of the main constructs studied (Vasconcellos et al., 2020). Recently, as a complement to the study of motivation, several research studies have been initiated focusing on students' emotions (e.g., Fierro-Suero et al., 2021; Niubò-Solé et al, 2022; Simonton & Garn, 2018, 2020), as this construct also conditions the experience of Physical Education classes and influences relevant variables such as academic performance, the intention to engage in extracurricular physical activity, or the level of physical activity practice in leisure time (Fierro-Suero et al., 2022, 2023; Simonton & Garn, 2020).

Emotions are understood as a series of multi-component (affective, cognitive, physiological, motivational, and expressive-behavioural) changes in an organism's psychophysical system that occur in response to important situations (Scherer & Moors, 2019). The Control-Value Theory of Achievement Emotions (CVTAE; Pekrun, 2006) has been the main theoretical framework used in general for research in education (e.g., Camacho-Morles et al., 2021; Pekrun et al., 2017) and in Physical Education in particular (Fierro-Suero et al., 2023; Simonton & Garn, 2018, 2020). This theory categorises emotions in the academic field from a cognitive-social perspective, establishing a sequential model in which there is feedback between different phases such as the learning environment generated, the appraisals of value and control made by students, the emotions of achievement experienced and, finally, the consequences related to these emotions.

Students make evaluations about their surroundings, either consciously or unconsciously, on an ongoing basis (Pekrun & Stephens, 2010). These regulatory processes are associated with people's basic psychological needs (Deci & Ryan, 2000) and to some extent act as mediators between learning environments and experienced emotions (Pekrun et al., 2006). As a result, the CVTAE proposes a categorisation of emotions based on three main criteria: valence (positive or negative), level of activation (activating or deactivating), and object focus (process-task focused or outcome focused). The most researched emotions in Physical Education have been enjoyment, pride, boredom, hopelessness, anxiety, and anger. In this sense, enjoyment is a positive, activating, task-focused emotion that arises when attractive and creative challenges are solved; pride is a positive, activating, outcome-focused emotion that arises when the learner feels an important part of a success; boredom is a negative, deactivating, activity-focused emotion that arises when the proposed tasks lack value for the learner or are repetitive tasks; hopelessness is a negative, deactivating, outcome-focused emotion that arises when the learner feels it is impossible to avoid failure; anxiety is a negative, activating, outcome-focused emotion, which arises when the learner places a high value on the outcome, but the situation is not entirely dependent on them and their concentration is on losing or failing; finally, anger is a negative, activating emotion, which may be task-focused when the learner feels they have the task under control but its demands are excessively high, or outcome-focused, when the learner feels that the final outcome has been decided by someone else (Pekrun, 2006; Pekrun et al., 2007; Pekrun & Stephens, 2010). For examples of how each of the emotions arise in specific situations in Physical Education classes, it is recommended to read Fierro-Suero et al. (2023).

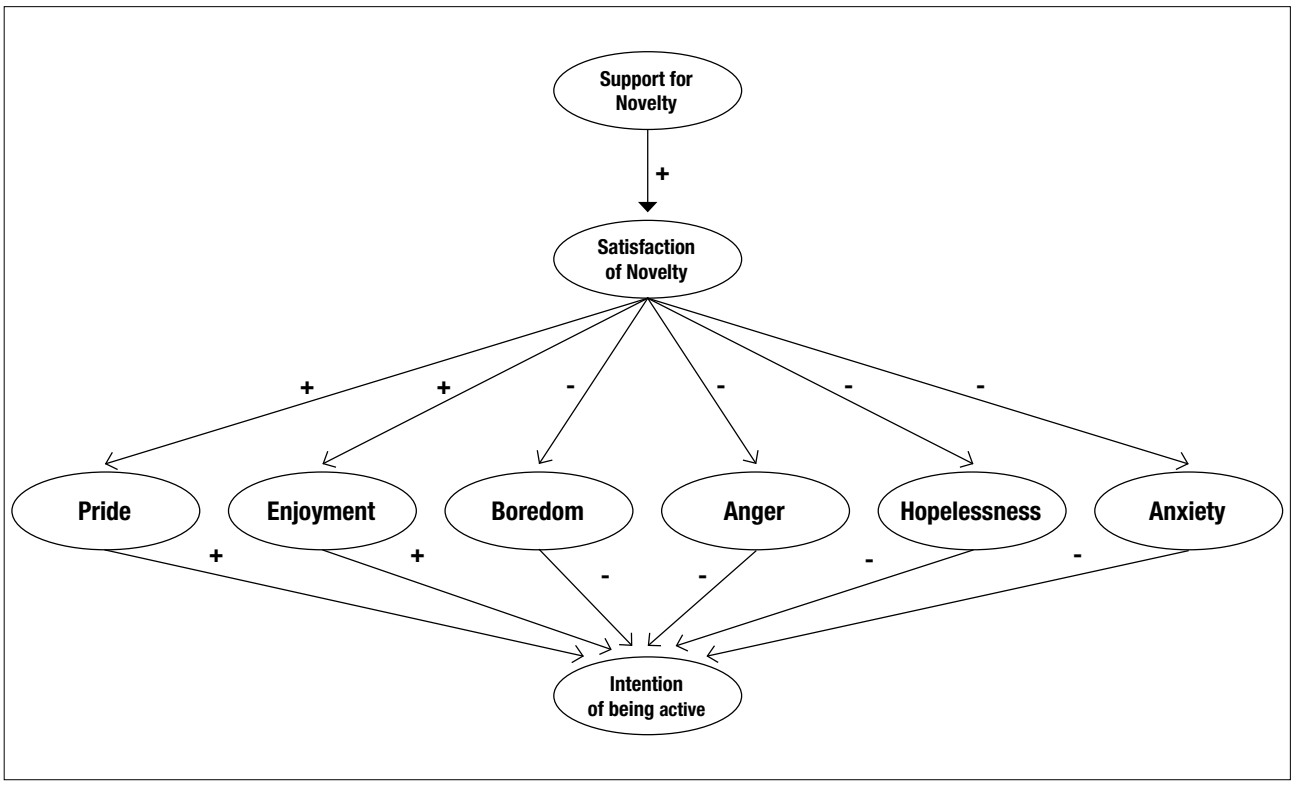
Aspects related to the learning environment that influence emotions include teachers' support for autonomy (Pekrun, 2006). This concept has often been used generically to refer to the interpersonal styles that teachers acquire when supporting students' basic psychological needs (Ryan & Deci, 2017). Self-determination theory (Deci & Ryan, 1985; Ryan & Deci, 2017) explains that people innately and universally have basic psychological needs such as autonomy, competence, and relatedness to others. Different emotions can arise from the satisfaction or frustration of these needs (Flunger et al., 2013; Ryan & Deci, 2001).

For some years now, novelty has been postulated as a candidate to be included as another basic psychological need (González-Cutre et al., 2016; Vansteenkiste et al., 2020). Novelty has been defined as the need to experience something not experienced before or different from what is experienced in the daily routine (González-Cutre et al., 2016). In other words, Physical Education teachers establish styles that support novelty when they propose activities that are not usual for students, address alternative contents

to the traditional ones, use different materials, or establish innovative methodologies (Fierro-Suero et al., 2020c). So far, studies have shown that novelty satisfaction is related to positive consequences in Physical Education classes such as well-being, enjoyment, intrinsic motivation, or the intention to practise extracurricular physical activity (Aibar et al., 2021; Fernández-Espínola et al., 2020; González-Cutre et al., 2020; González-Cutre & Sicilia, 2019), while novelty frustration is associated with negative consequences such as amotivation, boredom, or loss of concentration (González-Cutre et al., 2023). These studies have contributed evidence to the criteria established by Ryan and Deci (2017) for the analysis of new basic psychological needs, while showing that novelty in PE classes plays a role in the emotional experience of students. However, studies so far have only been able to include a few emotions in isolation (enjoyment and boredom), and only one study has been found that has covered a wide emotional range. In this study, developed by Fierro-Suero et al. (2020b) to validate the Achievement Emotions Questionnaire for Physical Education, it was found through criterion validity analysis using regression analysis that novelty satisfaction positively predicted positively valenced emotions (enjoyment and pride) and negatively predicted negatively valenced emotions (anger, hopelessness, and boredom). However, it was also found that novelty satisfaction positively predicted anxiety, an *a priori* outcome which was unexpected and should be explored further. In this sense, it was considered necessary to carry out a study in which the emotional impact of novelty in Physical Education classes is investigated more specifically, including all emotions in the same model, since in the aforementioned study the emotions were included independently in each regression analysis.

The practice of extracurricular physical activity is influenced by the prior intention to engage in it (Ajzen, 2020), with one of the fundamental aims of Physical Education being to get students active throughout their future lives as explained above. Recently, Fierro-Suero et al. (2023) have shown that the emotions experienced by students in Physical Education classes influence their intention. Based on the above, the present study tested the hypothesised structural equation model (Figure 1) in which it was expected that perceived teacher support for novelty would positively predict students' satisfaction with novelty (Fierro-Suero et al. 2020c) (H1). In turn, novelty satisfaction was expected to positively predict positively valenced emotions and negatively predict negatively valenced emotions (Fierro-Suero et al., 2020b) (H2). Finally, it was expected that positive emotions experienced by students would positively explain the intention to engage in physical activity outside school, whereas negatively valenced emotions would explain it negatively (H3) (Fierro-Suero et al., 2023).

Figure 1
Hypothesised model.



Method

Participants

A total of 799 ESO (mandatory secondary education) students (46.4% boys and 53.6% girls) aged between 11 and 17 years old participated in the study (M_{age} = 13.16; SD = 1.17). The students came from five different secondary schools in south-west Spain and were distributed among the four ESO grades as follows: 1st year ESO (n = 253), 2nd year ESO (n = 283), 3rd year ESO (n = 207), 4th year ESO (n = 56). Most of the students were of Caucasian origin and of average socio-economic status. The sample was selected on the basis of the centres that agreed to participate in the study (non-probabilistic).

Measures

The students completed a questionnaire with some socio-demographic questions and a series of scales described below. All resources were completed using a Likert-type scale where 1 was "Strongly Disagree" and 5 was "Strongly Agree".

Support for novelty

The four items referring to novelty support from the Basic Psychological Needs Support Questionnaire in Physical Education (SBPN4) (Fierro-Suero et al., 2020c) were used. The questionnaire used started with the sentence "In my P.E. classes, my teacher..." and an example item is "They often propose new activities".

Satisfaction of novelty

The five items of the Novelty Satisfaction Scale (González-Cutre & Sicilia, 2019; González-Cutre et al., 2016) were used. The scale starts with the sentence "In my PE classes..." and an example of the items is "I feel that I do new things".

Emotions in Physical Education

The Achievement Emotions Questionnaire for Physical Education (AEQ-PE) (Fierro-Suero et al., 2020b) was used. This questionnaire, consisting of a total of 24 items, measures six different emotions such as enjoyment (e.g., "I enjoy being in P.E. classes"), pride (e.g., "I take pride in being able to keep up with the pace of PE class"), boredom (e.g., "I'm looking forward to the end of PE class because it's so boring"), anxiety (e.g., "I worry about the difficulty of the things I might be asked to do in PE class"), anger (e.g., "I get irritated at the thought of all the useless things I have to learn in PE"), and hopelessness (e.g., "I have lost all hope of doing PE activities effectively").

