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SUMÁRIO

The expected number of olympic medals: a case study of team Portugal at Tokyo 2020 205
Tiago Manuel Barbosa

Culture, policies, and a move to integrate an assets-based approach to development in the portuguese sport system 208
Fernando Santos, Martin Camiré, Dany J. MacDonald, Leisha Strachan, Marta Ferreira, Scott Rathwell

Asymmetry in Parkinson's disease and its relationship with strength 214
Sacha Clael, Wagner Martins, Ana Clara Bonini-Rocha, Sandro Nobre Chaves, Elaine Brandão, Jhonatan Rodrigues, Rafaela do Vale, José Celi, Lídia Bezerra

Effects of virtual rehabilitation on postural control of individuals with parkinson disease 220
Jéssica Maria Ribeiro Bacha, Maria Carolina Carrer da Cunha, Tatiana Beline de Freitas, Rosemeyre Alcarde Nuvolini, Flávia Doná, Keyte Guedes da Silva, Camila Torriani-Pasin, Fernando de Freitas Ganança, José Eduardo Pompeu

Strength training with blood flow restriction in HIV patients positive: a case study 228
Thiago Siqueira Paiva de Souza, Patrick Alan de Souza Pfeiffer, Jordan do Nascimento Pereira, Elísio Alves Pereira Neto, Thaysa Silva Dutra, Mayara Gabriel Lima de Mendonça, Gabriel Rodrigues Neto, André Louis Carvalho dos Santos, Maria do Socorro Cirilo-Sousa

Reliability of the handheld dynamometer in the evaluation of the muscle strength of trunk extensors in healthy adults 235
Mariana do Carmo Pinto Oliveira Barros, Nathália Passos Clemente, Fábio de Lima Rezende, Thaís Brasil Cardoso, Sérgio Ricardo Thomaz, Patrícia Azevedo Garcia, Alexandre Lima de Araújo Ribeiro, Wagner Rodrigues Martins

Psychometric properties of the of the university sport experiences scale – portuguese 242
Scott Rathwell, Patrícia Aparecida Gaion, Fernando Santos, Aryelle Caruzzo, Rhuan Lima, Vinicius Gobbi, José Roberto Andrade do Nascimento

Dietary intake of young portuguese handball players 255
Carla Sá, Sérgio Monteiro, Sofia Osório, Tiago Barbosa, Paulo Sá

Análise fatorial confirmatória do tactical skills inventory for sports em jovens basquetebolistas brasileiros.....262
Dilson Borges Ribeiro Júnior, Marije Elferink-Gemser, Helder Zimmermann Oliveira, Francisco Zacaron Werneck, António José Barata Figueiredo, Manuel João Coelho e Silva

Effects of age and experience on the development of aquatic competence in children aged 36 to 72 months.....273
Rossane Trindade Wizer, Flávio Antônio de Souza Castro

Análise de processo da tarefa de levantar-se do solo em idosos saudáveis.....281
Frederico Santos de Santana, Camila de Santana Mota, Leonardo Costa Pereira, Maria Teresa Cattuzzo, Marisete Peralta Safons

Carreiras duais no alto rendimento desportivo na europa: uma revisão sistemática da literatura.....290
Sónia Picamilho, José Saragoça, Mário Teixeira

Instrumentos de avaliação de crianças no meio aquático: uma revisão sistemática 306
Rossane Trindade Wizer, Cássia Daniele Zaleski Trindade, Wellington Gomes Feitosa, Dayana da Silva Oliveira, Flávio Antônio de Souza Castro

EDITORIAL

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The expected number of olympic medals: a case study of team Portugal at Tokyo 2020

Tiago Manuel Barbosa[1*,**]

The 2020 Summer Olympic Games reached to an end in Tokyo, Japan. Even though all the hiccups, constraints, and challenges imposed by the COVID-19 pandemic, the Games were successfully held in August 2021. For the first time in history, Team Portugal won four medals (one gold, one silver, and two bronzes). In 2018 the Portuguese Olympic Committee signed a contract with the Portuguese Institute of Sport and Youth (i.e., Portuguese government) listing the deliverables of the mission Tokyo 2020 against a funding scheme of 18.5 million euros (Contrato n.º 33-A/2018; Contrato — Programa de Desenvolvimento Desportivo n.º CP/1/DDF/2018). The document sets, among other goals and deliverables, that no less than two medals would be won at Tokyo 2020 (section IV.1. of the contract).

On the road to Tokyo, Portugal got more than two medallists at World Championships in several Olympic sports. Indeed, there were six to eight potential medallists at the 2020 Olympic Games (O Jogo, 2021). There is evidence that just one-third to one-fourth of the Olympic athletes are able to excel and outperform at the Olympic Games. In the sport of competitive swimming, just 29.82% of all male Olympians and 53.84% of the finalists at Rio 2016 improved their entry times (Barbosa, 2016a). On average, only 30% of the swimmers were able to improve their entry time at the 2012 and 2016 Olympic Games (Barbosa, 2016b). At Rio 2016, Team Portugal was expected to win two medals out of nine potential medallists, i.e., almost 25% of effectiveness (Garcia, 2016). Thus, one can wonder if the Portuguese Olympic Committee was sensible, assuming that two athletes would reach the podium spot out of six to eight potential medallists. Also, it begs the question if the four medals won were an outstanding achievement, deemed as a substantial improvement of the Portuguese sports system or, if alternatively, the Portuguese Olympic Committee underestimated the number of medals that the country could win.

To address these questions, two Monte Carlo simulations were run. One using a normal distribution and another a triangular distribution. In each case, it was run 10,000 simulations, for a confidence interval of 99.5%, expecting two medals out of eight potential medallists.

Figure 1 depicts the histograms of normal and triangular distributions of the simulations predicting the number of medals to be won by Team Portugal at Tokyo 2020. In the case of the normal distribution, the mean and median number of medals are 1.97 and 1.98, respectively (Table 1). Conversely, for a triangular distribution, the mean is 3.31, and the median is 3.07. I.e., a normal distribution suggests that two medals could be won; whereas, the triangular distribution three. Thus, under these assumptions, the simulations suggest that Team Portugal can win two to three medals at the Olympic Games.

The follow-up question is what the probability is of Team Portugal overachieve, winning two to four medals. If a normal distribution is considered, the probability is 29% (Table 1). However, if a triangular distribution is taken into consideration, such probability increases to 40% (Table 1). Winning four medals corresponds to percentile 80 in the normal distribution and 65 in the triangular distribution (Table 2).

In the previous two Olympiads (London 2012 and Rio 2016), Team Portugal brought home one single medal in each edition. Fast forward to this year, the tally raised to four medals at Tokyo 2020. Therefore, the number of medals won in the past three Olympiads seems to be more due to chance for a sports system that is designed and set to bag 2-3 medals. Notwithstanding, Team Portugal competed at 12 Olympic Games since 1976 (under the democratic political

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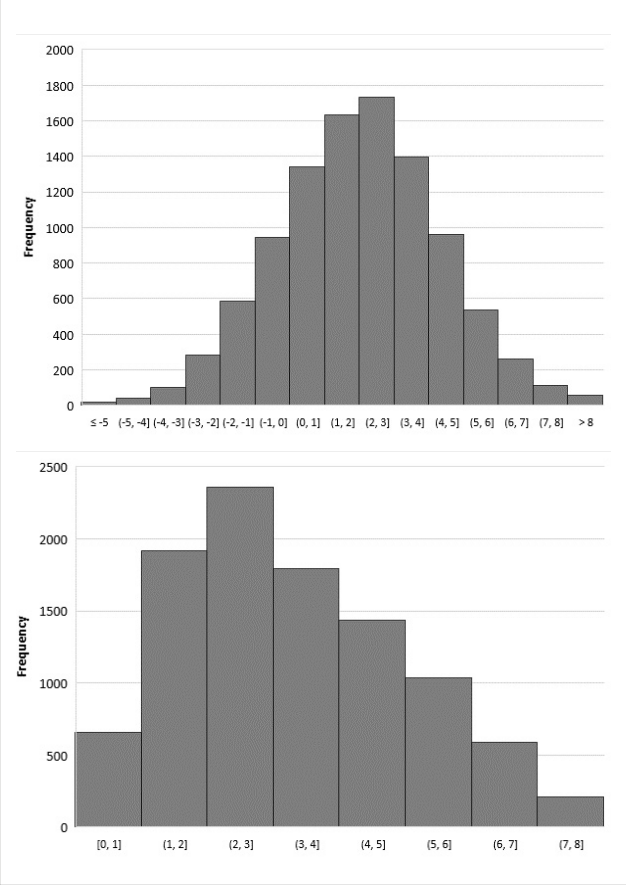

Figure 1. Histogram for normal distribution (top panel) and triangular distribution (bottom panel) of the Monte Carlo simulations predicting the number of medals to be won by Team Portugal at Tokyo 2020.

Table 1. Statistics of the Monte Carlo simulations predicting the number of medals to be won by Team Portugal at Tokyo 2020.

	Normal distribution	Triangular distribution
N	10,000	10,000
Mean	1.98	3.31
Median	1.97	3.07
Standard-deviation	2.36	1.70
Variance	5.57	2.88
Minimum	-7.653	0.048
Maximum	11.170	7.928
Skewness	0.014	0.455
Kurtosis	0.149	-0.543
Probability of winning 2-4 medals	29%	40%

system). The country won two or three medals in six editions (Montreal 1976, Los Angeles 1984, Atlanta 1996, Sydney 2000, Athens 2004, Beijing 2008).

Table 2. Percentiles of the Monte Carlo simulations predicting the number of medals to be won by Team Portugal at Tokyo 2020.

Percentile	Normal distribution	Triangular distribution
5	-1.9	0.9
10	-1.0	1.3
15	-0.4	1.5
20	0.0	1.8
25	0.4	2.0
30	0.8	2.2
35	1.1	2.4
40	1.4	2.6
45	1.7	2.9
50	2.0	3.1
55	2.2	3.3
60	2.6	3.6
65	2.9	3.9
70	3.2	4.2
75	3.6	4.5
80	4.0	4.9
85	4.4	5.3
90	5.0	5.8
95	5.9	6.5

Hence, the likelihood of Team Portugal winning more than two to three medals is rather small. Any results where Team Portugal wins less than two medals or more than three medals seems to be more due to randomness of the sports phenomena than changes in any underlying key-factor. To climb up the medal tally tables from 2-3 medals (not considering the randomness abovementioned) requires a meaningful change in the Portuguese sports and educational systems from grassroots to elite performance, underpinned by a reviewed funding scheme.

If climbing the medal tally table is indeed a mid- to long-term goal, a conversation should begin as soon as possible, and a few questions addressed: (1) what is the role of the sports system in Portugal? I.e., why does Portugal want to win more medals? (2) What is the vision of the sports landscape by 2036-2040? (3) what is the strategic plan to reach the Vision 2040? I.e., how to reach the vision? (4) what are the international best practices to be included in the plan and help us achieve the vision? (5) what is the funding scheme underpinning the strategic plan?

In such cases, analytics and other evidence-based tools can aid to make informed decisions on public policies, deliverables, and outputs. For instance, comprehensive simulations

can be run to forecast the medal tally based on inputs such as Team Portugal demographics (e.g., number of athletes, number of athletes by competitive level, number of participating sports, number of potential medallists, number of athletes engaged full-time in the Olympic preparation, number of dual-careers athletes), econometrics (e.g., country GPD, GDP per capita, percentage of GDP invested, absolute and partial contribution from public and private funding sources), key-performance indicators from the sports system (e.g., number of people actively engaged in sports and physical exercise, percentage of youngsters participating in youth sports, number of high-performance centres country-wide, number of part-time and full-time multi-disciplinary support staff, level of education and life-long learning of coaching staff), and educational system (e.g., physical education teaching hours, participation in extra and co-curricular sports activities in school, weight of physical education grade to GPA).

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RESEARCH NOTE

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Culture, policies, and a move to integrate an assets-based approach to development in the portuguese sport system

Fernando Santos[1,2,3]*, Martin Camiré[4], Dany J. MacDonald[5], Leisha Strachan[6], Marta Ferreira[1], Scott Rathwell[7]

ABSTRACT

The purpose of this article is to propose the integration of an assets-based approach to development in the Portuguese sport system. The propositions advanced are aimed at instigating reflections on policy-level initiatives that can be undertaken with the intent of bettering the state of sport in Portugal. We argue that changes from an assets-based approach are needed in both policy and practice to influence the current Portuguese sport culture positively. Specifically, an assets-based approach could prompt a move towards deliverables aimed at promoting social development rather than a unidimensional focus on winning and performance. Based on the current state of affairs, reflections for rethinking the culture and policies of the Portuguese sport system are offered.
KEYWORDS: sport; policy; youth; values; winning.

INTRODUCTION

For several decades, sport philosophers, pedagogues, politicians, researchers, and practitioners have had ongoing discussions on the state of the Portuguese sport system (Bento, 2004; Resende, Sequeira, & Sarmento, 2016; Lima, 2019). A direct result of these discussions has been the implementation of several policies by the Portuguese government aimed at bettering the sport experiences of all participants. Specifically, there are now national policies for fostering ethics and preventing violence in sport (National Plan of Ethics in Sport, 2015) and for the certification of coaches (Portuguese Institute of Sport and Youth, 2020). However, recent studies have shown that Portuguese youth sport participants still report negative experiences such as bullying (Nery, Neto, Rosado, & Smith, 2019) and gender stereotyping (Santos et al., 2019a) while partaking in sport. Considering these negative experiences, it is important to continue to reflect on the state of the Portuguese sport system to determine if further changes are needed to improve the experiences of youth sport participants.

The purpose of this article is to propose the integration of an assets-based approach to development in the Portuguese sport system. The propositions advanced are aimed at instigating reflections on policy-level initiatives that can be undertaken with the intent of bettering the state of sport in Portugal. This article can inspire a range of sport stakeholders such as coaches, sport administrators, policymakers and athletes to reflect on the current status quo. This article is organised into two sections. First, we review the current sports culture and policies within the Portuguese sport system. Second, based on the current situation, we offer reflections for rethinking the culture and policies of the Portuguese sport system to align with an assets-based approach to development.

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THE CURRENT SPORTS CULTURE IN PORTUGAL

Within today's neoliberal rationality, the pervasiveness of performance and competition create fertile grounds for a culture that casts people as capital who must incessantly lookout for their "value" (Smart, 2007). Neoliberalism extends way beyond market-specific sectors and engulfs non-wealth generating sectors of society, such as youth sport, which, in Portugal, is a very competitive environment (Bento, 2004; Santos et al., 2019a). The result is an ever increasing professionalisation of youth sport (Camiré & Santos, 2019), where exchanges between stakeholders (e.g., club administrators, coaches, athletes) are often transactional and economised, leading to a sports culture characterised by a strong focus on winning across ages, sport contexts, and performance levels. Given that youth sports clubs are funded based on the number of athletes they have, they use their success (i.e., most often measured in wins and championships) as a marketing tool to recruit athletes and convince parents to enrol their children in youth sports clubs. Such marketing ploys lead to winning being reinforced as the most important objective in youth sport (Sapo, 2021).

To better understand how winning permeates the Portuguese sport system, we need to consider several variables such as football's often toxic culture, the lack of importance provided to fair play and ethics, as well as the widespread notion that character development occurs automatically by taking part in sport. It should be noted these variables are influenced by the decisions made throughout the last decades by different parties and the lack of a coherent strategic plan for sports that may continue to move policies forward and enable sustainability (Silva, 2009).

First, the Portuguese sport system as a whole is highly influenced by the sport of football, which has numerous prominent groups of loyal supporters, athletes, and coaches (Seabra, Mendonça, Martine, Malina, & Maia, 2007; Pedras, 2019). Football garners an immense portion of media coverage, mainly focused on club performances but also on the corruption and violence ingrained in the sport. As a result of what has been labelled football's often toxic culture (Público, 2020), some television stations have decided to end some football programming. For example, one news channel ended two sports programs due to the toxic environment in Portuguese football created by commentators who made demeaning remarks about certain clubs in addition to questioning referees' decisions and athletes' professionalism. This news channel stated in a press release that: "The toxic environment created around these programs, to which clubs and their communication machines contribute, made us reach a point where we felt it was time to stop" (Público, 2020).

A second issue to consider is the propagandising from high-profile coaches and other stakeholders that fair play and ethics are unimportant (Correio da Manhã, 2007). For example, one high-performance football coach made headlines on social media with the statement "Fair play is bullshit". Recently, that same coach went a step further, stating that fair play is not needed in high-performance football and that his players should not give the ball to opponents when the game stops due to an injury or a similar event (Tribuna Expresso, 2020). Research has also shown youth sport coaches mainly focus on winning and achieving performance outcomes and give minimal attention to fair play and ethics (Pinheiro, 2013; Santos, Camiré, & Campos, 2018). Consequently, many sports stakeholders such as sports administrators, coaches and athletes publicly exchange accusations about issues such as corruption and violence (i.e., unethical behaviours) and do not embrace fair play and ethics in their own conduct (Diário de Notícias, 2021). In some cases, such behaviours consist of an attempt made by these stakeholders to explain the lack of results and deal with the emphasis placed on winning.

A third issue to consider is how certain youth sports clubs have made it clear in their mission statements that their primary focus is to win, with slogans indicating that their main objective is to win in every competition and develop athletes through winning. Such narratives create a culture that opposes government policies and inevitably compels stakeholders/participants to abide by a 'winning at all cost' attitude (Santos et al., 2018; Santos et al., 2019a). Thus, the present sport culture in Portugal has led to youth sport becoming a reflection of high-performance sport, where winning at all costs is prioritised. It has been argued that this winning at all costs mindset has contributed to a rise in the number of violent episodes amongst parents, referees, coaches, and athletes. In fact, Sofia and Cruz (2017) found that athletes from younger competitive categories tended to be more aggressive than athletes from older competitive categories, suggesting that a strong focus on winning is omnipresent even at the youngest levels of Portuguese sport.