Intention to be physically active

The Spanish version (Moreno et al., 2007) of the Physically Active Intention Scale (Hein et al., 2004) was used. The scale is composed of five items (e.g., "I am interested in the development of my physical condition"). The scale begins with the pre-sentence "Regarding your intention to practice any physical-sports activity...".

Procedure

The present study was conducted in accordance with the ethical principles established by the American Psychological Association (2020) and has been approved by the Andalusian Committee for Biomedical Research (TD-OCME-2018).

In order to carry out this research, we first contacted the management teams of the selected schools, informing them and requesting their collaboration in the participation of their pupils. As the students were minors, permission was requested from their legal guardians. Once all the consent forms had been collected, the data were collected by means of a written questionnaire during the second term and during school hours. During the completion of the questionnaire, a person responsible for the research was always present to remind participants that participation was anonymous and voluntary, to ensure the smooth running of the process, and to answer any questions they might have had. Students took around 10-15 minutes to complete the questionnaire.

Statistical Analysis

First, the validity and reliability of all resources were analysed through confirmatory factor analysis, Cronbach's alpha (α) and the Omega coefficient (ω). Subsequently, descriptive statistics (means and standard deviations) and bivariate correlations between the study variables were analysed. Correlations below .80 indicate the absence of multicollinearity between variables (Hair et

al., 2018). Prior to structural equation analysis, multivariate normality was tested and a Mardia coefficient of 114.99 was obtained. Given the lack of multivariate normality, the maximum likelihood method was used in conjunction with the bootstrapping procedure in the following analyses. After estimating the fit of the measurement model, the model proposed in Figure 1 was tested through structural equation analysis. The models were evaluated on the basis of the following fit indices: χ^2/df, CFI (Comparative Fit Index), TLI (Tucker-Lewis Index), RMSEA (Root Mean Square Error of Approximation) and SRMR (Standardized Root Mean Square Residual). The following values are indicators of acceptable fit indices: χ^2/df less than 5, CFI and TLI greater than .90, RMSEA and SRMR equal to or less than .08 (Hu & Bentler, 1999; Schermelleh-Engel et al., 2003). Analyses were carried out using PROCESS MACRO version 3.0 (Hayes & Coutts, 2020) for IBM SPSS Statistics version 23 and AMOS 23.0 (IBM, Armonk, NY, USA).

Results

Preliminary analysis

Table 1 shows that the different resources used showed acceptable validity and reliability values.

The descriptive results (means and standard deviations) and the results of the bivariate correlations are shown in Table 2. Correlations indicated that both support and novelty satisfaction were positively and statistically significantly related to positive valence emotions (enjoyment and pride) and intention to be physically active. In contrast, the relationship was significant and negative with negative emotions, except between support for novelty and anxiety, where there was no statistically significant relationship. The relationship between emotions and intention to be physically active was significant in all cases, being positive for positively valenced emotions and negative for negatively valenced emotions.

Table 1
Goodness-of-fit indices and reliability values of the resources used.

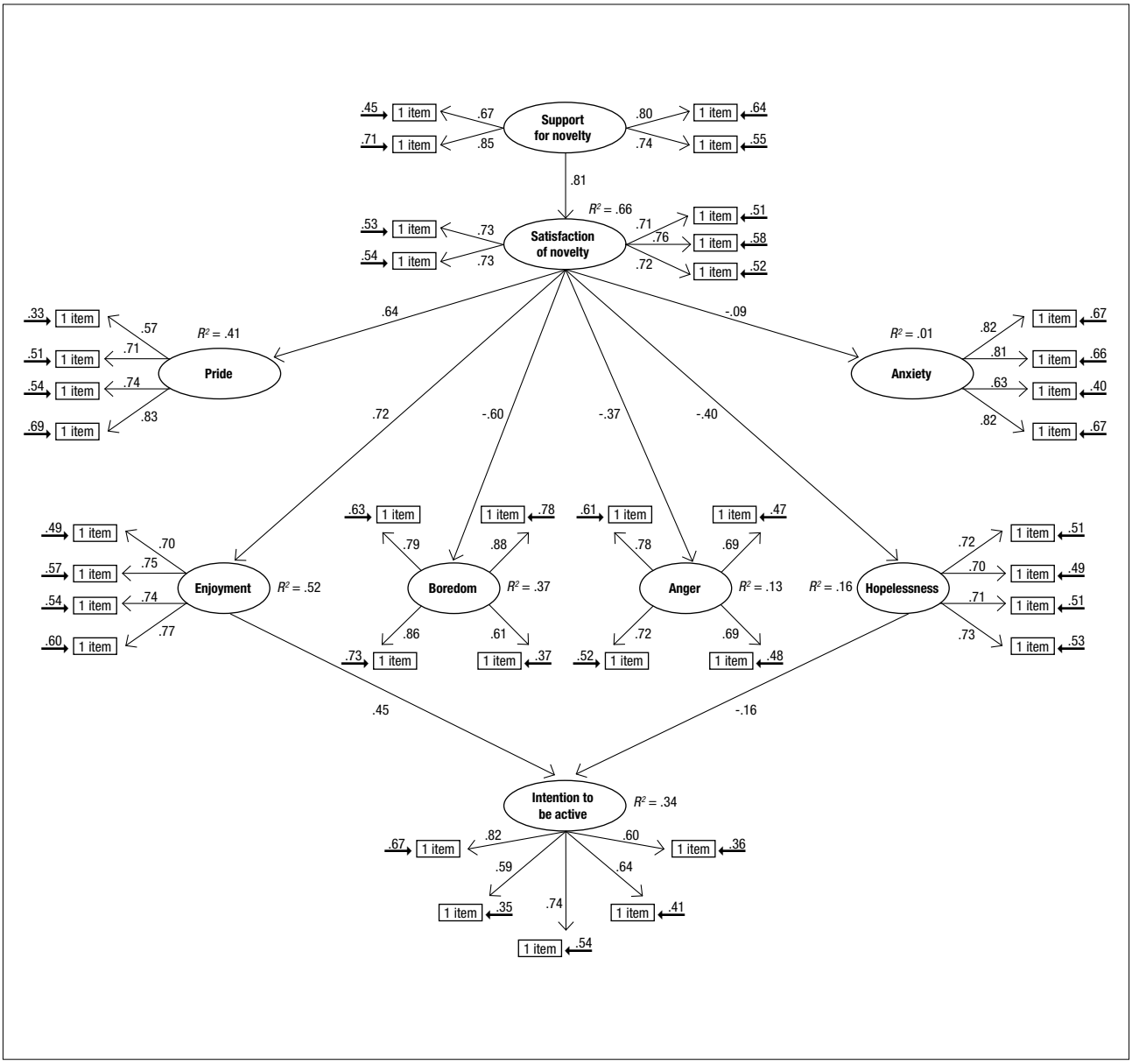
	χ2/df	CFI	TLI	RMSEA	SRMR	α	ω
Support for novelty	3.08	.99	.99	.05	.01	.85	.85
Satisfaction of novelty	2.32	.99	.99	.04	.01	.85	.86
Emotions in Physical Education	3.15	.94	.93	.05	.05	-	-
Enjoyment	-	-	-	-	-	.83	.83
Pride	-	-	-	-	-	.81	.81
Boredom	-	-	-	-	-	.82	.83
Hopelessness	-	-	-	-	-	.81	.81
Anxiety	-	-	-	-	-	.79	.80
Anger	-	-	-	-	-	.79	.79
Intention to be physically active	5.91	.99	.96	.08	.03	.79	.79

Table 2
Descriptive statistics and bivariate correlations.

	M	*SD*	1	2	*3*	4	5	6	7	8	9
1. Sup. novelty	3.56	1.03	-	.68**	.53**	.37**	–.51**	–.24**	–.04	–.28**	.24**
2. Sat. novelty	3.52	0.90		-	.60**	.52**	–.53**	–.34**	–.11**	–.31**	.29**
3. Enjoyment	4.05	0.90			-	.70**	–.68**	–.57**	–.22**	–.47**	.46**
4. Pride	4.01	0.87				-	–.50**	–.49**	–.24**	–.40**	.43**
5. Boredom	1.83	0.89					-	.48**	.21**	.55**	–.28**
6. Hopelessness	1.43	0.68						-	.45**	.50**	–.38**
7. Anxiety	1.98	0.91							-	.33**	–.16**
8. Anger	1.43	0.68								-	–.22**
9. Int. Phys. Act.	4.20	0.82									-

NB. Sup. novelty = Support for novelty; Sat. novelty = Satisfaction of novelty; Int. Phys. Act. = Intention to be physically active; *M* = Mean; *SD* = Standard deviation; ** $p < .01$.

Figure 2
Final structural equation model.



NB: All the ratios shown have a value of $p < .01$.

Structural equation modelling

The measurement model developed with the nine correlated study variables and their corresponding items yielded adequate fit indices (χ^2 (629) =1,499.44, χ^2/df = 2.38, p = .00, CFI = .94, TLI = .94, SRMR = .04, RMSEA = .04). Once the adequacy of the measurement model was checked, the hypothesised structural equation model was tested (Figure 1). Non-significant relationships between latent variables were eliminated. The final model (Figure 2) showed acceptable fit indices (χ^2 (641) = 1,558.13, χ^2/df = 2.43, p = .00, CFI = .94, TLI = .93, SRMR = .06, RMSEA = .05). This model shows how novelty support significantly predicted novelty satisfaction with 66% of the variance explained. In turn, novelty satisfaction significantly and positively predicted the emotions of pride and enjoyment, and significantly and negatively predicted the emotions of boredom, anger, hopelessness, and anxiety. The highest explained variances were found for the emotions of enjoyment (52%), pride (41%), and boredom (37%). Finally, the emotions of enjoyment and hopelessness predicted intention to be physically active with 34% of variance explained.

Discussion

In the last decade, the number of studies focusing on students' emotions in Physical Education classes has increased considerably. Some of these studies have focused on the analysis of emotions as a cause of various behaviours such as academic performance, intention to engage in extracurricular physical activity, intensity and timing of extracurricular physical activity, disruptive behaviour during classes, etc. (Fierro-Suero et al., 2023; Simonton & Garn, 2020; Zimmermann et al., 2021). Other studies have analysed possible antecedents of emotions highlighting aspects related to basic psychological needs (Fierro-Suero et al., 2020b) and teachers' interpersonal styles (Yoo, 2015; Zimmermann et al., 2021). However, although novelty has been proposed as a candidate for being a basic psychological need (González-Cutre et al., 2016, 2020; Vansteenkiste et al., 2020), the role that novelty may play from the interpersonal style of teacher support to student satisfaction and its relationship with emotions is still unknown, as none of the developed models have included it in the sequence. For this reason, the aim of this research was to test a structural equation model in which the role of novelty on students' emotions in Physical Education classes and its possible influence on the intention to be physically active was analysed.

The present study found that students' perception of teacher support for novelty predicted satisfaction of this candidate basic psychological need with high explained variance (H1). These results are in line with those of the first and only study known to have measured support for novelty in PE classes (Fierro-Suero et al., 2020c). This research found that, in addition to predicting novelty satisfaction, novelty support was able to significantly and positively predict the satisfaction of all three basic psychological needs. This result suggests that if teachers introduce novelty in their classes, for example in the activities, content, or methodologies they use, they can satisfy their students' need for novelty. Indeed, previous studies have found a positive association between pedagogical models that may be novel for learners (such as the comprehensive model or the sports education model), the satisfaction of the need for novelty, and motivational improvements (e.g., Gil-Arias et al., 2021).