Ironically, intertwined in the culture of winning described above is the widespread notion that character development occurs automatically by taking part in sport, despite researchers' efforts to dispel such notion (Coakley, 2011; Ferris, Ettekal, Agans, & Burkhard, 2016). In Portugal, sport is often considered an important platform for a range of positive developmental outcomes such as emotional control and leadership skills (Santos et al., 2018). For example, the National Plan of Ethics in Sport (2015) recognises sport practice teaches values. However, several studies conducted in Portugal (Santos, Corte-Real, Regueiras, Dias, & Fonseca, 2016, 2018; 2019a)

have shown how coaches have few concrete strategies to use sport's potential for athlete development. Coach education specific to youth development has been positioned as lacking in the Portuguese context, explaining some of the struggles coaches have in implementing developmental strategies (Santos et al., 2016; 2017).

CURRENT SPORT POLICY IN PORTUGAL

In Portugal, policies have been developed to guide sport participation and are considered important tools to influence sport culture and stakeholders' practices (Darnell et al., 2019). In the last 20 years, numerous sport policies have been enacted to delineate the objectives of sport (Fernandes, Tenreiro, Quaresma, & Maçãs, 2011). However, in many instances, our analysis points to how these policies tend to use evangelical narratives to identify sport as an inherently positive undertaking and as a panacea to solve a range of societal issues (Portuguese Institute of Sport and Youth, 2015). For example, the code of sports ethics from the Portuguese Institute of Sport and Youth (2015) states that "Sport can justify its presence in society through being an educational and training tool, for personal and social development and entrepreneurship, *of extraordinary power*" (emphasis added, p. 4). Such narratives ascribe to sport an unproportioned responsibility to overperform and overachieve to compensate for society's ills (Silva & Howe, 2012). The need for sport to compensate for society's ills is clearly outlined in the policy document guiding physical activity and sport in Portugal (2007) — Lei de Bases da Actividade Física e do Desporto —, where it is stated that efforts should be directed to "prevent and punish unsportsmanlike manifestations, specifically violence, doping, corruption, racism…" (article 3). Even the Constitution of the Portuguese Republic (Portugal, 1976) itself addresses how "it is the state's objective, in collaboration with schools and sports associations, to foster a physical and sports culture to prevent violence in sport" (article 79).

Based on the arguments and the evidence put forth, it appears that Portuguese sport policy may be misaligned with Portuguese sport culture. Specifically, sport is expected to have "extraordinary power" for social development (Portuguese Institute of Sport and Youth, 2015), but in practice, performance and winning remains the main outcomes (Santos et al., 2016; 2018; 2019b). Further, many policy statements are framed using a deficit-reduction approach (e.g., preventing racism), limiting sport's potential for "extraordinary power" to be reached. Deficit-reduction approaches aim to eliminate unwanted behaviours and undesired outcomes after their appearance (Lerner, Almerigi, Theokas, & Lerner, 2005) rather than using a proactive approach to development. For example, multiple awareness campaigns promoted by the Portuguese Olympic Committee (2020) proclaim "No to racism" but provide very few concrete actions to promote allyship, activism, diversity, and inclusion (Mac Intosh et al., 2020). Although deficit-reduction approaches are needed, they are usually insufficient as they generally fail to provide citizens with the skills needed to confront the challenges of everyday life (Lerner et al., 2005; Coakley, 2011).

Conversely, assets-building approaches focus on equipping people with the skills needed to deal with challenging issues as they arise (Lerner et al., 2005). Our position is that assets-building approaches should be prioritised as they help people develop the skills they need to thrive (Lerner et al., 2005; Coakley, 2011). Thus, in the Portuguese context, an important issue may lie in the lack of assets-based policies that explicitly state the developmental outcomes that should be attained through sport. Assets-based policies can perhaps be leveraged to support sports organisations in developing concrete strategies that can help youth learn the skills needed to thrive in and beyond sport.

The current misalignment we have identified between culture and policy in Portuguese sport may be best explained by the fact that funding is mainly tied to national sport organisations' ability to do three things: organise competitions, attain desired results, and promote sports participation (Portugal, 2018). The prominent funding focus on these three aims inevitably acts to limit the influence of policy, especially policy statements oriented towards sport's "extraordinary power" for development (Darnell et al., 2019). Logically, sports organisations implement managerial strategies and use their resources (e.g., time, coaches) based on funding requirements that dictate what the sport system demands of them in terms of deliverables. For example, the Portuguese Basketball Federation (2019) is projected to allocate 39.4% of its funding in 2020 to promote the sport and organise competitive events. However, no portion of its budget was explicitly allocated to efforts to promote ethics and athletes' personal development through sport. Similarly, the Portuguese Rowing Federation (2019) projected to spend nearly 200,000 € on logistical and administrative issues in 2020, while less than 7,000 € was allocated to programs aimed at fostering ethics in sport. These examples suggest that in the Portuguese sports landscape, where resources are often scarce, national sport organisations are compelled to focus on delivering outcomes that enable them to maintain their funding (Portugal, 2018). Having identified some of the misalignments inherent to the current Portuguese sport

system, in the next section, we propose reflections aimed at integrating an assets-based approach to sport, both in policy and funding structure.

INTEGRATING AN ASSETS-BASED APPROACH TO SPORT

If the Portuguese sport system is to implement an assets-based approach as part of its core values, policy changes should occur to influence the culture and delivery of sport in the country. Concerning the nature and scope of the changes that could be introduced in the Portuguese sport system, it may be necessary to consider how deficit-reduction and assets-promotion approaches can and should be combined to frame policy changes, with a particular programmatic focus on assets-building (Coalter, 2010). In concrete terms, it is important to acknowledge the worth of deficit-reduction approaches to eliminate racism, violence, and other forms of negative behaviours from sports. However, such approaches must be supplemented with assets-promotion approaches that promote diversity, activism, tolerance, and respect (Coalter, 2010). For such assets-building approaches to be enacted, policies are needed that provide a concrete plan of action that sports organisations can follow to address in meaningful ways contemporary social justice issues (e.g., racism, sexism, ableism; Mac Intosh et al., 2020). For example, sport policy could focus on explicitly stating what should be the developmental outcomes targeted across coaching domains (recreational sport, competitive sport), specifically which values and social justice life skills should be taught and how. A strategic plan for the Portuguese sport system may need to be created for the next ten years (2021–2031) to expand upon these issues. Currently, there are several laws, but there is not a strategic plan to determine the long-term developmental outcomes and methods to be used by sports organisations. A discussion that involves coaches, sports administrators, coach developers and policymakers may be needed to understand contemporary social justice issues, athletes' developmental needs and define concrete guidelines for sports organisations to help sport stakeholders teach a vast array of life skills and values. A needs assessment that captures the state of affairs in the Portuguese sport system may prompt practice-based policy change.

Nevertheless, it is essential to consider that policy, it and of itself, is not sufficient for sustainable long-term change to occur in the Portuguese sport system (Darnell et al., 2019). Additional strategies are needed to support sport organisations' efforts in implementing assets-based approaches. Such strategies could include educating sports organisations/coaches/parents on *what* developmental outcomes (e.g., inclusion, diversity, psychosocial development, life skills) should be sought through youth sport (i.e., above and beyond winning) and *how* these outcomes can be attained. It is important to note that current contemporary social justice issues and the focus on winning may suggest the need to help sport stakeholders understand how to use an explicit approach towards teaching values and life skills such as respect, empathy and leadership. This explicit approach involves direct and deliberate strategies focused on teaching values and life skills. The value of this approach has yet to be acknowledged in the Portuguese sport system (Santos et al., 2018; 2019a) but may be crucial for substantial and sustainable change in the current status quo. In many instances, sport is still portrayed as a tool that automatically leads to positive developmental outcomes (Coakley, 2011), which may require sports organisations to focus on *how* these outcomes can be attained. Therefore, large scale asset-based training programs may be needed to help sports organisations understand how to implement sport policy and realise the implications an asset-based approach to development may have for the whole system, specifically for youth sports clubs, coach training, coach developers and sports administrators.

Additionally, the funding system must be tied to organisations' ability to implement policy, not just in terms of the three traditional outcomes (i.e., organising competitions, attaining desired results, and promoting sport participation), but most importantly, promoting the benevolent development outcomes identified above. It must be noted that the suggested adjustments to the traditional funding model come with their own set of challenges (e.g., how do we measure sports organisations' attainment of development outcomes?) but are ultimately needed if sports organisations are to alter/improve how they deliver sport. In other words, sports organisations must be provided with compelling reasons (i.e., impacting how they secure funding) to reframe their mission statement and program delivery; otherwise, they will simply maintain the status quo. To face the challenge of measuring sports organisations' attainment of development outcomes, partnerships with universities and polytechnic institutes may be created and become a necessary and feasible step. Recently, a research group focused on ethics that involves researchers from diverse polytechnic institutes spread across the country was created. This research group is funded by the Portuguese Institute of Sport and Youth via the National Plan of Ethics in Sport and aims to develop asset-based training for sport stakeholders. This research group is well-positioned to broaden its reach and scope and work to measure sports organisations' attainment of development outcomes across

the country which could, in turn, influence sports organisations' ability to implement sport policy.

As highlighted by Coakley (2011), sports stakeholders usually assume that "sports participation and consumption will create healthy, productive people; decrease deviance…" (p. 2), which is not the case. To hold sports organisations accountable in terms of the extent to which they implement policy and create a renewed sport culture, new standards of behaviour are crucial. For example, the Portuguese Football Federation (2020) has launched an initiative to evaluate the extent to which its youth sports clubs define objectives and use strategies that provide high-quality developmental experiences for athletes. This initiative includes an evaluation of aspects such as training plans, developmental objectives set per team/age group, sports club's philosophy and training offered to sport stakeholders. However, there is a minimal focus on teaching values and life skills. This is the first initiative of its kind in Portugal, signalling that youth sports clubs that do not meet the criteria established by the Portuguese Football Federation (2020) cannot participate in certain competitions. Given the pervasive influence of football in Portugal, if/when evaluations are able to determine the effectiveness of this particular initiative, similar programs could be launched across sports nationwide further to promote assets-based approaches to development within national sport organisations. Ultimately, the hope is that a trickle-down effect occurs in a wide range of youth sports clubs, thereby shifting the Portuguese sport culture and positively influencing athletes' developmental experiences in sport.

CONCLUSIONS

The purpose of this article was to propose the integration of an assets-based approach to development in the Portuguese sport system. We argue that changes from an assets-based approach are needed in both policy and practice to influence the current Portuguese sport culture positively. It is proposed that an assets-based approach could prompt a move towards (some) deliverables aimed at promoting social development rather than a unidimensional focus on winning and performance. Given that less than 1% of Portuguese sport participants reach professional sports status[1], it is important to reflect on how to use sport as a tool for social change rather than simply focusing on competition. Updated policies and strategies can contribute to positive change.

1. See in: https://ipdj.gov.pt/lista-de-praticantes-de-alto-rendimento.

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ORIGINAL ARTICLE

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Asymmetry in parkinson's disease and its relationship with strength

Assimetria na doença de parkinson e sua relação com a força

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ABSTRACT

The onset side in Parkinson's disease remains unclear. Furthermore, the motor symptoms are typically unilateral, with the onset side often remaining more affected throughout the disease course. Therefore, as Parkinson's disease is an idiopathic disease, several questions are raised, one of them how the disease affects each person differently. For example, a person can be right-handed for the upper limb and left-footed for the lower limb, which can change strength scores. Thus, the aim of the study was to investigate the differences in muscle strength in people with Parkinson's disease, right-handed for upper limb and right-footed for lower limb, that have one most affected side, right or left side, on the upper and lower body. The sample consisted of 26 individuals diagnosed with Parkinson's disease, right-handed for the upper limb and right-footed for the lower limb. Subjects needed to visit the laboratory one time to assess handgrip and knee extensors strength. There were no differences between sides in upper limbs affected by the disease, and there were no differences between sides in lower limbs affected by the disease, $p > 0.05$. There were no differences in strength between sides of the same body part affected by the disease. To say that people affected on the determined side are weaker than others may be a misconception since Parkinson's disease is idiopathic.

KEYWORDS: handgrip; isokinetic; Hoehn & Yard; handedness; substantia nigra.

INTRODUCTION

Parkinson's disease (PD) is a neurodegenerative disease characterized by progressive deterioration of the substantia nigra in the midbrain, which cause a decrease in dopamine production, and the dopamine reduction modifies the somatic motor activities, in addition to decrease muscle strength (Clael, 2018). Regarding the onset of motor symptoms, PD typically demonstrates unilateral impairments, with the side of onset often more affected throughout the disease course (Earhart & Falvo, 2013), causing asymmetry between limbs (Frazzitta, Pezzoli, Bertotti, & Maestri, 2013).

The development of asymmetry can worsen the quality of life of people with PD because it leads to progressive disuse of the most affected limb, inducing increased difficulties in daily living activities and motor tasks (Beretta et al., 2015). Therefore, the quantification of limb asymmetry with the aim of disease treatment is an optimal resource. Once the asymmetry is identified, the health professionals can be more accurate to indicate appropriate treatments, perhaps to improve strength on the most affected limb. Therefore, the isokinetic dynamometer and (Thistle, Hislop, Moffroid, & Lowman, 1967) the handgrip dynamometer are used to quantify muscle strength, and both are recommended for limbs assessments (Fess, 1992). Both types of equipment are considered the gold standard and widely used in the assessment of people with PD (Cano-de-la-Cuerda, Perez-de-Heredia, Miangolarra-Page, Munoz-Hellin, & Fernandez-de-Las-Penas, 2010; Olivola et al., 2018; Alomari, Khalil, Khabour, & Wood, 2018).

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The idiopathic nature of PD raises several questions, such as how the disease affects each person differently. For example, for the upper limb, the disease can affect the right side more, while for the lower limb, PD can affect the left side more. Regarding limb asymmetry, a variety of authors performed studies to investigate upper and lower limb asymmetries; however, some important methodological aspects were not reported, as the dominant side (Frazzitta et al., 2015; Yust-Katz, Tesler, Treves, Melamed, & Djaldetti, 2008). A person can be right-handed for the upper limb and left-footed for the lower limb, in addition, the PD could affect only the right side of this person, upper and lower, which can change the strength scores since the dominant side tend to be the strongest side (Noguchi, Demura, & Aoki, 2009), and a person right-handed for upper limb and left-footed for lower limb would produce less strength on the lower limb test.

Thus, the aim of the study was to investigate the differences in muscle strength in people with PD, right-handed for upper limb and right-footed for lower limb, that have one most affected side, right or left side, on the upper and lower body. We hypothesize that there will be differences between muscle strength of the limbs from the same body part.

METODOLOGY

This is an experimental, analytical study with exploratory, descriptive and explanatory objectives and mixed (quantitative and qualitative) approach.

Participants

Subjects with a confirmed diagnosis of PD and right-handed for upper limb and right-footed for lower limb were recruited. The subjects were selected using the convenience sampling technique. The exclusion criteria were any trauma that prevents participation in the study and the inability to perform any tests part of the research study.

Instruments

Subjects visited the laboratory one time for anamnesis, anthropometric measurements, handgrip strength and knee strength, respectively. Also, the data collected were carried out in the morning. Participants were classified in one of four stages of the modified Hoehn and Yahr scale (Goetz et al. 2004), therefore all the participants were assessed in "*on*" medication period and instructed not to do physical exercises 24 hours prior to the tests. Moreover, the handedness for the upper and lower body and the disease onset was defined by volunteer self-report. This study was approved by the Faculty of Health Sciences at the University of Brasília ethics committee, and all volunteers signed the consent form.

Handedness

To assess dexterity, the answers to the questions "Which hand would you use to throw a ball?" and "which foot would you use to kick a ball ?" was used (Van Melick, Meddeler, Hoogeboom, Nijhuis-van der Sanden, & Van Cingel, 2007). The answers were based on the volunteers' current conditions.

Handgrip strength test

To assess upper limbs strength, the Jamar® dynamometer was used with the protocol from the American Society of Hand Therapists (Fess, 1992). Prior to the trials, familiarization was performed with each hand by performing a submaximal squeeze, and the individual can choose with which hand started the test.

Isokinetic dynamometer

To assess lower limbs strength, the Biodex system III Isokinetic Dynamometer (Biodex Medical, Inc., Shirley, NY) was used, with our protocol (Clael et al., 2016). All warm-ups and trials had 60 seconds of rest interval and were performed only on the concentric phase. Participants performed two trials of knee extension for each leg, and the protocol was counterbalanced.

The Warm-up consisted of 1 set of 10 repetitions at 180º/s as follows: subjects were asked to do one maximum contraction and then to do 9 more contractions between 50% and 60% of the maximal effort. The trial consisted of 2 sets of 4 repetitions at 60º/s and 2 more sets of 4 repetitions at 180º/s. The trial with the highest value at each speed was used to determine the Peak Torque (PT).

Statistical analyses

For sample characterization, descriptive statistics were performed with mean and standard deviation for quantitative variables and simple frequency for qualitative variables. To verify data normality, the Shapiro-Wilk test was used. An independent *t*-test was used between body sides comparison, and the statistical significance level was set at $p \leq 0.05$. All analyses were performed using the SPSS 24.0 (IBM Corporation, Armonk, NY, USA, 24.0) for iOS.

RESULTS

A total of 26 individuals were right-handed and right-footed, affected from different sides (right or left) in different parts of the body (upper or lower) (Table1).

Table 1. Sample characterization.

Sample (n= 26)	Mean± SD
Age (years)	67.31± 6.09
Height (meters)	1.68± 0.10
Weight (kilograms)	69.92± 12.20
Gender	**Frequency**
Men	18
Women	8
Modified Hoehn & Yard	**Frequency**
Level 1	2
Level 1.5	3
Level 2	11
Level 2.5	6
Level 3	4
Upper limb affected	**Frequency**
Right	16
Left	10
Do not exist	0
Lower limb affected	**Frequency**
Right	15
Left	7
Do not exist	4

SD: standard deviation.

There were no differences between sides in upper limbs affected by the disease (Table 2).

There were no differences between sides in lower limbs affected by the disease (Table 3).

DISCUSSION

Since PD is idiopathic, the way the disease affects the strength in both sides and parts is quite variable because the dopamine reduction in the central nervous system begins to generate incapacity of strength in the dominant or non-dominant side. PD is a neurodegenerative disease characterized by progressive deterioration of the substantia nigra in the midbrain, causing a decrease in dopamine production (Obeso, Rodriguez-Oroz, Rodriguez, Arbizu, & Gimenez-Amaya, 2002). This reduction in dopamine results in a GABA mediated tonic inhibition of the thalamus, reducing the excitation of the thalamus on cortical projection areas. This, in turn, is manifested as an alteration in somatic motor activities commonly observed in patients with PD (Purves, 2005). Also, the results presented no differences between sides of the same part affected for strength. Thus, affirming that patients affected on the right side are weaker than those affected on the left may be a misconception (Frazzitta et al., 2015). In addition, the strength decrease in people with PD is global because after initiating the disease process, all symptoms affect mobility and are progressively incapacitating since the disease is degenerative.

People with PD have bradykinesia and hypokinesia, which are slow movement performance and movement

Table 2. Comparison between Handgrip Strength Test for both sides affected.

	Right side affected n= 16	Left side affected n= 10	p
Handgrip strength test right side	31.56 (± 7.73)	29.20 (± 8.23)	0.467
Handgrip strength test left side	31.19 (± 6.83)	26.50 (± 9.04)	0.146

Presented as mean and standard deviation. Handgrip strength test values are expressed in kilograms.force (kg.f).

Table 3. Comparison between peak torque for both sides affected.

	Right side affected n= 15	Left side affected n= 7	p
PT 60°/s right side	122.74 (± 37.08)	114.94 (± 38.99)	0.665
PT 60°/s left side	123.90 (± 39.76)	104.07 (± 44.75)	0.338
PT 180°/s right side	84.44 (± 25.91)	73.30 (± 23.15)	0.344
PT 180°/s left side	84.53 (± 26.34)	69.01 (± 31.32)	0.287

Presented as mean and standard deviation. PT: peak torque; PT values are expressed in Newton.meter (N.m).

reduction, respectively (Van Hilten, Van Eerd, Wagemans, Middelkoop, & Roos, 1998); because of both symptoms, this population have difficulty performing high-velocity movements. Moreover, over time, the performance of high-velocity movements becomes more difficult due to the advancement of the disease (Bayle et al., 2016) and the ageing process (Clark et al., 2010), hence to use 120º/s as speed may not be appropriate because this speed is not very fast neither very slow speed. Therefore, freezing is a common symptom and highly disabling state that generates fear and anxiety, which increases freezing, consequently rises immobility and generates strength deficits (Frazzitta et al., 2013).

Substantia nigra deterioration in PD starts in one side of the brain, reflecting directly on the somatic motor activities, showing the cross-relation between central command and movement control (Kempster, Gibb, Stern, & Lees, 1989). Scherfler et al. (2012) showed that dopamine transporter is reduced in the left side of the brain compared with the right side, but it is possible a type 2 error because approximately 63.23% of the sample had the right side affected (Field, 2013). Thus, to say that the population with PD is weaker just by having the onset of disease manifested on one side of the body becomes a little strange, and as has been shown by Barrett, Wylie, Harrison and Wooten et al. (2011), handedness is related to disease onset.

The ability to perform maximal strength takes into account some factors, such as the number of muscle fibres, the sending of the central command signal to the target muscle and the reduction of the antagonist's coactivation (William, McArdle, Frank, & Katch, 2016). Although people with PD have a lower percentage of fast-twitch fibres (Rossi et al., 1996), the sending signals for muscle contraction are flawed due to a decrease in dopamine production (Obeso et al., 2002), and antagonist's muscles are coactivated (Glendinning & Enoka, 1994). Also, the diminished strength may be related to diagnosis time (Corcos, Chen, Quinn, McAuley, & Rothwell, 1996), medicaments type (Fabbrini, Brotchie, Grandas, Nomoto, & Goetz, 2007), medicaments interaction (Aquino & Fox, 2015), balanced diet (Tan et al., 2018), sleep (Van Gilst, Van Mierlo, Bloem, & Overeem, 2015) and freezing (Pieruccini-Faria, Jones, & Almeida, 2014).

In healthy young men, there is a strong and positive association between right and left upper body sides (Fink, Weege, Manning, & Trivers, 2014); it appears that there is no asymmetry in this population. In healthy elderlies, most of the population has some asymmetry type between the upper and right sides of the body (McGrath et al., 2021). In healthy or depressed women, the upper right side of the body tends to be stronger (Crews & Harrison, 1994). These studies (Fink et al., 2014; McGrath et al., 2021; Crews & Harrison, 1994), together with our research, show that asymmetry behaves differently in each population.

In individuals with HIV, the dominant lower limb is stronger than the non-dominant one, which generates asymmetry (Oliveira, Wiechmann, Narciso, & Deminice, 2017). In individuals with multiple sclerosis, the lower limb most affected by the disease is weaker, and this causes an asymmetry between the lower limbs in the knee (Workman, Fietsam, & Rudroff, 2020). Healthy elderly people may present asymmetry of the lower limbs (LaRoche, Villa, Bond, & Cook, 2017). In untrained healthy young people, the dominance of the lower limb does not influence the strength of the knee extensors (Maly, Zahalka, Mala, & Cech, 2015), appearing that there is no asymmetry in untrained healthy young people. And a systematic review with meta-analysis showed that the dominant lower limb in healthy adults is stronger, which generates an asymmetry of lower limbs (McGrath et al., 2016). These studies (Oliveira et al., 2017; Workman et al., 2020; LaRoche et al., 2017; Maly et al., 2015; McGrath et al., 2016), together with our study show that asymmetry behaves differently in each population.

A result against our findings performed in individuals with PD found that individuals affected on the right side of the lower limb are weaker (Frazzitta et al., 2015). Asymmetry in individuals with some disease type should be approached with caution, especially in an idiopathic disease, such as PD.

There are limitations associated with the present study. The first limitation is the small sample size which reduces the statistical power and generalizability of our findings. The second limitation is that there are more people with the disease on the right side than the left side, which may have caused a type 2 error because the sample was not paired.

CONCLUSIONS

The results suggest no differences in strength between body sides of the same part affected by the disease. Future studies can fill the gaps that we left open. For practical applications, the affected side or the side of onset of the disease has no association with limb weakness; moreover, people who work with these populations do not need to focus their treatments on the most affected side, working equally on both sides.

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ORIGINAL ARTICLE

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Effects of virtual rehabilitation on postural control of individuals with Parkinson disease

Efeitos da reabilitação virtual no controle postural de indivíduos com doença de Parkinson

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ABSTRACT

Parkinson's disease causes a progressive decline of motor and cognitive functions, often affecting postural control. Training through virtual reality has been shown to be effective in improving this condition. This study aims to analyse the effects of the Kinect Adventures! games in postural control of people with Parkinson's disease. Ten individuals diagnosed with idiopathic Parkinson's disease, in stages I to III of the Hoehn & Yahr scale, aged between 48 and 73 years, were selected. Fourteen training sessions of one hour each, twice a week, were performed. Individuals were evaluated pre, post-intervention and 30 days after the last session of intervention by a force platform that measured the oscillation area and velocity of the centre of pressure in ten different sensory conditions and the Limits of Stability. Limits of Stability showed a statistically significant increase immediately after the training the 14 sessions, as were observed and there were no significant changes in oscillation area and velocity immediately after the intervention or 30 days after the end of training. The results of this study indicate that the training with Kinect Adventures! Games improve the postural control of people with Parkinson's disease, by increasing the Limits of Stability.

KEYWORDS: Parkinson disease; postural balance; virtual reality exposure therapy; video game.

INTRODUCTION

Parkinson's disease (PD) affects the central nervous system, being degenerative, chronic, and progressive (Benjamin & Joseph, 2001).

PD is the second most common senile disease (De Rijk et al., 1997), while the first is Alzheimer's disease. In Brazil, 3.4% of the population over age 64 is affected by the disease (Barbosa et al., 2006). PD incidence increases significantly with age, ranging from 17.4 to 93.1 out of 100.000 in people aged between 50 to 59 and 70 to 79, respectively.

The cardinal signs of PD are rigidity, bradykinesia, tremor, and poor posture (Souza et al., 2001), and it also compromises the cognitive and perceptual functions (Hamani & Lozano, 2003). The posture instability is one of the most limiting symptoms of the disease (Waterston, Hawken, Tanyeri, Jantti, & Kennard, 1993; Pompeu et al., 2012; Doná et al., 2015). In the light and moderate stages of the disease, it is noted a decrease in the area of the stability limit (Doná et al., 2015), even on the period *on* of dopaminergic replacement (Mancini, Rocchi, Horak, & Chari, 2008; Menant, Latt, Menz, Fung, & Lord, 2011). Fukunaga et al. (2014) showed that individuals with PD have more posture instability than healthy individuals considering changes in the distribution of weight, in the synchronization of postural oscillation right/left and toes/heel, in the frequency bands of postural oscillation and in the risk of tumbling.

Individuals with PD fall twice as much as elderly people without the disease (Dibble, Christensen, Ballard, &

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Foreman, 2008). Besides, the incidence of people with PD falling increases as time passes, suggesting that individuals with the disease are falling earlier over the years (Wood, Bilclough, Bowron, & Walker, 2002). Approximately 75% of people with PD have their balance harmed (Nilsson, Hariz, Iwarsson, & Hagell, 2012). The fear of falling is the biggest reason they do not practice any kind of physical exercise (Ellis et al., 2013). Because of that, new interventions are being proposed to improve the posture control of people with PD, being interactive video games among the suggestions (Pompeu et al., 2012; Pompeu et al., 2014).

The Kinect® from X-Box 360® is an updated system of the video game, developed from the movement reception by infrared, in a way that the player does not need platforms or controls to play, having more freedom in the movements to interact with the games. It is also a commercial videogame, easy to be accessed and portable.

Individuals with PD need higher cognitive engagement to perform motor tasks related to daily living activities. Also, more cognitive demand is involved in the motor learning process. Besides, motivation and feedback can reduce the motor learning deficit in PD. Visual and auditory external cues can help PD patients to maintain motivation and attention to perform the previously automatic movements (Mazzoni & Wexler, 2009; Redgrave et al., 2010; Wu & Hallett, 2007; Petzinger et al., 2013). The X-Box Kinect® promotes visual, auditory, motor, and cognitive stimuli, which can help the motor sensorial integration reflecting positively in postural control training (Pedalini & Bittar, 1999; Galna et al., 2014; Pompeu et al., 2014).

The Kinect games integrate three elements that are essential to motor learning: repetition, motivation, and feedback (Holden, 2005), being able to facilitate the learning and transference of abilities to daily life (Conradsson et al., 2015; Mendes et al., 2015). Once motor, cognitive and sensorial stimulus can help to modify, repair, and develop new neural networks, virtual reality could promote an improvement in motor behaviour, more specifically in postural control of this population (Sudhof & Malenka, 2008)."

The use of virtual reality games with patients with PD is recent, and there are still few studies that verified the aspects related to the games in the symptoms of the disease (Barry, Galna, & Rochester, 2014). Considering that postural instability is the most refractory cardinal sign of PD to the dopaminergic replacing treatment (Latt, Lord, Morris, & Fung, 2009), and that tumbles, walking conditions, and postural instability might lead to higher mortality and morbidity of people with PD (Ebmeier et al., 1990; Bennett et al., 1996), studies that evaluate, through quantitative methods, the effects of new interventions with chances to improve the postural control, such as the case with virtual reality games, are necessary.

Finally, this study aims to analyze the effects of training through Kinect Adventures! Games on the area of the stability limits and postural oscillation in conditions of static and non-static visual environment in people with PD.

METHODS

The study refers to a range of cases analyzed in the Center of Teaching and Research of the Physical Therapy, Speech and Occupational Therapy, Faculty of Medicine at the University of Sao Paulo, Sao Paulo, Brazil.

The present research was approved by the Ethical Committee of the *Universidade Federal de Sao Paulo*, with the number 226.672.

Participants

Ten subjects were selected, aged between 48 and 73, with the PD idiopathic, diagnosed by neurologists specialized in extrapyramidal diseases, according to the Brain Bank of the Parkinson Society criteria from the United Kingdom (Hughes, Daniel, Kilford, & Lees, 1992).

All selected subjects were between stage I and III in the Hoehn and Yahr scale; they were under drug-based treatment with Levodopa and/or their synergistic; they did not present any other detectable neurologic or orthopedic disease; they did not present any clinical sign of dyskinesias; they all had a Mini-Mental State Examination score higher than 22 (Folstein, Folstein, & Mchugh, 1975; Brucki, Nitrini, Caramelli, Bertolucci, & Okamoto, 2003; Holden, 2005; Mendes, 2015), with average grade adjusted by schooling (illiterate people: 17; 1 to 4 years old: 23; 5 to 8 years old: 25; 9 years old or older: 22); all had regular or corrected visual and hearing acuity; subjects did not have previous experience with Kinect system, and could not start or stop a rehabilitation program throughout the study.

Subjects who presented any kind of clinical change, such as cardiorespiratory, orthopedic, or neurologic changes, inhibiting the achievement of physical exercises in two feet standing, or individuals who did not agree in signing Free and Clarified Consent term of the study were excluded.

Measures

It was collected the oscillation area of the center of pressure (COP) and oscillation velocity of the center of pressure (VOS), besides the Limits of Stability (LOS), using a force plate the *Balance Rehabilitation Uniti* (BRU). The equipment

measures the elliptical area corresponding to 95% of the time gap of confidence in the excursions to the COP in the middle lateral to rearward directions and the VOS. The COP and VOS were quantified in static and non-static visual environments. The BRU software sends a stimulus to a head-mounted display (HMD; eMagin Z800 3D Vision, New York, NY, USA), eliciting oculomotor reflexes (saccades, optokinetic, and vestibulo-ocular).

The LOS test evaluates the ability to displace the COP in anteroposterior and lateral planes without risk of falling. An increase in LOS indicates good stability meaning that the individual has a higher area to sway with stability in daily activities. COP represents the vertical projection of the center of mass onto the ground (Tamburella, Scivoletto, Iosa, & Molinari, 2014), and its displacements were used to estimate the COP sway area used in this study. Anteroposterior (COPap) and mediolateral (COPml) displacement were recorded at a sampling frequency of 50 Hz (Suarez et al., 2011). The VOS means how fast the COP displacements occur. The lower the COP and VOS values, the greater the individual's static stability. This happens because it is expected that in a good static postural control, there will be a smaller area of oscillation of the COP and a smaller velocity of oscillation of the COP in this small existing area, corroborating with a more efficient strategy of maintaining posture.

To evaluate the LOS, the participants remained standing on the BRU in orthostatic posture and stretched arms through the body. After that, they were asked to move in rearward and middle lateral directions, through ankle movements, without having upper body movements. To evaluate the COP and the VOS, the participants were instructed to remain in a quiet position for 60 seconds in each of the 10 sensorial conditions tested. The conditions tested were:

1) orthostatic position on a hard floor, eyes open;
2) orthostatic position on a hard floor, eyes closed;
3) orthostatic position on the surface of foam pad, eyes closed;
4) orthostatic position on a hard floor, sacral stimulation;
5) orthostatic position on a hard floor, optokinetic stimulation with horizontal direction from the left to the right;
6) orthostatic position on a hard floor, optokinetic stimulation with horizontal direction from the right to the left;
7) orthostatic position on hard floor, optokinetic stimulation with vertical direction from the top to the bottom;
8) orthostatic position on a hard floor, optokinetic stimulation with vertical direction from the bottom to the top;
9) orthostatic position on a hard floor, optokinetic stimulation with horizontal direction associated to slow and uniform movements of rotation of the head;
10) orthostatic position on a hard floor, optokinetic stimulation with vertical direction associated to slow and uniform movements of flexo-extension of the head.

Virtual reality Glasses were used from the fourth to the tenth condition. In these conditions, the glasses promoted visual stimulus capable of giving postural reflex responses.

The sensory conditions tested aim to promote the assessment of static postural control of individuals in different environments, as in real life, since they encounter different surfaces and visual stimuli and need to react to some of them in daily life.

Procedures

The participants were evaluated by a blind evaluator in three moments: pre-intervention; immediately after the intervention; and after 30 days after the end of the intervention. The evaluation collected data of their LOS, COP and VOS under ten different sensorial conditions.

The intervention was composed of 14 individuals one-hour sessions, twice a week, during seven weeks, scheduled in a way that was combined with the period on dopaminergic replacement medication. In the sessions, the participants played 4 different games of the program Adventure! From the Kinect®, having 5 chances in each game. In the first session, each game was shown one time to the participant. Then, the participant had two chances of familiarity with each game, with a physiotherapist helping through verbal orders and manual guiding to correct their movements and posture and guide the participant concerning the objectives of the game. After it, the participant had 5 chances in each game without corrections from the physiotherapist, and the scores were registered.

The games selected for the interventions were:

(1) 20,000 Leaks;
(2) Space Pop;
(3) Reflex Ridge;
(4) River rush.