Regarding the second hypothesis (H2), novelty satisfaction positively predicted the emotions of enjoyment and pride and negatively predicted the emotions of boredom, anger, hopelessness and anxiety. In this respect, the results obtained were in line with those of the study by Fierro-Suero et al. (2020b) with the caveat that they found a positive relationship between novelty satisfaction and anxiety. In the present study, when anxiety worked in synergy with the other emotions in a full model, novelty satisfaction was found to negatively predict anxiety, albeit with very low explained variance. These results are consistent with expectations, since the satisfaction of a basic psychological need should imply psychological growth, well-being and optimal functioning (Deci & Ryan, 2000). In this sense, we could interpret the satisfaction of the need for novelty as obtaining the optimal dose of novelty that each person needs (Ibáñez de Aldecoa et al., 2022), and not as an excess of novel stimuli that could generate anxiety if one does not perceive oneself as having the capacity to cope with them. However, it must be admitted that the satisfaction of the needs for autonomy, competence, and relatedness were not considered in this research, which prevents us from knowing the role played by the satisfaction of novelty beyond the satisfaction of the three basic psychological needs established by the self-determination theory.

Focusing on positive emotions, novelty satisfaction was positively associated with enjoyment and pride (H2) in line with previous work (Fierro-Suero et al., 2020b; González-Cutre et al., 2020). In this sense, novelty can make the tasks posed enhance creativity and the resolution of new problems, making them attractive and generating enjoyment in the students (Pekrun, 2006). At the same time, avoiding repetition of the same tasks by promoting new and changing situations will allow students to feel more likely to be an important part of overcoming some of the challenges posed, which will generate pride (Pekrun, 2006).

Regarding negative emotions, boredom was found to be the emotion with the highest variance explained by novelty satisfaction (H2) in line with previous studies (Fierro-Suero et al., 2020b). Monotony (Lye & Kawabata, 2021) and frustration of novelty (González-Cutre et al., 2023) have been shown to be direct predictors of boredom, which is in line with Pekrun (2006), who indicated that repetitive tasks or tasks that lack intrinsic value for learners would lead to boredom. Therefore, applying interpersonal styles that support novelty in Physical Education classes is seen as an effective strategy to reduce students' boredom.

Although to a lesser extent than boredom, novelty satisfaction also negatively predicted the emotions of anger and hopelessness (H2). These results suggest that creating novel situations in Physical Education could help to reduce students' anger when they have to repeat the same thing over and over again. Furthermore, for hopelessness to emerge in a learner, there needs to be a negative appraisal of the challenge, so that they become aware that success will be impossible (Pekrun, 2006). Thus, promoting new or different environments in Physical Education classes could make students, when faced with unfamiliar challenges, face them from a more positive point of view and without the negative prospective evaluations of facing something they already know they have failed to overcome on previous occasions, which decreases hopelessness.

Finally, regarding the relationships between positive emotions and the intention to practise extracurricular physical activity, only the effect of enjoyment was significant (H3), which shows the importance of students having fun in PE class in order for them to want to continue practising physical activity outside school. This result is in line with the work of Fierro-Suero et al. (2023), although they found that pride also played an important role in predicting this intention. Moreover, in the work cited above, it was found that these emotions had a different moderating effect on girls and boys, so it is necessary to attend to gender-specific strategies. Regarding negative emotions, hopelessness was the only emotion that negatively predicted intention to engage in physical activity outside school (H3) in line with previous studies (Fierro-Suero et al., 2023). Therefore, those students who experience hopelessness in PE classes show a refusal to engage in extracurricular physical activity. This is possibly due to the fact that their previous experience of physical activity has been so negative that their prospective evaluations of the new possibilities of extracurricular physical activity are still focused on failure and they do not feel like repeating it because it does not support their well-being.

The results of the study point to the benefits of novelty in PE classes from an emotional point of view and the creation of physically active habits. In this sense, teachers could develop unusual content such as alternative sports, new physical-expressive trends (Fierro-Suero et al., 2020c; González-Cutre et al., 2021; González-Cutre & Sicilia, 2019) or bring the different possibilities of extracurricular physical activity in the neighbourhood environment closer to Physical Education (Fierro-Suero et al., 2022). This could serve to make the first experience of such practices emotionally satisfying, as the students do not have previous negative appraisals, which will reduce their hopelessness and anxiety. Likewise, using new technologies, reconverting the traditional use of sports materials, using innovative materials and avoiding classical methodologies could be other possibilities to generate interpersonal styles that support novelty (Fierro-Suero et al., 2020c; González-Cutre et al., 2021; González-Cutre & Sicilia, 2019). These and other strategies could allow us to provide more opportunities for students to experience pride in being part of different successes, as well as to adapt tasks to be engaging challenges that generate enjoyment and avoid boredom and anger.

Despite the results obtained, the present research has a number of limitations that must be taken into account. Firstly, the study followed a correlational methodology that prevents the establishment of causal relationships. For this reason, it is necessary to carry out future intervention studies along the lines proposed. In addition, measuring students' perceptions of their teachers' novelty support could be a bias that could be avoided in the future by using other sources of information, such as self-reports by teachers or external evaluations using observation resources for this purpose (Fierro-Suero et al., 2020a). Similarly, it would be interesting to analyse in the future the role that variety (Eather et al., 2023) may play in the emotional experience of students and to see if the effects are similar to those of novelty. Another limitation of the present study is the failure to consider the gender of the students, as previous studies (e.g. Fierro-Suero et al., 2023) have highlighted the importance of gender in the relationships studied. Finally, the development of models that include the support and satisfaction of the three basic psychological needs is considered necessary to see how novelty works in synergy with these needs and to clarify the effect of each of them on students' emotions.

Conclusion

In summary, the results of this study have shown that students' perception of the strategies that their teachers develop to support novelty in PE lessons has a positive effect on the satisfaction of their need for novelty (H1). In turn, novelty satisfaction predicted positive emotions positively and negative emotions negatively (H2). Finally, only the emotions of enjoyment and hopelessness played a significant role in predicting intention to be physically active in the future (H3).

Acknowledgements

This paper has been possible thanks to the support of the University Teacher Training Programme (FPU18/04855) of the Ministry of Science, Innovation and Universities of the Spanish Government, as well as the Research and Transfer Policy Strategy of the University of Huelva.

References

Aibar, A., Abós, A., García-González, L., González-Cutre, D., & Sevil-Serrano, J. (2021). Understanding students' novelty satisfaction in Physical Education: Associations with need-supportive teaching style and physical activity intention. *European Physical Education Review*, *27*(4), 779-797. https://doi.org/10.1177/1356336X21992791

American Psychological Association. (2020). *Publication Manual of American Psychological Association* (7th ed).

Ajzen, I. (2020). The theory of planned behaviour: Frequently asked questions. *Human Behavior and Emerging Technologies, 2*(4), 314-324. https://doi.org/10.1002/hbe2.195

Camacho-Morles, J., Slemp, G. R., Pekrun, R., Loderer, K., Hou, H., & Oades, L. G. (2021). Activity achievement emotions and academic performance: A meta-analysis. *Educational Psychology Review*, *33*(3), 1051-1095. https://doi.org/10.1007/s10648-020-09585-3

Castillo, I., Molina-García, J., Estevan, I., Queralt, A., & Álvarez, O. (2020). Transformational teaching in Physical Education and students' leisure-time physical activity: The mediating role of learning climate, passion and self-determined motivation. *International Journal of Environmental Research and Public Health*, *17*, 4844. https://doi.org/10.3390/ijerph17134844

De Meester, A., Aelterman, N., Cardon, G., De Bourdeaudhuij, I., & Haerens, L. (2014). Extracurricular school-based sports as a motivating vehicle for sports participation in youth: A cross-sectional study. *International Journal of Behavioral Nutrition and Physical Activity*, *11*(1), 48. https://doi.org/10.1186/1479-5868-11-48

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behaviour*. Plenum.

Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Of behavior human needs and the self-determination. *Psychological Inquiry*, *11*(4), 227-268. https://doi.org/10.1207/S15327965PLI1104_01

Diloy-Peña, S., García-González, L., Sevil-Serrano, J., Sanz-Remacha, M., & Abós, A. (2021). Motivational teaching style in Physical Education: How does it affect students' experiences? *Apunts Educación Física y Deportes, 144*, 44-51. https://doi.org/10.5672/apunts.2014-0983.es.(2021/2).144.06

Eather, N., McLachlan, E., Sylvester, B., Beauchamp, M., Sanctuary, C., & Lubans, D. (2023). The provision and experience of variety in physical activity settings: A systematic review of quantitative and qualitative studies. *Journal of Sport & Exercise Psychology*, *45*(3), 148-165. https://doi.org/10.1123/jsep.2020-0355

Fernández-Espínola, C., Almagro, B. J., Tamayo-Fajardo, J., & Saénz-López, P. (2020). Complementing the self-determination theory with the need for novelty: motivation and intention to be physically active in Physical Education students. *Frontiers in Psychology*, *11*, 1535. https://doi.org/https://doi.org/10.3389/fpsyg.2020.01535

Ferriz, R., Gonzalez-Cutre, D., Sicilia, A., & Hagger, M. S. (2016). Predicting healthy and unhealthy behaviours through Physical Education: A self-determination theory-based longitudinal approach. *Scandinavian Journal of Medicine and Science in Sports*, *26*(5), 579-592. https://doi.org/10.1111/sms.12470

Fierro-Suero, S., Almagro, B., Castillo, I., & Sáenz-López, P. (2020a). Observational instrument for interpersonal motivational climate (OCIM) for Physical Education teachers. *Culture, Science and Sport*, *15(46)*, 575-596. https://doi.org/10.12800/ccd.v15i46.1647

Fierro-Suero, S., Almagro, B. J., & Sáenz-López, P. (2020b). Validation of the achievement emotions questionnaire for Physical Education (AEQ-PE). *International Journal of Environmental Research and Public Health*, *17*, 4560. https://doi.org/10.3390/ijerph17124560

Fierro-Suero, S., Almagro, B. J., Sáenz-López, P., & Carmona-Márquez, J. (2020c). Perceived novelty support and psychological needs satisfaction in Physical Education. *International Journal of Environmental Research and Public Health*, *17*, 4169. https://doi.org/10.3390/ijerph17114169

Fierro-Suero, S., Fernández-Ozcorta, E. J., & Sáenz-López, P. (2022). Students' motivational and emotional experiences in Physical Education across profiles of extracurricular physical activity: The influence in the intention to be active. *International Journal of Environmental Research and Public Health*, *19*, 9539. https://doi.org/10.3390/ijerph19159539

Fierro-Suero, S., Saénz-López, P., Carmona, J., & Almagro, B. (2023). Achievement emotions, intention to be physically active and academic performance in Physical Education: Gender differences. *Journal of Teaching in Physical Education*, *42*, 114-122. https://doi.org/10.1123/jtpe.2021-0230

Fierro-Suero, S., Velázquez-Ahumada, N., & Fernández-Espínola, C. (2021). The influence of the classroom climate on the student's emotions. Retos, 42, 434-442. https://doi.org/10.47197/retos.v42i0.87305