In the game "20,000 leaks", the player's avatar is in a glass cube underwater, and suddenly fish and sharks start to cause cracks and holes in the cube. The player's objective is to plug the cracks to avoid having water inside the glass cube, using their hands and feet, which require fast movements of these parts of the body. In the game "Space Pop", transparent balls (soap bubbles) shuttle between holes on the walls, floors and ceilings. The player attempts to pop the bubbles by touching them with their hands, moving their arms up and down just like a bird. In the game "Reflex Ridge", the player races on a platform, jump over hurdles, lean away from obstacles

and limbo to avoid hitting their heads on low beams. In the game "River rush" the player's avatar stands in a raft and goes down the river. The raft is controlled by stepping left or right to steer and jumping to jump the raft.

In general, the games stimulated the individuals to move in different directions in a fast and controlled way, walk in different directions, move their centre of mass, sit down and jump, move their upper and lower body in a coordinated way and move their upper body in the three plans of movements. Besides, the games presented cognitive demands such as taking decisions quickly, monitoring the place, selecting visual stimuli, unwanted responses and divided attention (Pompeu et al., 2014; Mendes et al., 2015).

Statistics analysis

The patients' demographic and clinical data were collected, and normality and homogeneity tests were carried out through the Kolmogorov-Smirnov and Levene tests, respectively. For the parametric variables, that were the LOS and the COP in three out of the ten different sensorial conditions (stable ground with closed eyes, stable ground with optokinetic vertical stimulus from the top to the bottom, and stable ground with vertical optokinetic stimulus associated with the flexo extension of the head), the comparisons in the three conditions (before, after the intervention, and 30 days after the intervention) were made using the ANOVA. The non-parametric variables involved the other seven sensorial conditions of the COP and the ten sensorial conditions in which the VOS was also tested. Kruskal Wallis tests were carried out. The alpha was set at 0.05, and the Confidence interval was 95%.

RESULTS

Table 1 presents the clinical and demographic characteristics of the participants of this study. The majority of the participants were classified in stage 1.5 of Parkinson's Disease, according to the Hoehn and Yahr scale, presenting unilateral and axial involvement.

Table 2 presents the results for parametric data, which were the LOS and three out of ten sensorial conditions in which the COP was evaluated. There was a significant increase in the LOS immediately after the intervention with the Kinect and maintenance of results after 30 days following the intervention's end. Concerning COP's three conditions, no significant decrease was observed in the oscillation area after the intervention as well as 30 days after the end of the intervention. However, in the three conditions, COP's average decreased

Table 1. Clinical and demographic characteristics.

Characteristics	Average (CI) or n (%)
Age, years	63.4 (56.7–70.1)
Women, n (%)	4 (40)
HY, n (%)	1.85 (1.4–2.3)
Stage 1	2 (20)
Stage 1,5	3 (30)
Stage 2	2 (20)
Stage 2,5	2 (20)
Stage 3	1 (10)
MEEM, escore	27.4 (25.6–29.2)
Schooling, years	10.6 (7.1–14.1)

CI: confidence interval; HY: Hoehn and Yahr scale; MESE: Mini-Mental State Examination.

Table 2. Effects of Kinect in sway of the center of body-pressure area in individuals with Parkinson's disease (n= 10) pre-intervention, post-intervention and 30 days after intervention (parametric data).

	Pre-intervention average (CI)	Post-intervention average (CI)	30 days after intervention average (CI)	p*		MDC
				Pre x post	Post x 30 days after	
LOS (cm^2)	126.1 (88.5–163.7)	161.1 (122.7–199.5)	165.3 (127.8–202.8)	< 0.05	> 0.05	46.1
COP (cm^2) Stable ground, CE	3.5 (1.6–5.4)	3.0 (1.4–4.7)	2.3 (1.1–3.6)	> 0.05	> 0.05	2.3
COP (cm^2) Stable ground, VOS from the top to the bottom	4.5 (0.9–8.0)	3.0 (1.2–4.7)	3.5 (1.5–5.5)	> 0.05	> 0.05	2.2
COP (cm^2) Stable ground, VOS flexo-extension head	4.7 (2.9–6.6)	4.6 (3.2–6.1)	6.1 (3.8–8.4)	> 0.05	> 0.05	2.3

CI: confidence interval; LOS: limits of stability (cm^2); COP: sway of the center of body-pressure area (cm^2); CE: closed eyes; VOS: vertical optokinetic stimulus; MDC: minimmal detectable changes. *Analysis by ANOVA; Test after Hoc de Tukey.

immediately after the intervention. In one of them, this reduction remained with lower numbers than the ones obtained in the pre-intervention until 30 days after the intervention.

The non-parametric data referring to COP in the other 7 sensorial conditions evaluated are presented in Table 3. No significant decrease of COP was observed in any of the sensorial conditions, nor after the intervention, or 30 days after the end of the intervention. In most of the conditions presented, it is possible to observe a tendency to increase the medians of the COP in the two evaluations after the end of the intervention.

Table 4 shows the results of the non-parametric data of VOS in 10 sensorial conditions tested. No significant alteration was observed of the VOS in none of the sensorial conditions.

Table 3. Effects of Kinect in sway of the center of body-pressure area in individuals with Parkinson's disease (n= 10) pre-intervention, post-intervention and 30 days after intervention, medians (non parametric data).

	Pre-intervention median (interquartile range)	Post-intervention median (interquartile range)	30 days after intervetion median (interquartile range)	p*		MDC
				Pre x post	Post x 30 days after	
Stable ground, EO	2.4 (3.2)	2.7 (4.8)	2.7 (3.1)	> 0.05	> 0.05	2.7
Unstable ground, CE	8.0 (4.5)	7.1 (10.6)	8.6 (6.5)	> 0.05	> 0.05	5.7
Stable ground, SS	1.6 (3.2)	2.6 (3.2)	2.2 (1.8)	> 0.05	> 0.05	3.3
Stable ground, OHS from L to R	2.4 (1.7)	2.4 (1.3)	2.8 (1.9)	> 0.05	> 0.05	6.4
Stable ground, OHS from R to L	1.9 (2.7)	2.7 (2.4)	2.8 (2.1)	> 0.05	> 0.05	3
Stable ground, VOS from bottom up	2.1 (3.2)	2.6 (2.5)	2.9 (2.6)	> 0.05	> 0.05	5
Table ground, OHS head rotation	3.9 (4.3)	2.9 (5.6)	4.7 (5.5)	> 0.05	> 0.05	3.4

COP: sway of the center of body-pressure area (cm^2); EO: eyes open; SS: saccadic stimulus; OHS: optokinetic horizontal stimulus; L: left; R: right; VOS: vertical optokinetic stimulus; MDC: minimmal detectable changes. * Analysis by Kruskal Wallis test.

Table 4. Effects of Kinect in the vertical optokinetic stimulus in individuals with Parkinson's disease (n= 10) pré-intervention, post-intervention and 30 days after intervention, median (non parametric data).

	Pre-intervention median (interquartile range)	Post-intervention median (interquartile range)	30 days after intervetion median (interquartile range)	p*		MDC
				Pre x post	Post x 30 days after	
Stable ground, EO	0.7 (0.6)	0.8 (0.3)	0.9 (0.3)	> 0.05	> 0.05	0.3
Stable ground, CE	1.0 (0.2)	1.0 (0.4)	1.0 (0.2)	> 0.05	> 0.05	0.2
Unstable ground, CE	2.0 (0.5)	2.0 (1.7)	2.1 (0.6)	> 0.05	> 0.05	0.7
Stable ground, SS	0.9 (0.4)	1.0 (1.7)	1.3 (0.5)	> 0.05	> 0.05	0.4
Stable ground, OHS from L to R	1.0 (0.8)	0.8 (0.5)	1.0 (0.3)	> 0.05	> 0.05	0.4
Stable ground, OHS from R to L	0.9 (0.7)	1.0 (0.3)	1.1 (0.4)	> 0.05	> 0.05	0.4
Stable ground, VOS from top to bottom	1.1 (0.6)	0.9 (0.2)	1.0 (0.3)	> 0.05	> 0.05	0.4
Stable ground, VOS, from bottom to top	1.0 (0.4)	1.0 (0.3)	1.0 (0.3)	> 0.05	> 0.05	0.4
Stable ground, OHS, head rotation	1.7 (0.7)	1.6 (0.6)	1.6 (0.6)	> 0.05	> 0.05	0.9
Stable ground, VOS, flexo- extension head	1.8 (0.6)	1.8 (0.3)	2.3 (0.8)	> 0.05	> 0.05	0.4

VOS: velocity of oscillation in the center of body pressure (cm/s); EO: eyes open; CE: closed eyes; SS: saccadic stimulus; OHS: optokinetic horizontal stimulus; L: left; R: right; VOS: vertical optokinetic stimulus; MDC: minimmal detectable changes. * Analysis by Kruskal Wallis test.

DISCUSSION

This study analyzed the postural control of people with PD before, after, and after 30 days of intervention using Kinect® X-Box 360®.

The results of this study indicate a significant increase in the LOS immediately after the intervention, which means that the participants had an increase in the stability area, in other words, an increase in the area of rearward and lateral mobility through ankle movements. These increases allowed a better displacement of weight during the performance of tasks, better stability guaranteed, reducing the chances for these people to fall (Shenkman, 2011). In this way, the increase of LOS indicates that the patient presents a bigger area to sway without the risk of falling.

Besides, the recovery of balance is done under three strategies: ankles, hips, and step. The adjustment of the ankles is the first balance strategy activated by a slight disruption that moves the center of mass of a person's body. Therefore, the increase of the LOS indicates a better efficacy in the balance recovery, once the disruption has to be bigger to avoid the balance recovery by the ankles strategy and activate the hips strategies (Folstein et al., 1975; Hughes et al., 1992; Brucki et al., 2003; Richards, 2008; Shenkman et al., 2011). However, new studies are necessary to quantify the postural responses when facing external disorders to associate the increase of the LOS with the increase of efficiency in the recovery of balance.

It was expected that the values of the COP and the VOS would be decreased after the intervention, suggesting that the center of mass was being kept within the static support base with smaller and more controlled oscillations, lowering the number and risk of falling (Stel, Smit, Pluijm, & Lips, 2003). This could indicate an improvement in the static balance of the participants in the different sensorial conditions described in this study. These conditions mimic different environments and could appoint a possible decrease in the risk of falling in daily situations that require a static postural control in a stable or unstable surface while some visual stimuli are given and the individual needs to respond with some head movements (Folstein et al., 1975; Hughes et al., 1992; Brucki et al., 2003; Mendes et al., 2005; Richards, 2008; Shenkman et al., 2011).

There was no significant decrease in the COP and the VOS in this study, and it can be explained by the ample motor flotation presented in the PD and by the small sample of this study.

Motor flotation is common in the PD as it progresses. Studies show the appearance of flotations in people with PD, and the results showed that 58% of the people developed motor flotations after an average time of 35 months after the beginning of drug treatment with Levodopa. In this way, the fact that it was not observed a significant change in the COP and the VOS in the study could have happened due to the great motor flotation in people with PD, reflecting the values obtained in the evaluations after the intervention.

The chosen Kinect games for the training developed in this study stimulated upper and lower limbs movements in general, changes of direction, and it also cognitively stimulated the participants, since they were challenged to not only develop motor tasks but also to make decisions based on the virtual environment (Pompeu et al., 2014; Mendes et al., 2015). According to the tasks of each game, the participants had to move fast and develop abilities of postural adjustment that they possibly did not have before. Besides, the participants were challenged to improve their motor performance through intense visual and hearing feedback from the game (Barry et al., 2014). And it can have positively contributed to the increase of the LOS (Folstein et al., 1975; Ebmeier et al., 1990; Hughes et al., 1992; Bennett et al., 1996; Brucki et al., 2003; Mendes et al., 2005; Richards, 2008; Latt et al., 2009; Barry et al., 2014; Conradsson et al., 2015). The increase of the LOS could also be related to the decrease of the muscle and axial rigidity, bradykinesia, and the increase of the articular mobility. In addition, during games, individuals were constantly in movement, contributing to an increase in dynamic balance. Unlike COP and VOS measurements, in which greater static postural control is required, the LOS measurement depends on good dynamic postural control, and its improvement can be related to better dynamic control stimulated by the games.

The postural control depends on these four factors associated: the LOS, static balance, dynamic balance (during the movement), and balance recovered (in external disruption situations of balance) (Ebmeier et al., 1990; Hughes et al., 1992; Bennett et al., 1996; Brucki et al., 2003; Latt et al., 2005; 2009; Barry et al., 2014; Conradsson et al., 2015). Considering that, the results of this study indicate that the training with virtual reality games from the Kinect system improves the area of postural stability, which allows individuals with PD to sway their body with more safety and less risk of accidents, such as falling.

CONCLUSIONS

In conclusion, the results indicate that the training with Kinect Adventures! Games improved the postural control of people with PD by increasing the LOS. Studies with a larger number of participants are necessary to verify if virtual reality games also influence the area and oscillation speed of the COP in different sensorial conditions.

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ORIGINAL ARTICLE

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Strength training with blood flow restriction in HIV patients positive: a case study

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ABSTRACT

This study purposed to compare responses of segmented neutrophils, monocytes, lymphocytes, and T lymphocyte Clusters of Differentiation 4 and 8 to blood flow restriction training in HIV patients. Two HIV patients participated in the study, one patient had a sedentary lifestyle, and the other was physically active. HIV-infected female patients performed a blood flow restriction training session consisting of two exercises: flat bench press and knee extension. Blood (6 mL) was collected for analysis prior to training, immediately after training, and 30 minutes after. After blood flow restriction training, percentage changes in the number of leukocytes were observed in both patients. Monocytes showed different responses in the two patients: a decrease in monocyte count was seen in the physically active, and an increase was observed in the sedentary lifestyle. Lymphocytes showed a higher increase in the physically active than in the sedentary lifestyle. There was an increase in the CD4+ / CD8+ T lymphocyte ratio in both patients. It was concluded blood flow restriction promoted acute inflammation after training, shown by changes in immune cell counts. These changes did not promote immunosuppression; instead, an increase in CD4+ / CD8+ T lymphocyte ratio was observed; and HIV-infected came similar results.

KEYWORDS: muscle strength; acquired immune deficiency syndrome; HIV-1; exercise; Kinanthropometry.

INTRODUCTION

Various treatments have been proposed as part of the search for increased life expectancy and quality of life for HIV-infected patients. The primary pharmacological strategy for HIV treatment is highly active anti-retroviral therapy (HAART). HAART may produce severe side effects such as metabolic syndrome and lipodystrophy (Bittencourt, 2007; Castelo Filho, & Abrão, 2007). Physical exercise has shown to be effective in redistributing adipose tissue (Santos, Pereira, Silva, Lazzarotto, & Petersen, 2013) and improving metabolic syndrome (Lauriola et al., 2010), and it has been recommended as a strategy to be used together with HAART (Brasil, 2008). Furthermore, the use of blood flow restriction (BFR) in HIV-infected patients showed a significant increase in muscle strength and skeletal muscle tissue as much as traditional training (Alves et al., 2020).

Among previously studied methods, Lazzarotto et al. (2010) reported eight studies in which concurrent training with single or multiple series was used and observed that both types of training improved muscle and cardiorespiratory function. Calabrese and LaPerriere (1993) complemented these data, stating that exercises for asymptomatic patients should not be restricted and that such exercises may include high-intensity activities. On the other hand, patients who have shown at least one symptom may exercise but should be careful to avoid exhaustion.

Studies show that high-intensity physical exercise temporarily depresses the immune system, providing an "open

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window" for the development of infections (for example, upper respiratory tract infections) that may last for up to 72 hours after a training session, whereas exercise of mild to moderate intensity contributes to the maintenance and optimisation of immune responses (Nieman & Nehlsen-Cannarella, 1994). Despite this, some authors have used training loads of 70 to 80% of one-repetition maximum (1 RM) during strength training sessions of HIV patients, a regimen that resulted in chronic improvement of immune markers (Brito et al., 2013; Mendes et al., 2013).

Similarly, BFR has been used in strength training for more than four decades (Sato, Yoshitomi, & Abe, 2005). This method aims to increase muscle mass by combining low-intensity loads (20–40% of 1 RM) with compression of the upper or lower limbs by a sphygmomanometer cuff or a pneumatic tourniquet, thus, causing less mechanical stress. It can be a better method to use with patients on rehabilitation, as in patients with some inflammatory disease (Patterson et al., 2019), like in people living with HIV (Alves et al., 2020). Due to this advantage, testing this method in patients with special conditions, such as HIV-infected patients, has been proposed (Brito et al., 2013). However, the immune and inflammatory mechanisms involved in response to this type of training are complex and are still not completely clear.

About this topic, it is possible to state that after an exercise training session, the leukocyte count tends to decrease after 30 minutes, reaching lower numbers than baseline or pre-exercise levels (Dias, 2009) as a result of redistribution and apoptosis, mainly of neutrophils and lymphocytes (Pedersen et al., 1997; Pedersen & Hoffman-Goetz, 2000; Leandro, Castro, Nascimento, Pithon-Curi, & Curi, 2007; Walsh et al., 2011; Freidenreich & Volek, 2012) with neuroendocrine factors, especially cortisol, being one of the causes of this leukopenia (Pedersen & Hoffman-Goetz, 2000; Malm et al., 2004).

We hypothesized that the BFR training modulates the immune response without promoting immune suppression in people living with HIV. Our aim was to assess the modulation of leukocytes and the immunoinflammatory effects of BFR in HIV patients to permit clarification of the inflammatory and immunosuppression processes involved in this type of training and its relationship to hormonal responses (Pedersen et al., 1997; Leandro et al., 2007; Paulsen, Raastad, & Peake, 2012).

METHODS

Participants

This case study describes the response of segmented neutrophils, monocytes, lymphocytes, and lymphocyte subpopulations (CD4+ T and CD8+ T lymphocytes) to BFR training in two (2) HIV-infected patients. The physically active patient (ACTIV) was 37 years old, and her body mass was 46.6 kg, and her height was 1.58 m, yielding a BMI of 18.67 kg/m^2. The patient with a sedentary lifestyle (SED) was 39 years old and BMI= 31.37 kg/m^2 (weight= 85.4 kg; height= 1.65 m). The present research was approved by the Research Ethics Committee of the Health Sciences Centre of the Federal University of Paraíba, according to National Health Council Resolution CNS 466/12 (Number: 444.854).

The patients enrolled in this study were female and had clinical conditions that permitted the use of strength training as assessed by the medical team of the HIV/AIDS Specialised Care Service. The exclusion criteria included negative peripheral arterial disease, availability to train, not signing an informed consent form, and use of anti-retroviral therapy.

Blood analysis

Blood (6 mL) was collected from the median cubital vein of each participant before the training session began (Federal), immediately after the training session (post), and 30 minutes after training (30 min). After collection, the blood was transferred to two test tubes containing ethylenediaminetetraacetic acid-EDTA-K3 (0.15% volume/final volume solution). Two millilitres of blood were placed in one test tube to be used for the white blood cell (WBC) count, and 4 mL was transferred to another tube to be used for CD4+ and CD8+ T lymphocyte counts. All biological material was stored in insulated boxes at room temperature (18º–22°C) for a maximum of two hours.

WBC was performed at the Clinical Analysis Division of the Haematology Laboratory, Lauro Wanderley University Hospital, Federal University of Paraíba. Samples were homogenised in a homogeniser for haemogram tubes and subsequently analysed in a Cobas Mira Plus® (Roche Diagnostic System) biochemistry analyser. Lymphocyte subpopulation counts were performed at the Public Health Central Laboratory of the State of Paraíba (*Laboratório Central de Saúde Pública do Estado da Paraíba* — LACEN-PB) using flow cytometry equipment (FACSCalibur®, Becton Dickinson, San Jose, CA, United States of America) with a coefficient of variation of 3% for the analysis of CD4+ and CD8+ T lymphocytes.

Anthropometric assessment

Body mass was measured with a 100-g precision scale, and height was measured with a 0.1 cm precision stadiometer attached to the scale. Body mass index (BMI) was calculated using the following Equation 1:

$$BMI = \frac{Mass}{Height^2} \quad (1)$$

Blood flow restriction assessment

Restriction pressure (mmHg) was determined according to Laurentino et al. (2012) using a blood pressure sphygmomanometer (18 cm wide x 80 cm long) placed on the inguinal region of the thigh. A sphygmomanometer with a 12 cm wide x 50 cm long cuff was placed in the proximal area of each arm to determine the occlusion point of the upper limbs. The cuff was inflated until the auscultation pulse of the tibial (for lower limbs) or the radial (for upper limbs) artery was interrupted; the restriction pressure was calculated as 80% of the maximum arterial occlusion pressure (AOP). For vascular assessments, the patients reclined in a supine position for a Doppler exam with portable equipment (DV2001-Medpej). The transducer was placed on the skin with coupling gel towards the trajectory of the dorsal artery of the foot (lower limb point of restriction) and the radial artery (upper limb point of restriction) at a 60º angle.

One-repetition maximum assessment

To determine the percentage of exercise load for each participant, the 1 RM test was performed according to the mathematical model proposed by Baechle and Groove (2000) – Equation 2:

$$1\ RM = load \times [(0.0375 \times reps) + 0.978 \quad (2)$$

To minimise the test's margin of error, the volunteers received standard instructions prior to the tests to allow them to be aware of all data collection procedures (Dias et al., 2005). Thus, the following procedures were adopted: the patients received information on the technical aspects of exercise execution; the researchers monitored the techniques used by the patients during the exercises; the test began with a warm-up that consisted of four to 10 repetitions at 50% of the load used for the test; after a five-minute break, the exercise was performed at 80 to 100% maximum load; the participants attempted to perform the maximum number of repetitions until concentric failure; if the number of repetitions was greater than ten (10), the load was adjusted, and the participant repeated the exercise after a three- to five-minute break. The participants were inactive for a period of 48 hours prior to the training sessions.

Training sessions

Training sessions started with a warm-up on an exercise bicycle. The resistance exercises were performed at an intensity of 30% of 1 RM with blood flow restriction. Four sets (one set of 30 repetitions and three sets of 15 repeats) totalizing 75 repetitions with a 30-second interval between sets. An interval of 2-minutes between exercises was taken for each exercise. The speed of repetitions was monitored using a digital metronome that provided a rhythm of two seconds in each movement phase (concentric and eccentric). A phase of adaptation preceded the training phase to the exercises and the BFR pressure device. Two strength exercises were performed: one for the muscle groups of the upper body (flat bench press) and another for the lower limbs (knee extension).

Statistical analysis

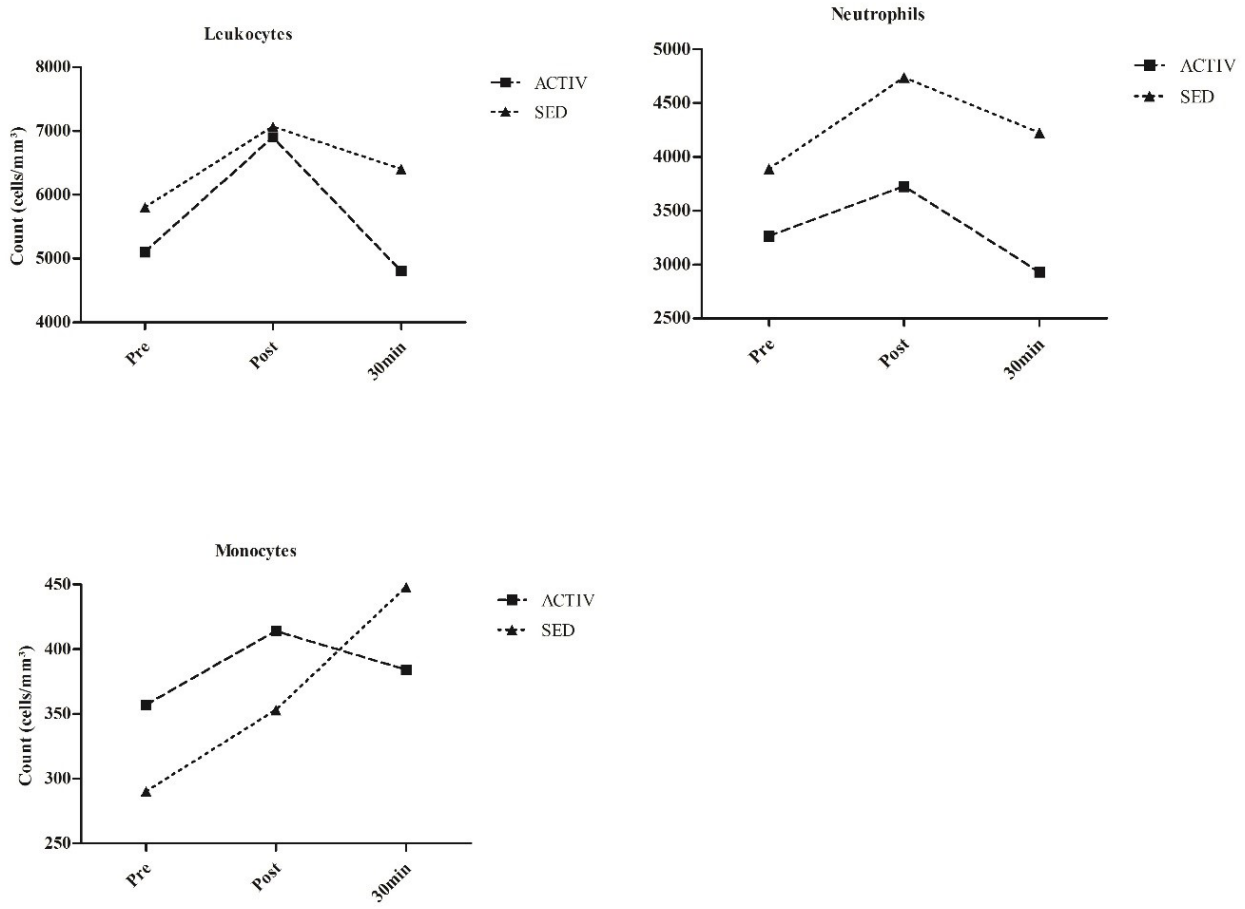
Descriptive statistics were used to present pre-intervention data. To assess time effects, percentage variations ($r\%_1$) in blood tests before and immediately after training ($r\%_1$), immediately after and 30 minutes after training ($r\%_2$) and before and 30 minutes after training ($r\%_3$) are shown. Data showing the effects on patients are presented in graphical form.

RESULTS

The ACTIV had been infected with HIV for more than 10 years and was in an asymptomatic disease stage. This patient had been working out for two months at a frequency of two training sessions per week. Her HAART regimen included Tenofovir, Lamivudine, and efavirenz. Coronary disease risk was predicted by the waist-hip ratio (WHR) as moderate (WHR= 0.78), and peripheral obstructive vascular disease was negative (ABI= 0.96). The result of the submaximal dynamic force test was 22.75 kg for the flat bench press and 50.56 kg for knee extension.

The SED had also been infected with HIV for more than 10 years and was in an asymptomatic disease stage. She was not physically active in her free time. Her HAART regimen included Biovir (lamivudine+ zidovudine) and Kaletra. Coronary disease risk predicted by WHR as very high (WHR= 0.96), and peripheral obstructive vascular disease (ABI= 1.02). The result of the submaximal dynamic force test for flat bench press was 27.00 kg, and for knee extension was 88.00 kg.

After one BFR training session, leukocyte modulation was observed in both patients (Figure 1) [ACTIV (pre= 5100 cells/mm^3; post= 6900 cells/mm^3; 30 min= 4800 cells/mm^3); SED (pre= 5800 cells/mm^3; post= 7069 cells/mm^3; 30 min= 6400 cells/mm^3)]. In both patients, modulation was primarily due to changes in the number of neutrophils [ACTIV (pre= 3264 cells/mm^3; post= 3726 cells/mm^3; 30 min= 2928 cells/mm^3); SED (pre= 3886 cells/mm^3; post= 4736 cells/mm^3; 30 min= 4224 cells/mm^3)]. Monocytes responded differently in the two



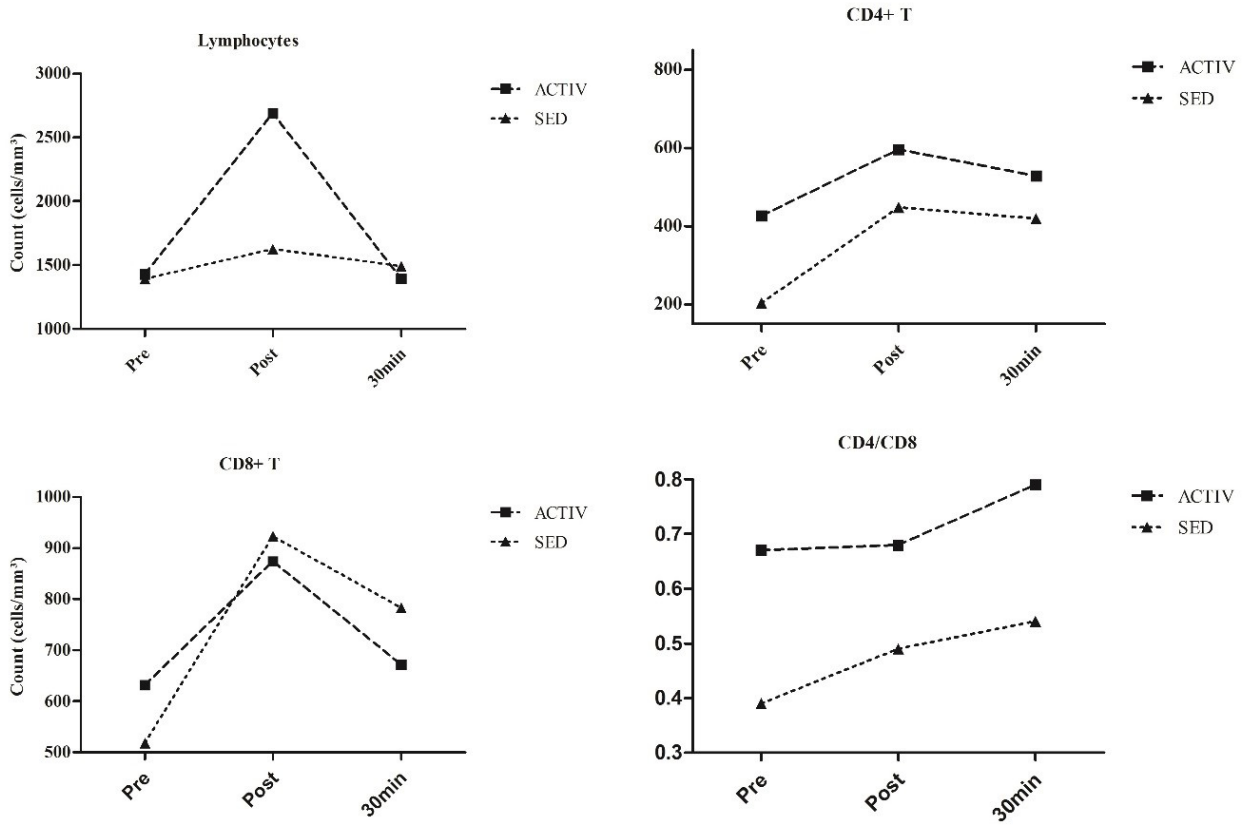
ACTIV: values for physically active; SED: sedentary; Federal: HIV-infected patients prior to the training session; post: immediately after training; 30 min: 30 minutes after training.

Figure 1. Responses of leukocytes, neutrophils and monocytes to blood flow restriction training.

patients, showing reduced counts in the ACTIV and increased counts in the sedentary patient [ACTIV (pre= 357 cells/mm^3; post= 414 cells/mm^3; 30 min= 384 cells/mm^3); SED (pre= 290 cells/mm^3; post= 353 cells/mm^3; 30 min= 448 cells/mm^3)].

Lymphocyte modulation was more intense in the ACTIVE than in the SED (Figure 2) [ACTIV (pre= 1428 cells/mm^3; post= 2691 cells/mm^3; 30 min= 1392 cells/mm^3); SED (pre= 1392 cells/mm^3; 1626 cells/mm^3; 30 min= 1492 cells/mm^3)]. By studying the modulation occurring in lymphocyte subpopulations, similar variations were found in CD4+ T and CD8+ T cell counts [CD4+ T: ACTIV (426 cells/mm^3; post= 596 cells/mm^3; 30 min= 528 cells/mm^3); SED (pre= 203 cells/mm^3; post= 448 cells/mm^3; 30 min= 419 cells/mm^3); CD8+ T: ACTIV (pre= 632 cells/mm^3; post= 874 cells/mm^3; 30 min= 672 cells/mm^3); SED (pre= 518 cells/mm^3; post= 923 cells/mm^3; 30 min= 783 cells/mm^3). These results showed an increase in the CD4+ / CD8+ T lymphocyte ratio in both patients (pre= 0.67; post= 0.68; 30 min= 0.79); SED (pre= 0.39; post= 0.49; 30 min= 0.54)].

About percentage variations (Δ%) in blood, both patients had an increase when compared the moments before and immediately after training following by a decrease between before and 30 minutes after training, except for monocytes in SED. Leukocytes showed Δ% for ACTIV ($\Delta\%_1$= 35,29; $\Delta\%_2$= -30,43; $\Delta\%_3$= -5,88) and SED ($\Delta\%_1$= 21,88; $\Delta\%_2$= -9,46; $\Delta\%_3$= 10,34), for neutrophils the Δ% was ACTIV ($\Delta\%_1$= 14,15; $\Delta\%_2$= -21,42; $\Delta\%_3$= -10,29) and SED ($\Delta\%_1$= 21,47; $\Delta\%_2$= -10,81; $\Delta\%_3$= 8,70) and monocytes showed ACTIV ($\Delta\%_1$= 15,97; $\Delta\%_2$= -7,25; $\Delta\%_3$= 7,56) and SED ($\Delta\%_1$= 21,72; $\Delta\%_2$= 26,91; $\Delta\%_3$= 54,48). For the lymphocytes, the variation was ACTIV ($\Delta\%_1$= 88,45; $\Delta\%_2$= -48,27; $\Delta\%_3$= -2,52) and SED ($\Delta\%_1$= 16,81; $\Delta\%_2$= -8,24; $\Delta\%_3$= 7,18) and the lymphocytes subpopulations CD4+ T showed ACTIV ($\Delta\%_1$= 39,91; $\Delta\%_2$= -11,41; $\Delta\%_3$= 23,94) and SED ($\Delta\%_1$= 120,69; $\Delta\%_2$= -6,47; $\Delta\%_3$= 106,40); CD8+ T ACTIV ($\Delta\%_1$= 38,29; $\Delta\%_2$= -23,11; $\Delta\%_3$= 6,33) and SED ($\Delta\%_1$= 78,19; $\Delta\%_2$= -15,17; $\Delta\%_3$= 51,16); and CD4+ / CD8+ T ACTIV ($\Delta\%_1$=



ACTIV: values for physically active; SED: sedentary; Federal: patients prior to the training session; post: immediately after training; 30 min: 30 minutes after training.

Figure 2. Lymphocyte and sublymphocyte responses observed in blood flow restriction.