Flunger, B., Pretsch, J., Schmitt, M., & Ludwig, P. (2013). The role of explicit need strength for emotions during learning. *Learning and Individual Differences*, *23*(1), 241-248. https://doi.org/10.1016/j.lindif.2012.10.001

Gil-Arias, A., Diloy-Peña, S., Sevil-Serrano, J., García-González, L., & Abós, A. (2021). A hybrid TGfU/SE volleyball teaching unit for enhancing motivation in Physical Education: A mixed-method approach. *International Journal of Environmental Research and Public Health*, *18*(1), 110. https://doi.org/10.3390/ijerph18010110

González-Cutre, D., Brugarolas-Navarro, M., Beltrán-Carrillo, V. J., & Jiménez-Loaisa, A. (2023). The frustration of novelty and basic psychological needs as predictors of maladaptive outcomes in Physical Education. *Physical Education & Sport Pedagogy* advance online publication. https://doi.org/10.1080/17408989.2023.2167969

González-Cutre, D., Jiménez-Loaisa, A., Abós, A., & Ferriz, R. (2021). Motivational strategies to include novelty and variety in Physical Education. In L. García (Ed.), *Cómo motivar en Educación Física. Practical applications for teachers based on scientific evidence* (pp. 99-116). Prensas de la Universidad de Zaragoza. https://doi.org/10.26754/uz.978-84-18321-22-1

González-Cutre, D., Romero-Elías, M., Jiménez-Loaisa, A., Beltrán-Carrillo, V. J., & Hagger, M. S. (2020). Testing the need for novelty as a candidate need in basic psychological needs theory. *Motivation and Emotion*, *44*, 295-314. https://doi.org/10.1007/s11031-019-09812-7

González-Cutre, D., & Sicilia, A. (2019). The importance of novelty satisfaction for multiple positive outcomes in Physical Education. *European Physical Education Review*, *25*(3), 859-875. https://doi.org/10.1177/1356336X18783980

González-Cutre, D., Sicilia, A., Sierra, A. C., Ferriz, R., & Hagger, M. S. (2016). Understanding the need for novelty from the perspective of self-determination theory. *Personality and Individual Differences, 102*, 159-169.https://doi.org/10.1016/j.paid.2016.06.036

Grao-Cruces, A., Segura-Jiménez, V., Conde-Caveda, J., García-Cervantes, L., Martínez-Gómez, D., Keating, X. D., & Castro-Piñero, J. (2019). The role of school in helping children and adolescents reach the physical activity recommendations: The UP&DOWN Study. *Journal of School Health*, *89*(8), 612-618. https://doi.org/10.1111/josh.12785

Guthold, R., Stevens, G. A., Riley, L. M., & Bull, F. C. (2020). Global trends in insufficient physical activity among adolescents: a pooled analysis of 298 population-based surveys with 1-6 million participants. *The Lancet Child and Adolescent Health*, *4*(1), 23-35. https://doi.org/10.1016/S2352-4642(19)30323-2

Hair, J. F. J., Black, W. C., Babin, B. J., & Anderson, R. E. (2018). *Multivariate data analysis.* 8th Edition. Cengage Learning EMEA.

Hayes, A. F., & Coutts, J. J. (2020). Use omega rather than cronbach's alpha for estimating reliability. But.. *Communication Methods and Measures*, *14*(1), 1-24. https://doi.org/10.1080/19312458.2020.1718629

Hein, V., Müür, M., & Koka, A. (2004). Intention to be physically active after school graduation and its relationship to three types of intrinsic motivation. *European Physical Education Review*, *10*(1), 5-19. https://doi.org/10.1177/1356336x04040618

Hollis, J. L., Sutherland, R., Williams, A. J., Campbell, E., Nathan, N., Wolfenden, L., Morgan, P. J., Lubans, D. R., Gillham, K., & Wiggers, J. (2017). A systematic review and meta-analysis of moderate-to-vigorous physical activity levels in secondary school Physical Education lessons. *International Journal of Behavioral Nutrition and Physical Activity*, *14*(1), 52. https://doi.org/10.1186/s12966-017-0504-0

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, *6(1)*, 1-55. https://doi.org/10.1080/10705519909540118

Ibáñez de Aldecoa, P., Burdett, E., & Gustafsson, E. (2022). Riding the elephant in the room: Towards a revival of the optimal level of stimulation model. *Developmental Review*, *66*, 101051. https://doi.org/10.1016/j.dr.2022.101051

Lye, C. M., & Kawabata, M. (2021). Perception of boredom in Physical Education lessons: What factors are associated with students' boredom experiences? *Journal of Teaching in Physical Education*, *41*(4), 710-719. https://doi.org/10.1123/jtpe.2021-0090

Moreno, J. A., Moreno, R., & Cervelló, E. (2007). Physical self-concept as a predictor of intention to be physically active. *Psychology and Health*, *17*(2), 261-267. https://doi.org/10.25009/pys.v17i2.710

Niubò-Solé, J., Lavega-Burgués, P., & Sáenz-López, P. (2022). Emotions according to type of motor task, sports and gender experience. *Apunts Educación Física y Deportes, 148*, 26-33. https://doi.org/10.5672/apunts.2014-0983.es.(2022/2).148.04

Pekrun, R. (2006). The control-value theory of achievement emotions: Assumptions, corollaries, and implications for educational research and practice. *Educational Psychology Review*, *18*, 315-341. https://doi.org/10.1007/s10648-006-9029-9

Pekrun, R., Elliot, A., & Maier, M. (2006). Achievement goals and discrete achievement emotions: A theoretical model and prospective test. *Journal of Educational Psychology*, *98*(3), 583-597. https://doi.org/10.1037/0022-0663.98.3.583

Pekrun, R., Frenzel, A. C., Goetz, T., & Perry, R. P. (2007). The control-value theory of achievement emotions. An integrative approach to emotions in education. In P. A. Schutz & R. Pekrun (Eds.), *Emotion in Education* (pp. 13-36). Academic Press. https://doi.org/10.1016/B978-012372545-5/50003-4

Pekrun, R., Lichtenfeld, S., Marsh, H. W., Murayama, K., & Goetz, T. (2017). Achievement emotions and academic performance: Longitudinal models of reciprocal effects. *Child Development*, *88(5)*, 1653-1670. https://doi.org/10.1111/cdev.12704

Pekrun, R., & Stephens, E. J. (2010). Achievement emotions: A control-value approach. *Social and Personality Psychology Compass*, *4*(4), 238-255. https://doi.org/10.1111/j.1751-9004.2010.00259.x

Ryan, R. M., & Deci, E. L. (2017). *Self-determination theory: basic psychological needs in motivation, development, and welness*. The Guilford Press. https://doi.org/10.1521/978.14625/28806

Ryan, R. M., & Deci, E. L. (2001). On happiness and human potentials: A review of research on hedonic and eudaimonic well-being. *Annual Review of Psychology*, *52*, 141-166. https://doi.org/10.1146/annurev.psych.52.1.141

Scherer, K. R., & Moors, A. (2019). The emotion process: Event appraisal and component differentiation. *Annual Review of Psychology*, *70*, 719-745. https://doi.org/10.1146/annurev-psych-122216-011854

Schermelleh-Engel, K., Moosbrugger, H., & Müller, H. (2003). Evaluating the fit of structural equation models: Tests of significance and descriptive goodness-of-fit measures. *Methods of Psychological Research*, *8*(2), 23-74.

Simonton, K. L., & Garn, A. (2018). Exploring achievement emotions in Physical Education: The potential for the control-value theory of achievement emotions. *Quest*, *71*(4), 434-446. https://doi.org/10.1080/00336297.2018.1542321

Simonton, K. L., & Garn, A. C. (2020). Negative emotions as predictors of behavioural outcomes in middle school Physical Education. *European Physical Education Review*, *26*(4), 764-781. https://doi.org/10.1177/1356336X19879950

Vansteenkiste, M., Ryan, R. M., & Soenens, B. (2020). Basic psychological need theory: Advancements, critical themes, and future directions. *Motivation and Emotion*, *44*(1), 1-31. https://doi.org/10.1007/s11031-019-09818-1

Vasconcellos, D., Parker, P. D., Hilland, T., Cinelli, R., Owen, K. B., Kapsal, N., Lee, J., Antczak, D., Ntoumanis, N., Ryan, R. M., & Lonsdale, C. (2020). Self-determination theory applied to Physical Education: A systematic review and meta-analysis. *Journal of Educational Psychology*, *112*(7), 1444-1469. https://doi.org/10.1037/edu0000420

Yoo, J. (2015). Perceived autonomy support and behavioural engagement in Physical Education: A conditional process model of positive emotion and autonomous motivation. *Perceptual and Motor Skills*, *120*(3), 731-746. https://doi.org/10.2466/06.pms.120v20x8

Zimmermann, J., Tilga, H., Bachner, J., & Demetriou, Y. (2021). The effect of teacher autonomy support on leisure-time physical activity via cognitive appraisals and achievement emotions: A mediation analysis based on the control-value theory. *International Journal of Environmental Research and Public Health*, *18*, 3987. https://doi.org/10.3390/ijerph18083987

Conflict of Interests: No conflict of interest was reported by the authors.

apunts EDUCACIÓN FÍSICA Y DEPORTES

ISSUE 156

Published: April 1, 2024
https://doi.org/10.5672/apunts.2014-0983.es.(2024/2).156.07

OPEN ACCESS

Lower extremity muscle fibers activation in two Latin dance modalities

Encarnación Liébana[1*], Cristina Monleón[1], Carlos Barrios[1] & Consuelo Moratal[1]

[1] Catholic University of Valencia San Vicente Mártir, Valencia (Spain).

Cite this article
Liébana, E., Monleón, C., Barrios, C. & Moratal, C. (2024). Lower extremity muscle fibers activation in two Latin dance modalities. *Apunts Educación Física y Deportes, 156*, 57-65. https://doi.org/10.5672/apunts.2014-0983.es.(2024/2).156.07

Editor:
© Generalitat de Catalunya
Departament de la Presidència
Institut Nacional d'Educació Física de Catalunya (INEFC)

ISSN: 2014-0983

***Corresponding author:**
Encarnación Liébana Giménez
encarnacion.liebana@ucv.es

Section:
Physical Preparation

Original language:
English

Received:
Juny 2, 2023
Accepted:
November 21, 2023
Published:
April 1, 2024

Front cover:
Mountain biker enjoying nature and open air.
© Adobe Stock. Delcio F/ peopleimages.com

Abstract

The main purpose of this study was to investigate the muscle activity of different types of muscle fibers between Rumba and Jive dancing styles in eighteen elite DanceSport athletes (mean age: 19.6 ± 3.2 years). Measurements were carried out using surface electromyography (EMG) during performance of the choreography. EMG was recorded in both legs from rectus femoris (RF), biceps femoris (BF), tibialis anterior (TA), and gastrocnemius medialis (GM) and analyzed. In Rumba, the whole activation of RF (median, 115.95; IQR, 36.00 mV) was lower as compared to BF (median, 146.68; IQR, 10.02 mV; p = .002) and to GM (median, 149.81; IQR, 85.66 mV; p = .035). In Jive, the highest global activation corresponded to the BF (median, 155.40; IQR, 44.89 mV), and differences were statistically significant as compared to the TA activation (median, 123.09; IQR, 51.24 mV; p = .028). Significant differences were found between the Rumba and Jive in RF type I fibers ($p \leq .05$), TA type IIa fibers ($p \leq .05$); and GM type IIb fibers ($p \leq .05$) in both male and females. In male dancers, there were differences GM type IIb fibers ($p \leq .05$) and TA type I fibers in females ($p \leq .05$). This study shows experimental evidence of significantly different muscular activation for the lower limb in dances with different tempo. The results of this study provide relevant information for optimizing high-performance training and injury prevention programs, which are key to the success of DanceSport careers.