1,49; $\Delta\%_2$= 16,18; $\Delta\%_3$= 17,91) and SED ($\Delta\%_1$= 23,08; $\Delta\%_2$= 12,50; $\Delta\%_3$= 38,46).

DISCUSSION

This study demonstrates the involvement of the immune system in the adaptation to BFR training and elucidates the mechanisms involved in such adaptation. In addition, the effects of this training method in chronically infected and immunosuppressed HIV patients were documented. In neither case studied, immunosuppression was observed above 30 minutes after the end of the training session, as showed in a study that demonstrated a significant increase in the count immediately post-exercise with a decrease in leucocyte count only 30 minutes after and 24 hours post-training (Souza et al., 2019).

The leukocyte modulation observed in the patients participating in this study shows evidence of an inflammatory response caused by BFR training, followed by rapid recovery, according to Souza et al. (2019). This response caused leukocyte demargination, resulting in leukocytosis (an increase in the number of circulating leukocytes). Other investigators have explained this increase by shear stress, increased circulating catecholamines, and increased cardiac output (Baganha, 2009; Walsh et al., 2011). In one study, leukocyte count was reduced 30 minutes after training, reaching a lower number than that observed in baseline or pre-exercise levels; this corroborates the findings of Dias et al. (2009) and is a likely consequence of leukocyte redistribution and apoptosis (Walsh et al., 2011).

In addition to inflammatory mechanisms, Raastad et al. (2003) observed an inversely proportional relationship between leukocyte accumulation and muscle strength after training. Due to this relationship, leukocyte modulation may be considered a valid and reliable marker of damage to skeletal muscles (Paulsen et al., 2012). Based on this information, it can be deduced that BFR training promoted tissue damage and functional adjustments of strength immediately after training in patients with HIV/AIDS.

Neutrophils are the first cells to arrive at the inflammation site and greatly contribute to leukocytosis following exercise (Peake, Nosaka, & Suzuki, 2005). Catecholamines have been indicated as one of the main causes of this neutrophilia, which results from an increase in muscle blood flow and a reduction in neutrophil adhesion due to the downregulation of adhesion molecules (Gray, Telford, Collins, & Weidemann, 1993). Based on our data, HIV-positivity and physical aptitude do not affect neutrophil demargination and seem not to affect catecholamine levels in BFR training.

Concerning monocytes, it has been reported in the literature that HIV viral replication causes an increase in oxidative stress due to chronic activation of the immune system, which consequently leads to monocyte activation (Israel & Gougerot-Pocidalo, 1997); however, at baseline, no difference was observed between healthy and HIV-positive subjects. In response to physical exercise, the number of monocytes in the blood slightly increases (monocytosis), probably due to an increase in cortisol and catecholamine levels (Walsh et al., 2011).

In our study, a greater increase in monocyte modulation occurred in the sedentary HIV-infected patient. Once the SED showed an increase in monocytes, this suggests that being physically inactive or having a higher BMI may affect the timing of monocyte responses to BFR training. These immune cells act as inflammatory signals by producing IL-1, IL-6, IL-8, IL-15, and TNF-α (Terra, Silva, Pinto, & Dutra, 2012), removing debris, and participating in tissue remodelling (Kanda et al., 2013); monocytes may take up to two hours to reach peak count (Walsh et al., 2011).

The differences in lymphocyte count observed in this study between pre and post-training and between immediately after and 30 minutes after training corroborate published data (Todo-Bom & Mota-Pinto, 2007; Kanda et al., 2013). Because lymphocytes express a high number of ß2-adrenergic receptors and these receptors tend to increase with exercise, a more significant increase might be expected in ACTIVs.

The expression of ß2-adrenergic receptors differs among lymphocyte populations: it is higher in CD8+ T lymphocytes than in CD4+ T lymphocytes (Walsh et al., 2011). For this reason, after very intense exercise, the CD4+ / CD8+ T lymphocyte ratio could be reduced; this would be associated with immunosuppression (Leandro et al., 2007) due to a higher increase in CD8+ T lymphocytes in comparison with CD4+ T lymphocytes. However, the BFR training method used in this study led to a rise in the CD4+ / CD8+ T lymphocyte ratio that maintained immunocompetence, even though this method produces results similar to high-intensity training.

Respecting the limitations of this research, that is, a small number of participants, low volume session and analysis time course up to 30 minutes after the conclusion of the training session, yet this study shows signs of safety for the application of the strength training method with BFR for people living with HIV.

CONCLUSIONS

In conclusion, BFR promoted acute inflammation after training, shown by changes in immune cell counts. These changes did not promote immunosuppression nor represent increased secretion of Cortisol and catecholamines; instead, an increase in CD4+ / CD8+ T lymphocyte ratio was observed; and HIV-infected came similar results.

This study shows similar results in the effectiveness of BFR training for booth HIV-infected patients undergoing HAART and have similar results between a sedentary and a ACTIV. However, additional studies with larger sample sizes are needed to confirm this hypothesis. In future studies, immune system cell functions and the possible effects associated with cytokines, chemokines, adipocytokines, and hormones should be analysed.

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ORIGINAL ARTICLE

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Reliability of the handheld dynamometer in the evaluation of the muscle strength of trunk extensors in healthy adults

Confiabilidade do dinamômetro manual na avaliação da força muscular de extensores de tronco em adultos saudáveis

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ABSTRACT

The muscular performance of the lumbar spine is frequently assessed in studies that compare populations with and without low back pain. However, the gold standard equipment used to evaluate the strength of these muscles has a high cost. Therefore, rarely used in the clinical practice of health professionals, being the handheld dynamometer an accessible alternative for use in clinical practice. Therefore, this study aimed to determine the reliability of the handheld dynamometer in the measurement of maximum voluntary isometric contraction of trunk extensors in healthy adults. Twenty-six healthy adults of both sexes (21.53± 1.88 years old) performed the test and retest with a 1-week interval. The comparison between test-retest demonstrated high and very high intraclass correlation coefficient for peak strength (0.82; 0.60 to 0.92) and mean strength (0.90; 0.76 to 0.95), respectively. Also, the Bland-Altman analyses indicate an error of 5.10 kg for peak strength and 5.7 kg for mean strength. In addition, the minimum detectable change for peak strength was 6.03kg (16.18%) and 5.92 kg for mean strength (20.95%). In conclusion, the test presents high reliability for the extensor muscles of the trunk in healthy adults. Therefore, the use of the handheld dynamometer can be indicated for clinical practice.

KEYWORDS: manual dynamometer; assessment; force; back strength; evidence-based practice.

INTRODUCTION

Low back pain is one of the most common musculoskeletal condition worldwide (Hoy et al., 2012). Moreover, it is the condition that demonstrates the highest level of disability (James et al., 2018). Therefore, the muscular performance of the lumbar spine is frequently assessed in studies since individuals with chronic nonspecific low back pain may present a high level of weakness and fatigue muscle compared to healthy individuals (Villafañe et al., 2016). Also, low back pain can affect young individuals, adults, and older adults, being most common between 30 and 60 years, being a significant determinant for absence from work (Yahia et al., 2010; Singh, Bailey, & Lee, 2013; James et al., 2018). Thus, strengthening the trunk muscles plays an important role in preventing and rehabilitating spine musculoskeletal dysfunctions.

Consequently, reliable evaluations of the strengthening of the trunk are necessary to define parameters for the rehabilitation process correctly. Due to the importance of muscle evaluations, some systematic review studies have

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already investigated the reliability of trunk performance tests. However, the majority of studies use muscular resistance as a way to infer the strength of this musculature (Demoulin, Vanderthommen, Duysens, & Crielaard, 2006; Carlsson & Rasmussen-Barr, 2013; Demoulin et al., 2016; Denteneer et al., 2018; Villafañe et al., 2016).

In another way, for an objective measurement of muscular force, the literature recommends the use of an isokinetic dynamometer, considered the gold standard in the evaluation of muscle strength in an open kinetic chain, for several body segments (Caruso, Brown, & Tufano, 2012; Zapparoli & Riberto, 2017) and health conditions (Pua, Bryant, Steele, Newton, & Wrigley, 2008; Jørgensen, Dalgas, Wens, & Hvid, 2017; Kristensen, Stenager, & Dalgas, 2017). However, due to the sophisticated technological characteristics and high cost of purchase and maintenance (Mavroidis et al., 2005), the use of isokinetic equipment is almost always restricted to the research environments, being almost inaccessible to all health professionals in clinical settings. Therefore, the handheld dynamometer is alternative equipment to substitute the isokinetic dynamometer (Kolber & Cleland, 2005; Bohannon, 2006), which is easy to handle, portable, and has a low purchase cost. The validity of the handheld dynamometer in relation to the isokinetic dynamometer and its reliability was demonstrated after a systematic review study in 2011 (Stark, Walker, Phillips, Fejer, & Beck, 2011), which strongly recommended its use in clinical practice. In this review, 17 studies were included, and minimal differences were detected in relation to the gold standard. However, evidence was reported for the knee, shoulder, elbow, hip, and ankle joints and, of the 17 included studies, none of them measured the strength of the trunk muscles.

Furthermore, the first studies on the reliability of the isometric trunk strength measurement were published recently. The first one, in 2015, performed the trunk extension strength test with the individual standing, using a metallic structure to support the handheld dynamometer (Jubany, Busquets, Marina, Cos, & Angulo-Barroso, 2015). In 2017, Harding et al. analysed the intra-examiner reliability in healthy subjects with a similar method. The handheld dynamometer was positioned between the participant's trunk and the wall, without the metal structure. Differently, also in 2017, the test was performed in the sitting position in an open kinetic chain in individuals without trunk impairments (Park, Baek, Kim, Park, & Kang, 2017). Therefore, considering the small number of studies objectively investigating the trunk strength and related topics to the lumbar spine, more evidence about the reliability of measures for this segment seems required. Thus, this study aimed to determine the reliability of the handheld dynamometer in the measurement of maximum voluntary isometric contraction of trunk extensors in healthy adults.

METHODS

Type of study

This is a prospective test-retest reliability study.

Ethical aspects

The Ethics and Human Research Committee of the University of Brasilia approved this study on August 15th, 2019, under protocol 3,509,474, according to resolution 196/96 of the National Health Council. Participation in the study was voluntary and, after clarification of the study's objectives and procedures, the Informed Consent Form from all participants was obtained prior to the beginning of the research.

Participants

Participants were included under a non-probabilistic sample (convenience) by invitations from the academic community of the Faculty of Ceilândia at the University of Brasilia, under the following characteristics: healthy adults (self-reported health status) from 18 to 30 years old. Participants with a history of low back pain; nonspecific back pain (cervical, thoracic or lumbar); lower limb pain in the 6 months prior to the study; pregnant women; or individuals who had a history of spinal, upper limb, lower limb, surgery were excluded.

Instruments

A questionnaire formulated by the authors was used to characterise the sample, containing questions on age, sex, smoking habits, weight, height, and participant's physical activity level.

To evaluate maximum voluntary isometric contraction, a handheld dynamometer (Lafayette Manual Muscle Testem, model 01165, USA) was used, and the values obtained were recorded on a spreadsheet in the Microsoft Excel® program, version 2016. In order to perform the strength test with the participants seated, a specific chair was made for the study (Figure 1), as in the study of Park et al. (2017). A wooden chair was used, with a seat height of 65 cm (non-adjustable) to ensure that the participants could not touch their feet on the floor (open kinetic chain on lower limbs), thus minimising any force exerted by the legs and feet. The chair backrest contains a place designed to fit the handheld dynamometer. An inelastic belt was attached to the chair for stabilisation of the hips since hip extensor muscles, such as the gluteus and hamstrings, can play a role in the extension

of the spine, which can affect the measurement accuracy (Park et al., 2017).

Procedures

For the present study, two visits were necessary, previously scheduled by the examiner, to the Physiology and Biophysics Laboratory of the University. A 1-week interval separated the first and second evaluation days. The time interval was chosen to minimise any muscle pain resulting from the maximum isometric strength in unaccustomed muscles, also limiting any training adaptation between the two visits (Harding et al., 2017). On the first day, sample characterisation data were collected, and the first measurement was performed with the handheld dynamometer. On the second day, only the dynamometry was retested, following the same steps as on the first day. The same evaluator performed the procedures on both days. In addition, this evaluator had received supervision and specific training.

The test was initiated by positioning the participant seated in the chair in an open kinetic chain with the lower limbs uncrossed and hips fixed by the inelastic belt, localised at the anterior superior iliac spines level (Figure 2). Once in this position, the participant received instructions to apply force in the posterior direction (move the trunk against the back of the chair) to press the device, positioned at the level of the seventh thoracic vertebra (T7). Before the test, with the participant positioned, the examiner requested a submaximal force attempt (five repetitions) to provide familiarisation with the test and, subsequently, the following instruction was given: "Now we are going to start the real test. Cross your arms over your chest and push the device as hard as you can". The test started after the examiner counted down from 3 to 1 and gave the verbal command "go". Three attempts were performed with a one-minute interval between them. Each contraction was sustained for 5 seconds. The participants received verbal encouragement to reach maximum strength. At the end of each attempt, a second examiner recorded the peak strength and mean strength values of the trials on the spreadsheet made for the study.

Statistical analysis

Descriptive statistics were used for sample characterisation data. The statistical approaches for test-retest reliability were employed considering 2 measures: (i) the peak strength (peak strength) of 3 repetitions and (ii) the mean strength of the 3 repetitions. The statistically significant level was set at 5% for all analyses.

For relative reliability, the intraclass correlation coefficient was used and 95% confidence interval (95%CI).

Figure 1. Chair used for the test.

Figure 2. The initial position of participants.

To determine the level (category) of the linear association between test-retest, Munro's classification was applied, based on the following coefficients: 0.26 to 0.49, reflecting low correlation; 0.50 to 0.69 moderate correlation; 0.70 to 0.89 high correlation; and 0.90 to 1.00 very high correlation (Munro, 2004). The Bland Altman Plots (95% limits of agreements) and the minimum detectable change were performed to determine the levels of absolute reliability. The following equations were used to calculate the minimum detectable change (Equations 1, 2 and 3):

$$MDC = Zscore \times \sqrt{2 \times SEM} \quad (1)$$

$$SEM = SD_{\text{baseline}} \times \sqrt{1 - r_{\text{testretest}}} \quad (2)$$

$$MDC\% = \frac{MDC}{Means} \times 100 \quad (3)$$

The sample size calculation of the study was performed using the G * Power (version 3.1.9.2) program considering the following parameters:

(1) bivariate correlation statistical test;
(2) correlation ⟩ H1= 0.5;
(3) type I error: 5%;
(4) type II error: 20%;
(5) power of the statistical test: 80%;
(6) correlation ⟩ H0= 0.

The parameters established an ideal sample of 23 participants.

RESULTS

Participants

In total, 34 individuals were volunteers to participate in the study; however, 3 were excluded based on the exclusion criteria and 5 because they were not present on the second day (1 injury off study; 4 drops out). Thus, 31 healthy individuals performed the test on the first day (16 women and 15 men), and of these, 26 returned for the second day (15 women and 11 men). The data of the excluded participants were not included in the final analysis. Table 1 presents sample characterization (n= 26).

Relative and absolute reliability

The intraclass correlation coefficient values demonstrated high to very high levels of correlation for test-retest reliability. For mean strength, the intraclass correlation coefficient value was 0.90 (0.76 to 0.95) and for peak strength 0.82 (0.60 to 0.92). The minimum detectable change for peak strength was 6.03 kg (16.18%) and 5.92 kg (20.95%) for mean strength (Table 2). The Bland-Altman plots (Figure 3 and Figure 4) demonstrated a disagreement of -5.2 kg (-9,15 to -1,26; Bland-Altman lower limit of agreement of -24,3 kg [-31,17 to -17,51] and upper limit of 13,9 [7,09 to 20,74]) for peak strength measurements and -5.7 kg (-9,45 to -1,93; Bland-Altman lower limit of agreement of -23,9 kg [-30,46 to -17,43] and upper limit of 12,5 [6,04 to 19,07]) for mean strength measurements.

Table 1. Characteristics of participants.

Variable	Total
Age (years)†	21.53± 1.88
Weight (kg)†	68.66± 14.54
Height (meters)†	1.69± 0.10
Body mass index	23.52± 3.37
Sex (%)	57.69% feminine
Smokers (%)	57.69%
Physical activity (%)	88.46%

† Presented in mean and standard deviation.

DISCUSSION

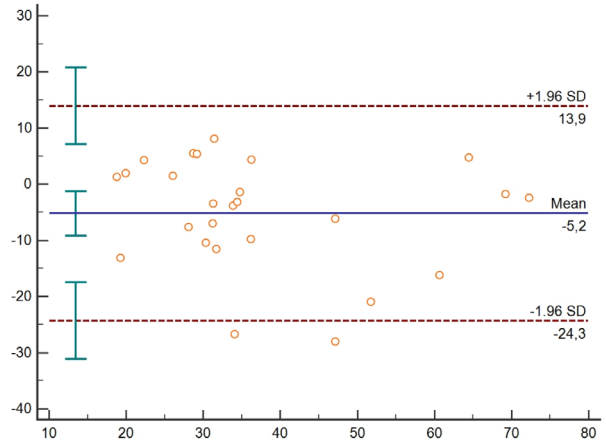
The present study aimed to determine the reliability of the handheld dynamometer in the measurement of maximum voluntary isometric contraction of trunk extensors in healthy adults. The results showed high agreement and minimal differences between test-retest, demonstrating that a handheld dynamometer can be considered a useful instrument for measuring trunk maximum voluntary isometric contraction in healthy adults.