Keywords: DanceSport, electromyography, fiber types, muscle activation, skeletal muscles.

Introduction

DanceSport is a combination of art, sport and sporting performance. It is performed by couples, allowing them to express emotions and form harmonious movements in response to different types of music (Lukić et al., 2011; Riding et al., 2013; Uzunović et al., 2009; Uzunović & Kostić, 2005).

This sport is made up of three specialities: Latin, standard and "10 dances", the latter being a combination of Standard and Latin dances (WDSF, 2017). Latin dances are mainly characterized by open or semi-open and closed figures, which require a visual connection (Čačković et al., 2012). Dances conforming to the Latin speciality are: the Samba, with a tempo of 50–52 beats per minute (bpm); Cha-cha-cha, with a tempo of 30–32 bpm; Rumba, with a tempo of 25–27 bpm; Pasodoble, with a tempo of 60–62 bpm, and the Jive, with a tempo of 42–44 bpm (FEBD, 2017).

The Rumba is a dance involving highly expressive body rhythm, in which attractive and delicate movements are represented. The fluidity and rhythm of movement in dancers' back muscles and hip action is of great importance (Shang, 2013). In this way, the hips naturally draw a trajectory of movement in an inverted "8" controlled by dancers (Shang, 2013).

The Jive is the most explosive Latin dance and generates a higher heart rate (Bria et al., 2011; Liiv et al., 2014). The basic characteristics of the Jive are a balance between "SWINGy" and "JUMPy", two basic principles that help overall performance of the dance (Dance Comp Review, 2014).

The "SWINGy" is present in each of the steps carried out in the Jive. The body tilts forwards causing lateral displacement by means of hip movement and stays upright during front or back steps. Foot support is mainly achieved by support from the first and second metatarsals (Dance Comp Review, 2014).

In the "JUMPy", the main action is knee flexion while at the same time the abdomen contraction is made, which results in a small jump. This is composed of four phases: step, jump, flight and landing. In the first phase, the step is performed with a small knee flexion, leading to the next phase when extension of the knee is performed, producing the impulse for a jump. This moves into the flight phase and later into the landing, where most support is provided by the first metatarsals with a slight bend of the knees to absorb the impact (Dance Comp Review, 2014).

Surface electromyography is a common, non-invasive technique for analyzing muscle contractions for real-world application (Hermens & Freriks, 1997; Liu et al., 2002). In humans, fast and slow fibers are not physically separated, but evolution has in some way maintained the separation of different types of fibers. Motor units of human muscle are typically categorized into three different groups commonly referred to as slow oxidative or type I (TI); fast oxidative or type IIa (TIIa); and fast glycolytic or type IIb (TIIb) (Von Tscharner & Goepfert, 2006; Brooke & Kaiser, 1970). These groups can be recruited in different proportions for different periods of a movement and can explain at least part of the spectral variability (Von Tscharner & Goepfert, 2003; Wakeling et al., 2001). To analyze data obtained with surface electromyography in variable muscle contractions, techniques have been adopted in time frequency measurements (Kumar et al., 2003). Continuous wavelet transformation (comparison of different frequency techniques over time) produces accurate results with a good representation of time and frequency location (Karlsson et al., 2000).

Scarce evidence exists on DanceSport and, in particularly, on muscle-activity of dancers. Zagorc et al. (2010) used tensiomyography to study the contraction time of DanceSport athletes and observed that the contraction time in muscles like the gastrocnemius varied between genres. Liébana et al. (2017) analyzed EMGs in DanceSport athletes performing the Rumba bolero and observed differences. In this way, found activation differences in women's Rectus Femoris (RF) and Gastrocnemius Medial (GM) muscles associated with the Rumba bolero, as well as in Tibial Anterior (TA) and GM muscles as well as differences between rhythms of various dance genres (Haeufle et al., 2010).

To understand how the complex musculoskeletal system can generate adequate leg strength, knowledge of intrinsic muscle properties is necessary (Haeufle et al., 2010). Therefore, the purpose of our study was to evaluate muscle-activity of the three types of muscle fibers of RF, BF, TA and GM of dancers, comparing the Rumba with the Jive in male and female to stablish specific workouts for these athletes. Expected results would indicate significant differences in activation of the three types of muscle fibers analyzed RF, BF, TA and GM (in both legs, dominant and non-dominant) in the lower limbs of dancers, comparing the Rumba with the Jive and between genders.

Materials and Methods

Participants

Participants consisted of 18 DanceSport athletes (nine couples). They are all category A dancers (the top category) with 10.44 ± 3.51 years of dance experience and who are specialists in "10 dances" or Latin dances (see table 2).

The inclusion criteria stipulated that participants had to be active during the study and over eighteen years old and conform to the 10 dances or Latin modality; participants needed to have been injury-free during the previous year and to have been dancing in category A for at least a year with the same partner. Six dance schools were contacted, which might be interested in participating in the assessments. Out of a total of 10 couples who fulfilled the inclusion criteria, nine couples were measured, i.e., 18 subjects, all of them with right dominance. One couple was excluded from measurements

due to scheduling problems and these dancers subsequently dissolved their partnership.

Procedures

Dancers were asked not to do any physical exercise in the 24 hours prior to the research session. During the session, height measurements (using a SECA 709 7021994 measuring rod; Seca GmbH & Co. KG., Germany) and anthropometrical data (weight and body-mass index) were collected using bioelectrical impedance (Tanita BC-418 MA Segmental Body Composition Analyzer; Tanita Corporation, Japan).

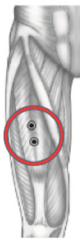
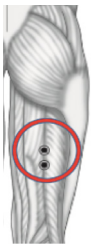
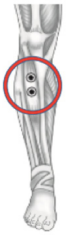
To compile the data with electromyography (EMG), the standard protocol (see Table 1) was followed in order to prepare the participants' skin and placing the electrodes (Torrence & Compo, 1998; Welch, 1967).

Later, the participants carried out an identic RAMP warm-up adaptation that consisted in integrating joint mobility in the ankles, knees, hips and shoulders, followed by specific movements in pairs without music, and continued activation by squats and planks, ending with the couples developing a dance to music (Jeffreys, 2007). Measurements were performed using surface electromyography of muscle activation during all competitive choreographies (120 s each type of dance), prepared and performed by the dancers (Mega Electronics Ltd., Kuopio, Finland).

There are previous works with pre-established choreographies (Liébana et al., 2018), and with this work we intend to measure activation in an ecological context, approaching the real context of competition.

The study was approved by the Ethics Review Board of the Catholic University of Valencia San Vicente Mártir,

Table 1
Placement of electrodes and coding of muscles and legs.

Muscle	Code left or right	Placement of electrodes	Figure location electrodes
Rectus femoris	RF1 Right RF2 Left	Halfway between the knee and the iliac spine; the electrode is, therefore, placed between these two areas.	
Biceps femoris	BF1 Right BF2 Left	The ischium must be located, and the distance between the ischium and the popliteal fossa must be measured. The electrodes are then placed ⅔ of the way down from the ischium.	
Tibialis anterior	TA1 Right TA2 Left	Parallel to the axis of the tibia, approximately in the first ⅓, between the knee and ankle.	
Gastrocnemius medialis	GM1 Right GM2 Left	The electrodes are placed ⅓ of the way down from the popliteal fossa, 2 cm from the midline of the muscle.	

Note. Figures adapted from Criswell & Cram (2011).

with the code UCV/2015-2016/60, and is in accordance with the Declaration of Helsinki. Participants were aware of the purpose of the study, and all were provided with a written informed consent.

Data processing

All EMG measurements were collected by Mega WBA sensors with a 1,000 Hz sampling rate, 20-500 Hz sensor frequency band-pass, Kendall 200 foam electrodes with conductive adhesive hydrogel (placed with a maximum inter-electrode distance of 20 mm) and were compiled using Megawin 3.1 software (Mega Electronics Ltd., Kuopio, Finland). They were then transferred to an ASCII file for further analysis. Data extracted from muscle activation are given in millivolts (mV). The file was transformed to .m for analysis using Matlab.

Data processing was initiated using Matlab R2017b, which automatically selects the central seconds of each exercise. The signal was filtered using a band-pass filter to establish the minimal values with a limit of 20 Hz and maximum values of 400 Hz. The root mean square (RMS) was obtained. A Fourier transform was carried out using the Fast Fourier Transform (Welch, 1967), indicating the spectrum of average power, which will allow an estimation of the spectral density. For this purpose, Welch's periodogram was used with a 1024 Hamming window of length, with the intention of estimating the spectral density (Welch, 1967). In this method, fragmentation of the time series is carried out, calculating in this way a modified periodogram for each of the segments. Once the average is calculated, this process facilitates estimation of the spectral density. The Welch method is an improvement to the standard method of the periodogram, since it performs a reduction of noise in the estimated power spectrum. However, a problem arises with this method. In order to correct this, a time-frequency analysis was applied, where a window of fixed length moves along the signal in order to relate the frequencies with time and the frequencies can be evaluated in each window.

After this, a non-stationary time series analysis is applied by means of the wavelet transform (Torrence & Compo, 1998), a method that can analyze the time-scale domain signal. This is a temporal series formed by families of functions defined temporally and spatially, which are produced by scaling and translation of a function called the base function. The scalogram consists of a power spectrum averaged for the different frequencies or scales, granted at each time value (Torrence & Compo, 1998).

The wavelet transform is divided into two variables: the continuous wavelet transform detects patterns or modifications along the temporal evolution of the signal at different scales; the discrete wavelet transform is obtained by the decomposition of the signal in different zones of the frequency spectrum, followed by data filtering to obtain the wavelet coefficients. Filtering occurs in relation to approximation, detail and the filters of low pass (5 Hz) and high pass (250 Hz). These results are the decomposition of the global signal into orthogonal signals that allow splitting of the signals in each of the frequency bands. In this case, three bands were fixed: the first, < 70 Hz; the second, 70-125 Hz, and the last, 126-250 Hz (Torrence & Compo, 1998).

Statistical analysis

The SPSS 22.0 statistical package (IBM, Chicago, IL) was used to analyze the data. Descriptive characteristics of anthropometry are presented as means and standard deviations (SD). Due to the limited sample size (9 couples), nonparametric tests were recommended to compare the quantitative variables. Changes in muscle activation between the two dance modalities were assessed with the Wilcoxon rank test. Given the possible variability of EMG measurements in the participants, values were presented as medians and interquartile ranges (IQR). Comparisons of quantitative variables between male and female dancers were assessed with the Mann-Whitney test. The Z value was also indicated. For all main effects and interactions, a confidence level of .05 was adopted.

Results

Descriptive anthropometric characteristics of the sample are presented in Table 2. There were no significative differences between male and female dancers in the anthropometric variables (Table 2).