The results of the intraclass correlation coefficient demonstrated high reliability for peak strength and very high reliability for mean strength. The mean error on the Bland-Altman graph (Figures 3 and Figure 4) was -5.2 kg for peak strength and -5.7 kg for mean strength. The negative values are due to the fact that the force exerted by a large proportion of the participants was higher on the second day (retest). Even with these results, it was possible to observe that the values remained within the confidence intervals, except for 2 tests that differed from the others. In addition, all participants were familiarised before the start of the test and were given the same instructions and verbal incentives. Still, they gave a stronger performance on the second day, which could be attributed to motor learning, even with a 1-week interval between measures.

Table 2. Handheld dynamometer reliability analysis for strength evaluation of trunk extensors.

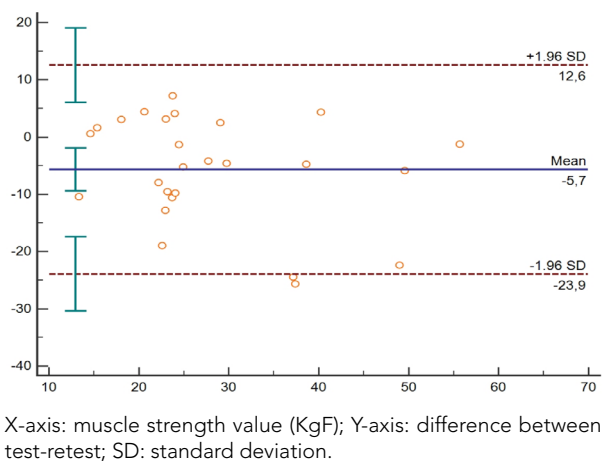
	Mean± SD	ICC (95%CI)	Bland-Altman ME (agreement limits)	SEM	MDC (MDC%)
Peak strength					
Test (kg)	34.70± 14.99	0.90 (0.76–0.95)	-5.21 (13.9; -24.3)	4.74	6.03 (16.18)
Retest (kg)	39.91± 16.69				
Mean strength					
Test (kg)	25.41± 10.75	0.82 (0.60–0.92)	-5.70 (12.6; -23.9)	4.56	5.92 (20.95)
Retest (kg)	31.10± 12.84				

kg: kilogram; SD: standard deviation; ICC: intraclass correlation coefficient; CI: confidence interval; ME: mean error; SEM: standard error of measurement; MDC: minimal detectable change.



X-axis: muscle strength value (KgF); Y-axis: difference between test-retest; SD: standard deviation.

Figure 3. Bland-Altman plot for peak strength measurements.



X-axis: muscle strength value (KgF); Y-axis: difference between test-retest; SD: standard deviation.

Figure 4. Bland-Altman plot for mean strength measurements.

The minimum detectable change has demonstrated a value of 6.03 kg (16.18%) for peak strength and 5.92 kg (20.95%) for mean strength. These values are considered slight for the sample (health adults) and region (back) investigated by the present study; since for healthy individuals, the trunk musculature presents a possibility of high torque, so the values observed are not clinically relevant. As for other groups, such as individuals with low back pain, or even other body segments, the interpretation may be different since the values mentioned above could signify important differences in the test.

Previous studies that addressed the reliability of a handheld dynamometer for trunk extensor muscles reported good results for the instrument, which is in accordance with the present study. Harding et al. (2017) conducted test-retest research with 50 healthy individuals over 18 years old, where they tested the reliability of the handheld dynamometer in the trunk extension strength. For this, two data collection sessions were held, also with 7 days apart. In its methodology, 3 repetitions of maximum isometric strength of 5 seconds each with a 1-minute interval between them were adopted, identical to the present study. Its results indicated very high reliability, with a CI of 0.901 (95%CI, of 0.833 -0.943), whereas our study had high reliability, with an intraclass correlation coefficient for the peak of the strength of 0.82. The minimum detectable change of Harding et al. (2017) was 7.14kg (13.59%), approximately 1kg difference from our study, with a minimum detectable change of 6.03kg (16.18%). The Bland-Altman plots showed an average error of +0.71 kg, with a significant difference compared with the present study, which obtained -5.2 kg for the peak of strength. In contrast to our study, the aforementioned research was carried out with the handheld dynamometer positioned on the wall and with the individual standing, fixed by an inelastic band at the height of

the anterior superior iliac spines and for the statistical analysis, they used only the peak values of strength.

In addition to Harding et al. (2017), Jubany et al. (2015) also analysed the reliability of handheld dynamometer for the trunk extensor musculature in a sample of 20 healthy individuals, with a mean age of 27.6 years. The intraclass correlation coefficient values were in agreement with our study, showing a very high correlation, with a value of 1 (95%CI of 0.9–1). The minimum detectable change showed was 2.2 kg (3.7%), with a significant difference compared to our study. Jubany et al. (2015) performed a trunk extension strength test with a standing individual, using the handheld dynamometer coupled to a customised metal structure. The handheld dynamometer was positioned on the back of the individuals with variable height according to the anthropometric characteristics of each one, and the stabilisation was done by a metal bar also in the anterior superior iliac spine. In its methodology, 3 repetitions of maximum isometric strength were adopted, but the time in each one was not described, not even the time interval between the repetitions and the days tested.

Park et al. (2017) also obtained results close to the current study, with an intraclass correlation coefficient of 0.82 (95%CI, 0.65–0.91). The authors indicated a high correlation for peak strength measurements, equaling the current research, showing an intraclass correlation coefficient of 0.82. For Bland-Altman, the authors presented a value of 6.3 kg (95%CI), approximately 1 kg different from the current study, which found a value of 5.2 kg, thus confirming the possibility of using a handheld dynamometer to measure the strength of the trunk muscles. In a test-retest methodology, Park et al. (2017) performed dynamometry of the trunk extensor muscles with 30 subjects in the sitting position and an open chain but stabilised above the anterior superior iliac spine. In the methodology, there was no clarification about the interval between the first and second test days. Moreover, a different protocol from the present study was adopted regarding the number of attempts at maximum strength and their time (5 repetitions of 3 seconds each), not to mention the time interval between each attempt. In the current study, we opted to use the inelastic belt at the anterior superior iliac spine, as we believe that this would minimise the use of hip extensor muscles. Stabilisation in this type of test is an important factor, as strength can increase up to 84%, compared to individuals who are measured without a belt or with inadequate stabilisation (Bohannon, Kindig, Sabo, Duni, & Cram, 2012). Differing from the study of Park et al. (2017), we only adopted three repetitions of 5 seconds each since by decreasing the number of repetitions, we can also reduce possible muscle adaptations, ensuring more reliable data.

Limitations of the study

The current study presents some limitations. One is the influence of external factors on the test, which may have modified the effort made by some individuals since strength can be influenced by several factors such as anxiety and stress (Feldman, Schreiber, Pick, & Been, 2019). Another possible limitation is that the chair used in the test was not fixed to the wall, which may have influenced the results since the lack of total stabilisation can alter the participants' confidence when performing maximum strength. Finally, we had no control over the participants' physical activity during the test period, which may also, in some way, have influenced their performance in the test.

CONCLUSIONS

The handheld dynamometer presents high reliability for the extensor muscles of the trunk in healthy adults. Therefore, the use of the handheld dynamometer can be indicated for clinical practice. In addition, given the low number of studies in this area and the lack of standardised protocols, we suggest continuing research on volunteers with different characteristics, such as pain in the thoracic or lumbar spine, enriching the discussion about the use of the manual dynamometer for the trunk extensor muscles.

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ORIGINAL ARTICLE

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Psychometric properties of the of the university sport experiences scale – portuguese

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ABSTRACT

Over the last decades, qualitative methods have dominated Positive Development through sports research. Therefore, valid and reliable quantitative measurement tools are scarce. Additionally, most Positive Development research has focused on youth sport contexts. University sport has been considered a crucial period for a Positive Development approach, and researchers have created the University Sport Experience Survey, which assesses Positive Development in university sport. Although the psychometric properties of USES were confirmed, its validity may be confined to Canadian settings. This study aimed to investigate a cross-cultural adaptation of the University Sport Experiences Survey for a Portuguese-speaking population of university athletes. Our results suggest this confirmed model, containing Portuguese translated items, has strong factorial validity for assessing developmental outcomes of university-aged student-athletes in Brazilian university contexts. Current results support the external validity of University Sport Experiences Survey and offer evidence of the first validated Portuguese assessment tool for assessing Positive Development in university sport.

KEYWORDS: positive development; measurement; student-athletes; validity.

INTRODUCTION

Over the past decades, researchers have attempted to understand how sport can be used to create developmentally sound experiences for youth and adult participants (Holt et al., 2017). In many cases, sports participation is associated with optimal developmental experiences and outcomes such as learning leadership skills and transferring them to other life domains (Fraser-Thomas, Côté, & Deakin, 2005). Positive Development (PD) has been used as an overarching asset-based framework (Lerner Almerigi, Theokas, & Lerner, 2005) to enhance optimal development through sport. As a framework, PD acknowledges the need to intentionally teach sport participants personal and social skills that may be applied in and outside sport. Several researchers (e.g., Camiré, Forneris, Trudel, & Bernard, 2011; Weiss, Bolter, & Kipp, 2016) have used PD to develop structured sport-based programs conducive to PD outcomes such as emotional control, perseverance, and goal-setting in the past.

Although PD is a popular framework for understanding the experiences of sport participants (Holt et al., 2017), assessing PD has been a complicated endeavor from a quantitative perspective (MacDonald & McIsaac, 2016). One reason

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for the measurement issues surrounding PD is that no consensus exists on which outcomes and experiences constitute PD (Geldhof et al., 2014; Weiss, 2016). Another factor that has negatively impacted assessment within PD research is the lack of validated tools (MacDonald & McIsaac, 2016). To increase the rigor of the quantitative measurement of PD, Holt, Deal, and Smyth (2016) suggested that researchers provide operational definitions of PD constructs and identify suitable assessment tools for analyzing the impact of PD-based programming.

In recent years, reliable and valid quantitative assessment tools for measuring PD have emerged within the youth sport context (Cronin & Allen, 2017; MacDonald, Côté, Eys, & Deakin, 2012). For instance, the Youth Experience Survey for Sport (YES-S) has 37 items that measure four dimensions of positive experiences (i.e., personal and social skills, initiative, goal setting, cognitive skills) and one dimension of negative experiences related to youth sport (MacDonald et al., 2012). Similarly, Cronin and Allen (2017) created the Skills Scale for Sports (LSSS) to assess the skills athletes learned in sport that will help them succeed in other areas of life. The LSSS contains 43 items, divided into eight subscales: teamwork, goal setting, social skills, problem-solving and decision making, emotional skills, leadership, time management, and interpersonal communication. Although the advent of these new assessment tools is promising, these quantitative assessment tools are limited to youth and adolescent populations. This is problematic since PD continues beyond adolescence and into emerging adulthood (Arnett, 2006; Rathwell & Young, 2016). As such, a need remains for similar PD based quantitative assessment tools designed for older populations of athletes (Rathwell & Young, 2016).

One population that is promising for evaluating PD through sport is university athletes. Rathwell and Young (2016) argued that university sport was a valuable context for PD-based programs (Rathwell, & Young, 2016) since university athletes have entered emerging adulthood and need to develop the requisite personal and social skills for successful integration in society (Arnett, 2006). Rathwell and Young's (2017, 2018a) series of studies on the PD processes within university sport led to the development and validation of a scale for assessing PD outcomes within the university sport context (Rathwell & Young, 2016). The scale is known as the University Sport Experiences Survey (USES — Rathwell & Young, 2016) and measures PD outcomes specific to initiative, basic skills, interpersonal relationships, teamwork and social skills, adult networks and social capital, stress, negative peer interactions, social exclusion, and inappropriate adult behaviors.

From a scale development perspective, Rathwell and Young (2016) found evidence for the factorial validity and reliability of the USES using data from two independent samples of Canadian university athletes. Evidence for the face validity of the USES scales was found in a qualitative study of Canadian university athletes, where athletes spoke in detail about PD outcomes found on the USES (Rathwell & Young, 2018a). Finally, Rathwell and Young (2018b) described initial evidence for the concurrent validity of the USES scales as well. They surveyed 605 Canadian university athletes about their perceptions of Full Range Leadership behaviours (i.e., transformational, transactional, and laissez-faire leadership) using the Multifactor Leadership Questionnaire (Avolio & Bass, 2004). They found that coaches' use of transformational leadership was positively associated with initiative, basic skills, and interpersonal relationships through university sport. Taken together, the advent of the USES broadens the possibilities for understanding PD processes to emerging adult populations. However, the current evidence for the validity of the USES is limited to the Canadian context, which creates complex challenges for researchers attempting to assess PD worldwide.

Considering that PD has become an extensively used framework worldwide (Gaion-Rigoni, Nascimento Junior, Belem, Vieira, & MacDonald, 2018; Santos, Camiré, & Campos, 2018), more research is needed to expand the catalogue of validated quantitative assessment tools to study PD processes across different cultures. A major barrier to the quantitative assessment of PD globally is that most measurement tools have only been validated within English-speaking countries. As such, measurement tools for non-English speaking populations are scarce (e.g., Gaion et al., 2018). For instance, in Portuguese speaking countries, where PD through sports research has proliferated throughout the last few years (Martins, Rosado, Ferreira, & Biscaia, 2015; Santos et al., 2018), it is difficult to compliment qualitative findings without access to valid and reliable quantitative assessment tools. There is a need to validate existing PD measurement tools to understand PD in these contexts reliably to study PD in non-English speaking countries. Thus, the purpose of this four-phase research program was to validate a cross-cultural adaptation of the USES using data from a Portuguese-speaking population of university athletes.

In Phase 1, the USES items were translated from English to Portuguese, and the content validity of the translated items was assessed by a group of PD sport psychology researchers and a sample of university athletes. In Phase 2, the factorial validity and reliability of the translated items were explored and confirmed with data

from two large independent samples of University athletes from Brazil. In Phase 3, the temporal stability of athletes' responses on the translated USES items was assessed across time. In Phase four, the concurrent validity of the translated USES was assessed by testing associations between the USES subscales and theoretically relevant constructs. Together, these four phases of research sought to address a notable gap in the literature by establishing a survey capable of PD in University sport in alternative non-English speaking contexts. This translated scale will be referred to as the University Sport Experience Scale — Portuguese (USES-P) for the remainder of this paper.

PHASE ONE — TRANSLATION AND CONTENT VALIDITY

The purpose of Phase One was to translate the USES (Rathwell & Young, 2016) to Portuguese without losing the original meaning of the items (see Table 1 for a summary of different USES subscales). Following the translation, a small pilot study on Brazilian university athletes was conducted to test USES-P item comprehension. The content validity of the USES-P was also assessed by a group of sport psychology researchers.

Translation

The first step in adapting the instrument was to perform a back-translation, which consisted of translating the original USES items (Rathwell & Young, 2016) from English to Portuguese and then translating the items back to English again (Vallerand, 1989). The back-translation was performed by four professional scientific text translators. The first step involved two of the translators independently translating the USES from English to Portuguese. Next, the two other translators, who had no previous exposure to the original version of the USES, independently back-translated the Portuguese items to English. All translators were instructed to consider the content of the version they received (original or Portuguese) and to preserve the same meaning of the items (Cassepp-Borges, Balbinotti, & Teodoro, 2010).

Following the back translation process, a committee was established to determine the final version of the USES-P. This committee comprised three experts on PD through sport who had a Ph.D. in sport sciences (one of whom was the creator of the original USES) and the most experienced translator from the back translation process. The committee was provided with all the four versions of the translations (i.e., two versions in English and two in Portuguese) and was asked to:

(a) compare the two back-translated English versions with the original USES to assess fidelity;
(b) compare the two translated Portuguese versions with the original USES to assess if the same meaning was preserved (Cassepp-Borges et al., 2010).

When minor wording issues were identified, the committee changed the language until a final Portuguese version was determined (Vallerand, 1989).

Table 1. Items and meanings of University Sport Experiences Survey subscales.

Subscales	Items	Meaning
Initiative	1–9	Extent to which student athletes see their self-navigation abilities improve as a result of their involvement in university sport.
Basic skills	10–13	Degree to which athletes believe their involvement in university sport has helped improve their creativity and ability to find information.
Interpersonal relationships	14–19	Extent to which participation in university sport has facilitated the acquisition of personal relationships with others who have different socio-economic and ethnic backgrounds.
Teamwork and social skills	20–27	Extent to which athletes perceive that sport involvement has improved their ability to work with others in relation to group dynamics.
Adult networks and social capital	28–30	Degree to which athletes feel they have developed off-campus social networks as a result of their sport participation.
Stress	31–34	Athletes' perceptions of mental and emotional strain related to their university sport experience or their student athlete roles.
Negative peer interactions	35–37	Athletes' perceptions regarding how their participation in university sport is related to immoral or risky behavior.
Social exclusion	38–40	Extent to which athletes perceive that sport involvement has led to their exclusion from others.
Inappropriate adult behavior	41–46	Players' perceptions of inappropriate or misplaced behaviors, interactions, or expectations from their sport leaders.

Pilot study

Following the back translation, a pilot study was conducted to test whether the USES-P was understood by Brazilian university athletes. Prior to collecting data, approval was received from the host university's research ethics and integrity office. The pilot test involved a sample of 20 university athletes (12 male and 8 female) aged 18 and 25 years. After providing consent, athletes were asked to answer the USES-P items and report any concerns regarding the clarity of language or relevance of the items to the university sport context (Marôco, 2010). All athletes answered the USES-P items and indicated no concerns about the clarity or relevance of the items.