Table 2
Anthropometric characteristics.

	Men (*n* = 9)		Women (*n* = 9)		Mann-Whitney	
	Mean ± SD	95 % CI	Mean ± SD	95 % CI	Z	*p*
Age (years)	20.4 ± 3.7	17.5 - 23.3	18.8 ± 2.5	16.8 - 20.7	-1.333	.190
Height (cm)	166.7 ± 10.8	158.4 - 175.1	170.0 ± 8.0	163.8 - 176.2	-.710	.478
Weight (kg)	62.2 ± 11.7	53.1 - 71.2	60.2 ± 9.4	52.9 - 67.4	-.309	.757
BMI	22.1 ± 1.8	20.8 - 23.5	20.7 ± 1.9	19.2 - 22.2	-1.370	.171

Note. SD: Standard deviation

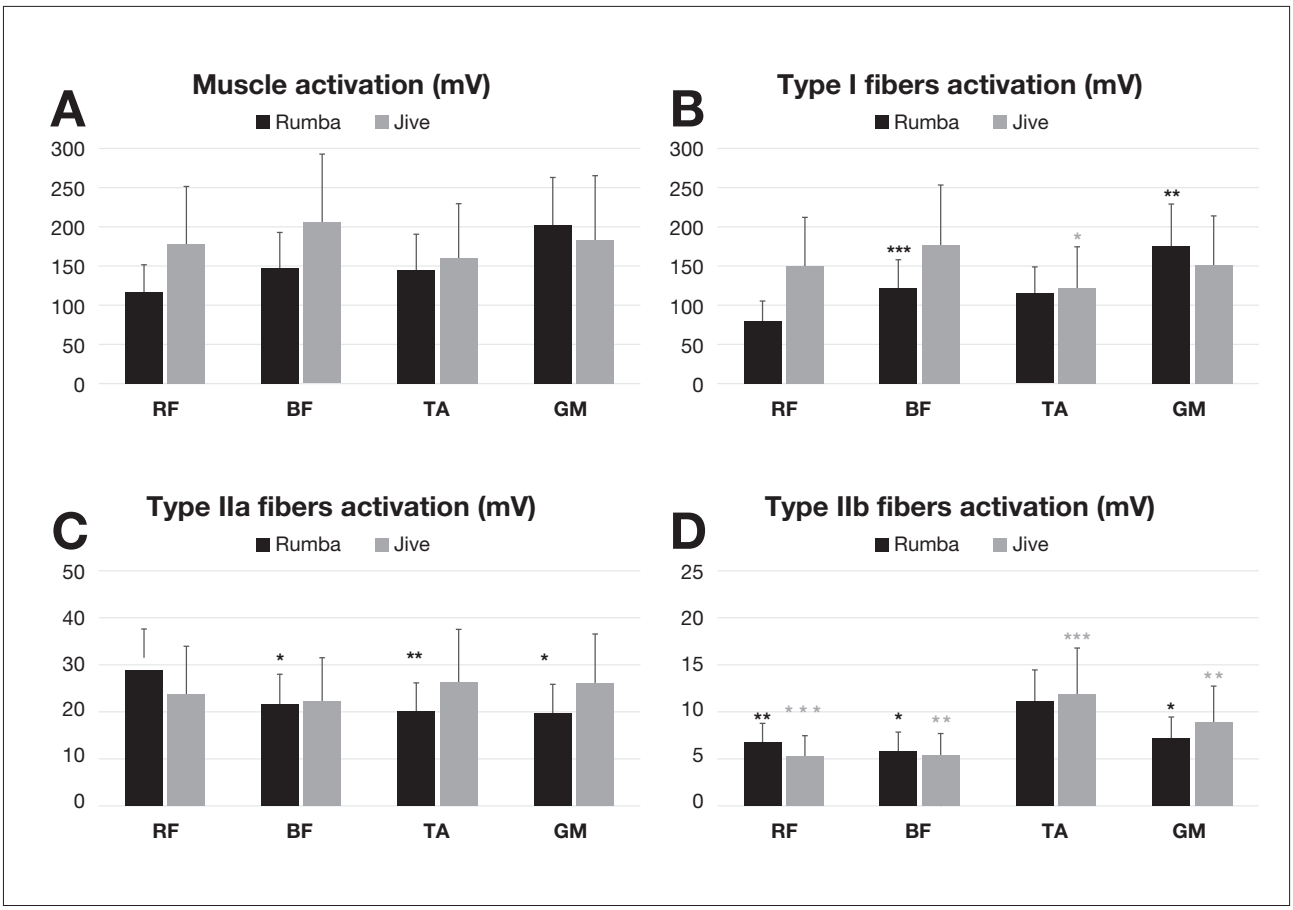
Considering EMG activation of all muscle fibers together in the different muscles analyzed, Rumba dance modality showed less activation than Jive in the muscles of the proximal aspect of the lower extremity (RF and BF), although there were no differences between the two dance modalities (Figure 1A). In Rumba, the activation of RF (median, 115.95; IQR, 36.00 mV) was lower as compared to BF (median, 146.68; IQR, 10.02 mV; $p = .002$) and to GM (median, 149.81; IQR, 85.66 mV; $p = .035$). GM showed the highest muscle activation in Rumba dance. In Jive, the highest activation corresponded to the BF (median, 155.40; IQR, 44.89 mV), and differences were statistically significant as compared to the TA activation (median, 123.09; IQR, 51.24 mV; $p = .028$). There were no differences between dominant and non-dominant leg in global EMG activation of the muscles during the two dance modalities.

In figure 1, B, C and D show a more detailed comparison between activation of different fiber types in the muscles evaluated at the dominant leg in relation to the dance modality. In Rumba, the Type I fibers activation of RF was significantly lower than BF ($z = –3.201$; $p = .001$) and GM ($z = –2.635$; $p = .008$). Furthermore, GM showed the highest type I fiber muscle activation in Rumba dance. In Jive, the highest activation corresponded to the BF (median, 124.05; IQR, 55.35 mV), and differences were statistically significant as compared to the TA activation (median, 85.90; IQR, 35.52 mV; $p = .028$).

Concerning type IIa fibers, RF muscle showed higher activation in Rumba than in Jive. In Rumba, RF activation was significantly higher than BF ($z = –2.3301$; $p = .020$), TA ($z = –2.809$; $p = .005$), and GM ($z = –2.243$; $p = .025$) (Fig. 1C).

The activation of type IIb fibers was very low in all muscles studied. In both dance modalities the highest activation was found in TA (Figure 1D). In Rumba, TA activation showed statistically significant differences as compared to RF ($z = –2.940$; p = .003), BF ($z = –2.461$; $p = .014$), and GM ($z = -2.025$; $p = .043$). In Jive, TA activation also showed statistically significant differences as compared to RF ($z = –3.201$; $p = .001$), and BF ($z = –3.157$; $p = .002$). In Jive, there were also differences between RF and GM activation ($z = –2.765$; $p = .006$), and between BF and GM (z = –3.157; $p = .002$).

Figure 1
Recording activation.



Note. *$p < .05$; **$p < .01$; ***$p = .001$. A: EMG recording global activation of the different muscles analyzed in the dominant leg; B: activation of type I fibers; C: activation of type IIa fibers; D: activation of type IIb fibers in the dominant leg. (RF: Rectus Femoris; BF: Biceps Femoris; TA: Tibialis Anterior; GM: Gastrocnemius Medialis).

Descriptive data, relating to the activation of the different types of muscle fibers in both dominant and non-dominant leg during the two dance modalities, are presented in Table 3. Regarding type I muscle fibers, Rumba dance showed less activation than Jive in RF and BF muscles of the dominant leg, but differences were only significant for RF (p = .022). In type IIa fibers, TA and GM of the dominant leg in Jive showed higher activation than in Rumba, but differences were only statistically significant in TA (p = .002). The activation of type IIb fibers was very low in all muscles studied. Differences between Rumba and Jive were only detected in the GM of the non-dominant leg (p = .016). When dominant and non-dominant legs were compared within each dance modality, there were only differences in the activation of type I fibers of the GM, which were higher in the dominant leg in Rumba dance (p = .006).

In Jive dance, there were no differences in the activation of the different muscles analyzed. Distal muscles (TA and GM) were more activated in Jive than in Rumba. In Jive, the highest type IIa fibers activation was detected in GM at both sides (Table 3).

Table 3
Rumba - Jive differences between dances and type of fibers.

Muscle and fiber	RUMBA		JIVE		Wilcoxon rank test	
	Median (IQR)	95 % CI	Median (IQR)	95 % CI	Z	*p*
Dominant leg						
RF1_TI	79.09 (40.73)	66.30 - 93.88	99.38 (47.94)	80.92 - 216.57	-2.286	.022*
RF1_TIIa	30.18 (4.00)	22.37 - 35.86	28.34 (16.98)	18.75 - 28.94	-1.502	.133
RF1_TIIb	7.24 (4.01)	5.07 - 8.39	5.30 (3.00)	4.06 - 6.49	-1.633	.102
BF1_TI	118.65 (20.27)	100.61 - 139.78	124.05 (55.35)	108.20 - 249.55	-.762	.446
BF1_TIIa	24.11 (3.67)	18.65 - 24.61	24.02 (10.19)	18.19 - 26.35	-1.111	.267
BF1_TIIb	5.29 (2.62)	3.63 - 8.30	5.48 (3.81)	4.16 - 6.55	-1.372	.170
TA1_TI	79.44(138.13)	65.63 - 163.07	85.90 (35.52)	41.83 - 205.02	-.806	.420
TA1_TIIa	24.33 (13.00)	15.39 - 24.94	27.52 (7.90)	21.24 - 31.63	-3.027	.002**
TA1_TIIb	11.47 (6.61)	8.45 - 13.78	11.86 (5.98)	8.26 - 15.39	-1.111	.267
GM1_TI	122.62 (95.24)	91.93 - 259.49	98.12 (42.77)	66.11 - 235.37	-.457	.647
GM1_TIIa	22.72 (14.74)	14.39 - 25.66	27.46 (10.32)	20.34 - 31.74	-1.677	.094
GM1_TIIb	7.22 (6.17)	4.86 - 9.62	8.11 (4.17)	6.83 - 11.21	-1.502	.133
Non-dominant leg						
RF2_TI	81.60 (23.77)	73.34 - 107.23	98.30 (58.09)	73.90 - 144.18	-1.459	.145
RF2_TIIa	29.86 (4.70)	21.94 - 34.56	28.98 (8.89)	22.45 - 33.50	-.675	.500
RF2_TIIb	6.67 (3.04)	5.20 - 8.78	5.19 (4.10)	4.88 - 7.55	-1.198	.231
BF2_TI	128.27 (39.77)	112.54 - 203.61	129.55 (45.10)	104.49 - 295.01	-.936	.349
BF2_TIIa	21.70 (8.66)	15.78 - 24.35	22.07 (8.56)	16.25 - 24.25	-.327	.744
BF2_TIIb	4.82 (3.16)	3.49 - 6.41	4.99 (3.67)	3.59 - 6.39	-1.28	.199
TA2_TI	65.50 (75.72)	39.15 - 179.11	82.08 (52.91)	49.92 - 200.74	-1.023	.306
TA2_TIIa	23.60 (10.69)	15.35 - 26.20	23.34 (12.11)	16.10 - 28.92	-1.241	.215
TA2_TIIb	9.91 (8.58)	6.77 - 12.41	9.77 (7.18)	6.89 - 11.75	-.240	.811
GM2_TI	84.17 (40.96)	65.33 - 105.32	84.80 (100.03)	64.85 - 222.78	-1.851	.064
GM2_TIIa	23.17 (10.25)	15.61 - 26.90	24.92 (10.31)	20.23 - 33.15	-1.285	.199
GM2_TIIb	8.52 (5.83)	5.98 - 10.89	11.02 (7.76)	8.55 - 13.35	-2.417	.016*

Note. *p < .05; **p < .01; RF1_TI = Rectus femoris (right), fiber type I; RF1_TIIa = Rectus femoris (right), fiber type IIa; RF1_TIIb = Rectus femoris (right), fiber type IIb; BF1_TI = Biceps femoris (right), fiber type I; BF1_TIIa = Biceps femoris (right), fiber type IIa; BF1_TIIb = Biceps femoris (right), fiber type IIb; TA1_TI = Tibialis Anterior (right), fiber type I; TA1_TIIa = Tibialis Anterior (right), fiber type IIa; TA1_TIIb = Tibialis Anterior (right), fiber type IIb; GM1_TI = Gastrocnemius Medial (right), fiber type I; GM1_TIIa = Gastrocnemius Medial (right), fiber type IIa; GM1_TIIb = Gastrocnemius Medial (right), fiber type IIb; RF2_TI = Rectus femoris (left), fiber type I; RF2_TIIa = Rectus femoris (left), fiber type IIa; RF2_TIIb = Rectus femoris (left), fiber type IIb; BF2_TI = Biceps femoris (left), fiber type I; BF2_TIIa = Biceps femoris (left), fiber type IIa; BF2_TIIb = Biceps femoris (left), fiber type IIb; TA2_TI = Tibialis Anterior (left), fiber type I; TA2_TIIa = Tibialis Anterior (left), fiber type IIa; TA2_TIIb = Tibialis Anterior (left), fiber type IIb; GM2_TI = Gastrocnemius Medial (left), fiber type I; GM2_TIIa = Gastrocnemius Medial (left), fiber type IIa; GM2_TIIb = Gastrocnemius Medial (left), fiber type IIb.

Descriptive data relating to fiber types for the Rumba and Jive dancing in both sexes are shown in Table 4. Significant differences were obtained for men and for women in TA type I fibers in both Rumba and Jive at the dominant leg (p = .028). In females, there were significant differences TA non-dominant activation between Rumba and Jive (p = .038). When male and female dancers were compared within each modality, differences in EMG activation were only found in the GM of the dominant leg during Rumba (Table 4). Males showed a lower activation of GM type I fibers (p = .019) and higher activation of GM type IIa fibers (p = .014) than females.

Discussion

Dancers in general and DanceSport in particular have not been studied in depth, and there is a notable lack of information on the behavior of muscle fibers during this sport. The importance of the present study lies in the significant differences identified between the Rumba and Jive, facilitating the programming and planning of neuromuscular training according to our findings. Although we are aware of the limitations due to the small number of the sample, since it is a minority sport. These dances have key differences in technique, rhythm and tempo, but the fact that there are clear differences in muscle

Table 4
Data relating to fiber types for the Rumba and Jive between genders.

Muscle and fiber	Mean (SD)		Man		Mean (SD)		Woman	
	Rumba Man Median (IQR)	Jive Man Median (IQR)	Z	*p*	Rumba Woman Median (IQR)	Jive woman Median (IQR)	Z	*p*
Dominant leg								
RF1_TI	83.02 (44.65)	100.05 (106.13)	. -1.48	.139	75.20 (29.26)	98.13 (67.49)	-1.83	.066
RF1_TIIa	29.20 (4.06)	28.35 (13.28)	-.415	.678	31.41 (3.70)	27.51 (17.07)	.67	.086
RF1_TIIb	5.63 (4.03)	4.78 (2.75)	-.533	.594	7.92 (4.13)	5.48 (4.57)	-1.362	.173
BF1_TI	113.69 (24.37)	112.72 (38.13)	. -1.599	.110	124.30 (33.60)	129.60 (200.89)	-.059	.953
BF1_TIIa	24.16 (2.59)	25.13 (7.38)	. -1.836	.066	22.88 (5.33)	22.54 (17.45)	-.296	.767
BF1_TIIb	5.46 (2.54)	5.77 (3.50)	-.415	.678	5.11 (3.76)	5.46 (4.88)	-1.481	.139
TA1_TI	73.86 (143.55)	79.46 (29.96)	-2.192	.028*	85.01 (144.81)	87.87 (74.58)	-2.192	.028*
TA1_TIIa	24.93 (19.17)	27.90 (7.12)	-1.244	.214	23.21 (11.13)	27.14 (12.49)	-.415	.678
TA1_TIIb	11.49 (12.26)	11.87 (6.12)	-.652	.515	11.45 (5.97)	11.85 (7.12)	-1.244	.214
GM1_TI	91.64 (44.20)	98.57 (51.51)	-1.955	.051	164.27 (241.70)	97.67 (95.12)	-1.362	.173
GM1_TIIa	25.08 (5.64)	27.72 (8.17)	-.770	.441	13.12 (18.84)	23.30 (16.36)	-1.362	.173
GM1_TIIb	8.86 (4.56)	9.96 (4.97)	-.652	.515	4.82 (9.19)	6.92 (4.96)	-1.244	.214
Non-dominant leg								
RF2_TI	81.04 (31.19)	81.63 (51.21)	-.059	.953	82.16 (49.64)	105.14 (52.78)	-1.955	.051
RF2_TIIa	29.94 (8.35)	31.86 (7.28)	-.178	.859	29.49 (10.02)	26.37 (14.04)	-.652	.515
RF2_TIIb	5.92 (3.99)	5.32 (4.29)	-.889	.374	6.84 (2.38)	4.95 (4.46)	-.652	.515
BF2_TI	123.78 (46.23)	120.52 (43.00)	-.415	.678	137.56 (119.12)	147.85 (281.04)	-.889	.374
BF2_TIIa	21.88 (7.42)	24.93 (± 5.05)	-1.362	.173	21.60 (17.06)	19.97 (15.20)	-1.007	.314
BF2_TIIb	4.96 (3.10)	4.87 (2.32)	-.059	.953	4.49 (4.52)	4.92 (7.14)	-1.362	.173
TA2_TI	65.19 (141.56)	76.59 (47.97)	-.770	.441	65.82 (49.02)	90.64 (124.99)	-2.073	.038*
TA2_TIIa	23.62 (27.16)	23.15 (26.98)	-.533	.594	23.58 (6.19)	23.53 (11.89)	-1.481	.139
TA2_TIIb	11.89 (12.26)	10.95 (12.23)	-.296	.767	9.09 (8.73)	8.86 (4.29)	-.059	.953
GM2_TI	84.38 (23.73)	100.44 (78.84)	-1.007	.314	73.56 (69.00)	87.55 (210.68)	-1.481	.139
GM2_TIIa	26.62 (8.26)	27.59 (18.90)	-.415	.678	20.08 (23.29)	21.86 (11.99)	-1.599	.110
GM2_TIIb	9.00 (3.27)	14.10 (4.41)	-2.666	.008**	5.92 (14.77)	8.31 (7.96)	-.533	.594

Note. *p < .05; **p < .01; ***p < .001

activation must also be taken into account in the development of training sessions to optimize performance and reduce the risk of injury.

Technique, rhythm and movements associated with the Rumba are slower than in the Jive. In the Rumba, particular aesthetics are sought, so that its technique favors extension of the lower limbs (Shang, 2013). In contrast, the Jive has characteristics similar to hopping with its consecutive jumps and kicks. This exercise combines speed and strength to produce an explosive-reactive movement (Cappa & Behm, 2013). These exercises involve a circle of eccentric (stretch) and concentric (shortening) muscle contractions, generally using the body as an overload and generating a stretch-shortening cycle (SSC) (Cappa & Behm, 2013). For a muscle action to be classified as a stretch-shortening cycle during rebounding activity, the muscular activation pattern must include preactivation prior to contact with the ground, a fast eccentric action, and an immediate and rapid transition between the eccentric and concentric phases (Komi, 2000). For this reason, there are significant differences between the Rumba and Jive in RF1_TI, TA1_TIIa and GM2_TIIb on the non-dominant leg. As with hopping, in Jive, the hamstring muscles and quadriceps muscles must be active at the same time to create stability (Wibawa et al., 2016).

The TA is a muscle which is activated not only in dorsiflexion of the foot but also for controlling pronation, so that in the Jive it would be acting eccentrically to support both movements (Cappa & Behm, 2013). Hence, differences are mainly found in TA1_TIIa between the Rumba and Jive. The fibers of TA1_TIIa are activated in short, high intensity movements as this muscle provides support by eccentric braking activation. This activation is also favored for support and when dancers are performing a landing technique using the first and second metatarsals (Dance Comp Review, 2014).

Significant differences were also found between the Rumba and Jive in relation to GM2_TIIb. This may be due to the SSC work of this muscle, since a Jive technique favors the continuous performance of fast jumps and kicks, thus generating plyometric work and the performance of a stretch-shortening cycle (Cappa & Behm, 2013). Nicol et al. (2006) highlight in their work that the gastrocnemius reacts differently on landing following a jump. If the jump is small, the fibers of the gastrocnemius muscle tend mainly to shorten for braking. If the jump is high and requires significant braking, the muscle fibers tend to lengthen. This is due to the lower resistance to stretching due to the possible release of cross bridges (Nicol et al., 2006). The impact load determines the behavior of the fascicle in a specific muscle and the intensity of the effort after the braking phase has some influence on this interaction by affecting the tendon recoil in the final thrust (Nicol et al., 2006).

On the other hand, our results show differences in muscle activation between men and women. These data would be in line with those obtained in the study by Liébana et al. (2017). Differences in muscle activation between genders were observed in the Tibialis Anterior and Gastrocnemius muscles, showing that activations between men and women were different (Haeufle et al., 2010). This may be due to both the differences between the women's and men's steps, and the marked difference between heels in men's and women's dance shoes, and consequently different active forces are generated in the legs by the muscles. Hill (1938) described and separated the intrinsic properties of a single muscle, represented by a serial elastic element and a contractile element with force-length and force-velocity relations. Muscular properties can compensate for disturbances and facilitate the convergence of dynamic and explosive movements. The intrinsic muscle properties represented by the force-length-velocity function in Hill-type muscle models act as a zero-delay peripheral feedback system (Haeufle et al., 2010).

The differences in muscle activation between the types of fibers, muscles, genders and dances observed in our study would demonstrate the need for individualized and planned training for each type of dance and partner (male vs. female). Hence the need for specific training for dancers, addressing the type of strength worked, mobility training, technique and motor control. These factors are of great importance to prevent injuries and achieve maximum athletic performance.

Regarding the data shown in this study, it is worth noting the limitations in terms of the sample, since it is a low number of participants compared to other research, but representative of the number of participants in the Spanish championship, taking into account that DanceSport is a minority sport.

Conclusions

The results of this study provide experimental evidence of significantly different muscle activations for the lower extremity as a function of gender and dance modality. Significant differences in activation as a function of fiber type were found between Rumba and Jive. From a clinical perspective, our findings can help coaches and sports physicians understand the specific sports profile of elite dancers. Knowledge regarding muscle function, activity, and balance is extremely important to optimize the high level of performance of these athletes and to support injury-prevention programs, which are key to maximizing their athletic success. These results are a first step in providing reference values for muscles fibers involved in dance sport movements that can contribute to the design of exercises to aid both sports performance and injury prevention. By carrying out this type of analysis using wavelets, it has been possible to observe how this analysis is sensitive and shows consistent results, considering the limitations of the study at all time. The wavelets can be used for analysis of movements with

similar characteristics (Cappa & Behm, 2013). This analysis allows us to understand the muscular demands of different types of dance. Thus, for the correct development of the Jive, plyometric work is important, with a shortening-stretching cycle. In addition, to minimize muscle imbalance between the posterior and anterior chain, as well as asymmetry between the dominant and non-dominant leg, strength work would be recommended.

References

Bria, S., Bianco, M., Galvani, C., Palmieri, V., Zeppilli, P., & Faina, M. (2011). Physiological characteristics of elite sport-dancers. *The Journal of Sports Medicine and Physical Fitness*, *51*(2), 194-203.

Brooke, M. H., & Kaiser, K. K. (1970). Muscle Fiber Types: How Many and What Kind? *Archives of Neurology*, *23*(4), 369-379. https://doi.org/10.1001/archneur.1970.00480280083010

Čačković, L., Baric, R., & Vlasic, J. (2012). Psychological stress in dancesport. *Acta Kinesiologica*, *6*(2), 71-74. https://actakin.com/PDFS/BR0602/SVEE/04%20CL%2013%20LC.pdf

Cappa, D. F., & Behm, D. G. (2013). Neuromuscular Characteristics of Drop and Hurdle Jumps With Different Types of Landings: *Journal of Strength and Conditioning Research*, *27*(11), 3011-3020. https://doi.org/10.1519/JSC.0b013e31828c28b3

Criswell, E., & Cram, J. R. (Eds.). (2011). *Cram's introduction to surface electromyography* (2nd ed). Jones and Bartlett.

Dance Comp Review. (2014). *Principals of International Latin Jive*. Dance Comp Review. http://dancecompreview.com/principals-international-latin-jive/

FEBD. (2017). *Código Básico de Competiciones*. https://www.febd.es/wordpress/wp-content/uploads/2017/01/codigo_basico_de_competiciones_11_5.pdf

Haeufle, D. F. B., Grimmer, S., & Seyfarth, A. (2010). The role of intrinsic muscle properties for stable hopping—Stability is achieved by the force–velocity relation. *Bioinspiration & Biomimetics*, *5*(1), 016004. https://doi.org/10.1088/1748-3182/5/1/016004

Hermens, H., & Freriks, B. (1997). *The state of the art on sensors and sensor placement procedures for surface electromyography: A proposal for sensor placement procedures*. Roessingh Research and Development.

Hill, A. V. (1938). The Heat of Shortening and the Dynamic Constants of Muscle. *Proceedings of the Royal Society B: Biological Sciences*, *126*(843), 136-195. https://doi.org/10.1098/rspb.1938.0050

Jeffreys, I. (2007). Warm up revisited – the 'ramp' method of optimising performance preparation. *Professional Strength and Conditioning*, *6*, 12-18.

Karlsson, S., Jun Yu, & Akay, M. (2000). Time-frequency analysis of myoelectric signals during dynamic contractions: A comparative study. *IEEE Transactions on Biomedical Engineering*, *47*(2), 228-238. https://doi.org/10.1109/10.821766

Komi, P. V. (2000). Stretch-shortening cycle: A powerful model to study normal and fatigued muscle. *Journal of Biomechanics*, *33*(10), 1197-1206. https://doi.org/10.1016/S0021-9290(00)00064-6

Kumar, D. K., Pah, N. D., & Bradley, A. (2003). Wavelet analysis of surface electromyography. *IEEE Transactions on Neural Systems and Rehabilitation Engineering*, *11*(4), 400-406. https://doi.org/10.1109/TNSRE.2003.819901

Liébana, E., Blasco, E., Monleón, C., Pablos, C., & Moratal, C. (2017). Muscular activation in rumba bolero in elite dancers of DanceSport. *Journal of Human Sport & Exercise*, *12(3proc)*, S807-S812. https://doi.org/10.14198/jhse.2017.12.Proc3.04

Liébana, E., Monleón, C., Morales, R., Pablos, C., Moratal, C., & Blasco, E. (2018). Muscle Activation in the Main Muscle Groups of the Lower Limbs in High-Level Dancesport Athletes. *Medical Problems of Performing Artists*, *33*(4), 231-237. https://doi.org/10.21091/mppa.2018.4034

Liiv, Jürimäe, T., Mäestu, J., Purge, P., Hannus, A., & Jürimäe, J. (2014). Physiological characteristics of elite dancers of different dance styles. *European Journal of Sport Science*, *14*, S429-S436. https://doi.org/10.1080/17461391.2012.711861

Liu, J. Z., Brown, R. W., & Yue, G. H. (2002). A dynamical model of muscle activation, fatigue, and recovery. *Biophysical Journal*, *82*(5), 2344-2359. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1302027/

Lukić, A., Bijelić, S., Zagorc, M., & Zuhrić-Sebić, L. (2011). The importance of strength in sport dance performance technique. *Sportlogia*, *7*(1), 61-67. https://doi.org/10.5550/sgia.110701.en.061L

Nicol, C., Avela, J., & Komi, P. V. (2006). The Stretch-Shortening Cycle. *Sports Medicine*, *36*(11), 977-999. https://doi.org/10.2165/00007256-200636110-00004

Riding, T., Wyon, M., Ambegaonkar, J., & Redding, E. (2013). A Bibliographic Review of Medicine and Science Research in DanceSport. *Medical Problems of Performing Artists*, *28*(2), 70-79. https://doi.org/10.21091/mppa.2013.2013

Shang, Y. (2013). Technical analysis of the hips squeezing action in rumba based on biomechanics. *Trade Science Inc*, *8*(9), 1205-1209.

Torrence, C., & Compo, G. P. (1998). A practical guide to wavelet analysis. *Bulletin of the American Meteorological Society*, *79*(1), 61-78. http://journals.ametsoc.org/doi/abs/10.1175/1520-0477(1998)079%3C0061:APGTWA%3E2.0.CO;2

Uzunović, S., & Kostić, R. (2005). A study of success in Latin American sport dancing. *Facta Universitatis*, *Series physical education and sport 3*, 23-35.

Uzunović, S., Kostić, R., & Miletić, Đ. (2009). Motor status of competitive young sport dancers-gender differences. *Acta Kinesiologica*, *3*(1), 83-88. http://www.actakin.com/PDFS/BR0301/SVEE/04%20CL%2014%20SU.pdf

Von Tscharner, V., & Goepfert, B. (2003). Gender dependent EMGs of runners resolved by time/frequency and principal pattern analysis. *Journal of Electromyography and Kinesiology*, *13*(3), 253-272. https://doi.org/10.1016/S1050-6411(02)00111-6

Von Tscharner, V., & Goepfert, B. (2006). Estimation of the interplay between groups of fast and slow muscle fibers of the tibialis anterior and gastrocnemius muscle while running. *Journal of Electromyography and Kinesiology*, *16*(2), 188-197. https://doi.org/10.1016/j.jelekin.2005.07.004

Wakeling, J. M., Pascual, S. A., Nigg, B. M., & Tscharner, V. (2001). Surface EMG shows distinct populations of muscle activity when measured during sustained sub-maximal exercise. *European Journal of Applied Physiology*, *86*(1), 40-47. https://doi.org/10.1007/s004210100508

WDSF. (2017). *World Dance Sport Federation*. About DanceSport. http://www.worlddancesport.org/about

Welch, P. (1967). *The use of fast Fourier Transform for the Estimation of Power Spectra: A Method based on time avering over short, modilied periodograms*. *15*, 70-73. https://doi.org/10.1109/TAU.1967.1161901

Wibawa, A. D., Verdonschot, N., Halbertsma, J. P. K., Burgerhof, J. G. M., Diercks, R. L., & Verkerke, G. J. (2016). Musculoskeletal modeling of human lower limb during normal walking, one-legged forward hopping and side jumping: Comparison of measured EMG and predicted muscle activity patterns. *Journal of Biomechanics*, *49*(15), 3660-3666. https://doi.org/10.1016/j.jbiomech.2016.09.041

Zagorc, M., Šimunič, B., Pišot, R., & Oreb, G. (2010). A comparison of contractile parameters among twelve skeletal muscles of inter-dance couples. *Kinesiologia Slovenica*, *16*(3), 57-65.

Conflict of Interests: No conflict of interest was reported by the authors.

apunts EDUCACIÓN FÍSICA Y DEPORTES

ISSUE 156

Published: April 1, 2024
https://doi.org/10.5672/apunts.2014-0983.es.(2024/2).156.08

BIBLIOGRAPHIC REVIEW

OPEN ACCESS

Book review: Lloret, M. (2023). *RITME Training. Readaptación inicial con técnicas motrices y ejercicios*

Toni Caparrós[1]

[1] National Institute of Physical Education of Catalonia (INEFC), center of Barcelona (Spain).

Cite this article
Caparrós, T. (2024). Book review: Lloret, M. (2023). RITME Training. Readaptación inicial con técnicas motrices y ejercicios. *Apunts Educación Física y Deportes, 156*, 66. https://doi.org/10.5672/apunts.2014-0983.es.(2024/2).156.08

Editor:
© Generalitat de Catalunya
Departament de la Presidència
Institut Nacional d'Educació Física de Catalunya (INEFC)

ISSN: 2014-0983

Section:
Bibliographic review

Original language:
Spanish

Published:
April 1, 2024

Front cover:
Mountain biker enjoying nature and open air.
© Adobe Stock. Delcio F/ peopleimages.com

RITME Training is a book that, under a solid and simple theoretical foundation, shows how to apply the current proposals for the rehabilitation of some of the most common injuries, such as back pain and neck pain. The aim of this paper is to show basic motor tasks and exercises for the initial rehabilitation of people with specific and non-specific chronic low back pain and cervical pain. The exercises presented are aimed at sedentary people and are the basis of a progression that aims to lay the foundations for improving quality of life.

Lloret explains and justifies a wide range of tasks to start the process of readaptation of these disorders so that graduates in Physical Activity and Sport Sciences can prescribe, supervise and regulate their volume and intensity, as well as determine those tasks that are suitable for each user according to their individual needs. These initial exercises are known as spinal unloading, and are proposed in a horizontal position for low back pain and in a horizontal position and standing upright for cervical pain. Progression will evolve towards more complex exercises. In turn, these supervised tasks are classified as muscle toning or stretching.

Readers interested in the subject matter and its application will appreciate the structure of the content, which reflects the author's extensive field experience. It facilitates practitioners' understanding and reasoning in the choice of exercises. It is not only a work that allows programming for a specific injury: it is a useful tool for learning in the field of rehabilitation. Its logic will allow those with an academic background to develop new proposals in this professional field.

RITME TRAINING. READAPTACIÓN INICIAL CON TÉCNICAS MOTRICES Y EJERCICIOS

Mario Lloret

Edicions de la Universitat de Lleida

Year of issue: 2023