Content validity

Following the pilot test, the content validity of the USES-P was tested using an expert group of sport psychology researchers, who were independent of the current study. More specifically, the USES-P was sent to three university professors who were external to this research project, who had expertise on PD through sport, were fluent in English, and were currently working in Brazilian universities. These university professors received the USES-P items in a random order (i.e., not organized by factor) and were asked to assess each item regarding clarity of language (i.e., Is this item written in an understandable way?) and theoretical importance (i.e., Does this item enabled an understanding about PD through university sport). The questions were answered on a 4-point Likert scale (1= not at all, 4= very much). The university professors were then provided with the operational definitions of the USES scales (i.e., initiative, basic skills, interpersonal relationships, teamwork and social skills, adult networks and social capital, stress, negative peer interactions, social exclusion, and inappropriate adult behavior) and asked to place each item within the scale they believe it belonged to (Hernández-Nieto, 2002).

Data analysis

Content validity coefficients (CVC) were calculated based on the university professors' Likert scale responses regarding clarity of language and theoretical importance separately. An overall CVC was calculated for USES-P on language clarity and theoretical relevance. Individual item level CVC scores were also assessed on these two dimensions. CVC scores of 0.80 were deemed acceptable (Hernández-Nieto, 2002). Additionally, a Kappa coefficient was calculated to assess the university professors' ability to match each item within their appropriate scale. A Kappa score > 0.60 was considered acceptable, and a Kappa score > 0.80 was considered excellent (Landis & Koch, 1977).

Results

The overall CVC and all item level CVC scores were acceptable on theoretical importance (CVC> 0.80). With regards to the clarity of language, the overall CVC score was 0.88. All item level CVC scores were above 0.80 except for four items (items 7= 0.76; 34= 0.69; 38= 0.76; and 45= 0.76). Despite having four items with CVC scores below 0.80, a decision was made to keep all items considering that the CVC scores were relatively close to 0.80 and that the athletes raised no concerns. With this said, the research team flagged these four items for consideration in future analyses. The Kappa coefficient representing agreement among experts regarding USES-P item classification was 0.83, indicating that the evaluators effectively placed USES-P items within their appropriate scales.

PHASE TWO — CONSTRUCT VALIDITY AND INTERNAL RELIABILITY

The purpose of Phase Two was to assess the construct validity of the USES-P by testing the fit and factor structure of the instrument with a larger sample of Brazilian university athletes.

Method

Recruitment

Prior to collecting data, approval was received from the host university's research ethics and integrity office. A consent form to the athletes competing in the participant in the Brazilian University Games. For participants to be included in this study, they must have satisfied the following criteria:

(a) be an athlete participating in the 2017 Brazilian University Games;
(b) provide consent;
(c) complete the USES-P with minimal missing data.

Data collection was conducted in the athletes' accommodations in the city where the Brazilian University Games took place in the second half of 2017.

Participants

In total, a sample of 1021 athletes completed the in-person survey. However, 60 athletes were missing the majority of data for the subscales of interest. As a result, these 60 athletes were excluded from the study. The final sample consisted of 961 university athletes (492 male and 469 female) from four regions of Brazil: Midwest (198); North (66); Northeast

(188); South (247), and Southeast (262). Athletes were between 17 and 39 years old (M_{age}= 21.00 years; SD= 2.89 years) and reported an average practice time of 10.28 hours (SD= 4.58) per week. Athletes were members of their current university team for an average of 2.80 years (SD= 2.02) and represented the following sports: athletics (104); badminton (20); basketball (154); 3x3 basketball (29); beach volleyball (21); chess (13); handball (125); indoor football (122); judo (65); swimming (97); table tennis (13); taekwondo (29); tennis (6); volleyball (161).

Of importance, this study was the first to our knowledge to test a Portuguese version of the USES with non-Canadian athletes. As such, it was important to split our data randomly into an exploratory and confirmatory sample. The reason for independent exploratory and confirmatory samples is that during the modification process (if required), it is possible to capitalize on unstable chance-based factors when determining the fit and factor structure of the model (Hair, Black, Babin, Anderson, & Tatham, 2014). With an independent sample, no such chance exists because the data from the confirmatory sample did not influence which items were trimmed or retained in the exploratory process. Therefore, we randomly split our data into two independent samples (sample one= 480 athletes; sample two= 481 athletes) to obtain an exploratory (i.e., sample one) and confirmatory sample (i.e., sample two).

Measures

For this study, we were interested in athletes' responses to the USES-P.

Analysis

Using the Mplus software program (Muthén & Muthén, 2012), Exploratory Structural Equation Modeling (ESEM) with a target rotation (oblique) was used to test the fit and factor structure of the USES-P. In recent years, the use of Confirmatory Factor Analysis (CFAs) for evaluating complex survey data has been criticized for being too restrictive, resulting in poor item-level factor structures, and producing multicollinearity amongst factors (Marsh, Morin, Parker, & Kaur, 2014). ESEM provides an alternative approach that also provides parameter estimates, goodness-of-fit statistics, and standard errors (Marsh et al., 2014). Further, ESEM overcomes many of the issues with CFA by allowing cross-loadings to be freely estimated, which is more consistent with social science data. We used a robust maximum likelihood estimator (MLR) for our ESEM analyses. MLR produces both standard errors and tests of model fit. Various indices were used to assess model fit: Comparative Fit Index (CFI), Tucker Lewis Index (TLI), Standardized Root Mean Square Residual (SRMR), Root Mean Square Error of Approximation (RMSEA), and the normed chi-square (χ^2/df). Hair et al. (2014) suggest a good model fit if CFI≥ 0.90, TLI≥ 0.90, SRMR≤ 0.08, RMSEA≤ 0.05, and χ^2/df≤ 5.

For the confirmation sample (i.e., sample two), we elected to used both CFA and ESEM since we aimed to replicate the factor structure of the USES-P with an independent sample of university athletes' data. Marsh et al. (2014) recommended using both ESEM and CFA and comparing the results for confirmatory analyses. A target rotation (oblique) was used for the ESEM, and an MLR estimator was used for both ESEM and CFA analyses. The aforementioned fit indices were used for both CFA and ESEM, with cutoff values remaining the same. Good model fit was assumed if CFI≥ 0.90, TLI≥ 0.90, SRMR≤ 0.08, RMSEA≤ 0.05, and χ^2/df≤ 5 (Hair et al., 2014).

As a final step, exploratory ESEM with a target rotation (oblique) was used to conduct measurement invariance tests in order to assess the homogeneity across our two samples (1= exploratory sample; 2= confirmatory sample). More specifically, invariance tests were used to verify if the latent variables and items measured in the USES-P were the same across the two samples of athletes. Measurement invariance was tested using a hierarchically ordered set of models (i.e., configural, metric, scalar) that increased in restrictiveness over each successive step (Wang & Wang, 2019). For configural invariance, equivalence was assumed if model fit criteria were satisfied. To assess metric and scalar invariance χ^2 differences, tests and changes in CFI were used. Specifically, χ^2 and CFI scores were compared at each level (i.e., configural vs. metric, metric vs. scalar), and homogeneity was assumed if the χ^2 difference test was non-significant and change in CFI< 0.01 (Byrne, 2016).

Results

Only 0.93% of the data were missing for the final sample. When less than 5% of data are missing, the influences of missing data are negligible (Tabachnick & Fidell, 2013). Missing data were treated with multiple imputations using an expectation-maximization method (Tabachnick & Fidell, 2013).

Exploratory sample

Using data from sample one, we began by testing the hypothesis that that responses to the 46 items would a) be explained by 9 correlated factors, and b) each item would have a primary factor loading of 0.32 or greater on its intended factors, and a loading of less than 0.32 on unintended factors. A factor loading of 0.32 was chosen as a cutoff value because this represents 10% or greater variance explained by the factor

(Tabachnick & Fidell, 2013). In general, ESEM summary statistics showed good model fit: CFI= 0.908, TLI= 0.855, SRMR= 0.029, RMSEA= 0.047 (90%CI= 0.043–0.051), and χ^2/df= 2.060. However, items 36 and 37 failed to load above 0.32 on the Negative peer interactions factor, item 10 had a problematic cross-loading (0.454) on initiative (an unintended factor), and item 20 had a problematic cross-loading (0.516) on Interpersonal Relationships (an unintended factor). These results suggest that modifications were required to the USES-P.

The first step in our modification process involved removing items that cross-loaded above 0.32 on unintended factors, starting with the items with the highest cross-loadings. Items were removed one at a time, and the model was retested after each removal. The purpose of removing items with high cross-loadings on unintended factors was to safeguard Rathwell and Young's (2016) hypothesized factor structure while improving the interpretability of the factor structures and model fit. In the final phase of data trimming, we removed any items that loaded below 0.32 on their intended factors. The iterative process of testing and removing items for violating loading criteria resulted in the loss of seven items (items 1, 2, 10, 20, 35, 36, 37) and one factor (Negative peer interaction). Negative peer interactions were removed because there were less than three items that loaded, which severely inhibits the interpretability of the factor. The resulting model was an eight-factor 39 item solution that showed good fit in general: CFI= 0.930, TLI= 0.886, SRMR= 0.027, RMSEA= 0.044 (90%CI= 0.039–0.048), and χ^2/df= 1.915. All factor loadings were significant, and all loadings were above .32 (range= 0.59–0.86) on their intended factor. No items loaded above .32 on unintended factors. All construct reliability (CR) scores were above 0.7, except for Basic Skills (CR= 0.69). CR scores above 0.7 indicate strong internal consistency reliability, while CR scores between 0.6 and 0.7 indicate adequate internal consistency reliability (Hair et al., 2014).

Confirmatory sample

Using data from sample two, we tested the final factor structure found with data from sample one using both ESEM and CFA. For ESEM, we hypothesized the 39 items would a) be explained by 8 correlated factors, and b) each item would have a primary factor loading of 0.32 or greater on intended factors and a loading of less than 0.32 on unintended factors. In general, ESEM summary statistics showed good model: CFI= 0.915, TLI= 0.862, SRMR= 0.027, RMSEA= 0.049 (90%CI= 0.045–0.054), and χ^2/df= 2.117. All factor loadings were significant and above 0.32 (range= 0.358–1.008). Each factor had a CR score above 0.7, except for Basic Skills (CR= 0.66), indicating strong internal consistency reliability in general. See Table 2 for the ESEM factor structure and loadings for group two.

Correlations between subscales ranged from 0.01 to 0.57. All significant correlations between the positive subscales were positive. All significant correlations between the negative experience subscales were also positive (i.e., move in the same direction), and all significant correlations between the positive and negative subscales were in the inverse direction, as would be expected.

As another means of confirming the factor structure of the USES-P, we conducted a CFA using the data from sample two. CFAs are more restrictive than ESEM and test the hypothesis that a specific number of factors are explained by a specific number of indicators. In CFA analyses, each item is only allowed to load onto one factor, and all non-intended item loadings are constrained to zero. For our CFA, we hypothesized that 8 correlated factors would explain the 39 items. In general, summary statistics showed good model: CFI= 0.904, TLI= 0.895, SRMR= 0.048, RMSEA= 0.043 (90%CI= 0.040–0.047), and χ^2/df= 1.896. Factor loading was strong and ranged from 0.500 to 0.942. Correlations between subscales ranged from 0.09 to 0.68. All significant correlations between the positive subscales were positive. All significant correlations between the negative experience subscales were also positive (i.e., move in the same direction), and all significant correlations between the positive and negative subscales were in the inverse direction.

Invariance testing

Factorial equivalence for the USES-P was assessed using our exploratory and confirmatory samples. Results showed that the USES-P was invariant across our two samples of athletes. See Table 3 for invariance testing results.

PHASE THREE — TEMPORAL STABILITY

The purpose of Phase Three was to assess the stability of responses on the USES-P across time.

Method

Participants and data collection

24 athletes from Brazil completed the questionnaire at two different time points, with an interval of seven days between completion to investigate the temporal stability

Table 2. University Sport Experience Scale — Portuguese factor loadings using Exploratory Structural Equation Modeling (i.e., sample 2).

Items	IN	BS	IR	TS	AN	ST	SE	IB
1	**0.575**	0.014	0.077	0.050	-0.013	-0.049	0.015	0.002
2	**0.664**	0.090	-0.082	0.023	0.063	-0.027	0.002	0.012
3	**0.717**	0.099	0.011	-0.122	0.056	-0.024	-0.056	0.020
4	**0.633**	0.024	0.079	0.069	-0.059	-0.046	-0.028	-0.029
5	**0.717**	-0.019	-0.021	-0.003	0.007	-0.058	0.024	-0.001
6	**0.834**	-0.041	-0.002	-0.028	-0.047	0.105	-0.011	-0.053
7	**0.608**	-0.031	-0.043	0.184	0.029	-0.002	0.023	0.012
8	0.013	**0.538**	0.082	0.035	-0.026	-0.032	0.115	-0.055
9	0.053	**0.778**	0.000	0.103	-0.029	0.053	-0.059	0.031
10	0.074	**0.541**	0.049	0.002	0.113	0.009	-0.014	-0.045
11	0.010	0.163	**0.483**	0.092	0.025	-0.004	0.007	-0.010
12	0.051	-0.092	**0.598**	0.115	0.019	-0.046	0.057	-0.111
13	-0.051	0.028	**0.393**	0.131	0.046	0.062	0.039	-0.087
14	-0.063	0.060	**0.578**	-0.020	0.068	-0.015	0.049	-0.017
15	0.079	-0.036	**0.731**	0.019	0.018	0.027	-0.042	0.020
16	-0.028	0.051	**0.749**	-0.101	-0.019	-0.050	-0.062	0.059
17	0.138	0.065	0.178	**0.387**	0.027	-0.058	-0.080	0.053
18	0.207	0.013	0.200	**0.358**	0.030	-0.020	-0.035	0.028
19	-0.078	0.070	0.008	**0.689**	0.033	-0.001	-0.045	0.005
20	0.075	-0.099	-0.069	**0.738**	0.033	0.013	0.048	-0.039
21	-0.083	0.021	-0.105	**0.892**	0.002	-0.091	0.032	0.010
22	0.000	0.017	0.058	**0.715**	-0.080	0.084	-0.023	-0.001
23	0.074	0.151	0.071	**0.394**	0.078	0.059	-0.056	0.009
24	-0.113	-0.018	0.150	0.116	**0.515**	0.019	-0.123	0.012
25	0.003	-0.010	-0.009	-0.040	**0.979**	-0.020	0.023	0.003
26	0.080	0.020	-0.030	0.005	**0.737**	0.045	0.072	-0.008
27	-0.022	-0.060	-0.029	-0.037	0.109	**0.677**	-0.063	0.041
28	-0.037	0.084	-0.065	0.045	0.029	**0.728**	-0.049	-0.018
29	-0.012	0.008	0.028	-0.041	-0.086	**0.668**	0.096	-0.027
30	0.031	0.006	0.033	0.011	-0.021	**0.640**	0.092	0.021
31	-0.060	0.063	-0.020	-0.093	0.030	0.069	**0.583**	0.054
32	0.022	0.007	-0.021	0.024	0.004	-0.041	**1.00**	-0.025
33	-0.008	-0.074	0.119	-0.026	-0.037	0.150	**0.371**	0.266
34	-0.030	-0.156	0.089	0.028	-0.011	0.068	0.136	**0.561**
35	-0.131	0.054	0.056	0.038	-0.045	-0.017	0.055	**0.659**
36	-0.031	0.049	-0.015	-0.027	0.050	-0.046	-0.001	**0.890**
37	0.034	-0.025	0.087	0.046	0.015	0.001	-0.014	**0.891**
38	0.073	0.058	0.007	0.013	-0.063	0.059	-0.047	**0.732**
39	0.031	0.064	-0.064	-0.054	0.031	-0.013	0.045	**0.815**

The item order corresponds with the items found in Appendix A. IN: initiative; BS: basic skills; IR: interpersonal relationships; TS: teamwork and social skills; AN: adult networks and social capital; ST: stress; NP: negative peer interactions; SE: social exclusion; IB: inappropriate adult behavior.

Table 3. Results of USES-P Measurement and Structural Invariance Tests for the Exploratory and Confirmatory sample

Invariance type	Overall fit indices						Model comparison	Change of fit indices				
	SBx2	*df*	CFI	TFI	SRMR	RMSEA		ΔSBx2	ΔCFI	ΔTFI	ΔSRMR	ΔRMSEA
1. Configural	1863.026**	914	0.923	0.874	0.027	0.046	2 against 1	209.704	0.003	0.031	0.011	-0.006
2. Metric	2072.730**	1162	0.926	0.905	0.038	0.040	3 against 1	245.744	0.002	0.033	0.012	-0.006
3. Scalar	2108.800**	1193	0.925	0.907	0.039	0.040	3 against 2	36.07	-0.001	0.002	0.001	0.000

USES-P = University Sport Experience Scale – Portuguese; SBχ^2 = satorra-bentler chi-square; df = degrees of freedom; CFI = comparative fit index; TLI = Tucker-Lewis index; SRMR = standardized root mean squared residual; RMSEA = root mean square error of approximation.*$p \leq 0.05$.**$p \leq 0.01$.

of the USES-P (Marôco, 2010). This sample was selected through a non-probabilistic sampling technique.

Instrument and procedures

The 8-factor USES-P with 39 items determined in Phase Two was used. Local sports organizations were contacted to obtain approval for data collection with athletes involved in their programs. Following consent, athletes were sent on the online link and asked to complete the USES-P.

Data analysis

Data were analyzed using SPSS version 22.0. Temporal stability was assessed through the intraclass correlation coefficient (ICC> 0.70), verifying the test-retest reliability of the instrument (Nunnally & Bernstein, 1994).

Results

The ICC assessed the test-retest reliability (temporal stability) of the scale. It was found that all USES-P dimensions showed ICCs higher than 0.70 (Initiative= 0.90; Basic skills= 0.84; Teamwork and Social Skills= 0.78; Adult Networks and Social Capital= 0.71; Stress= 0.90; Social Exclusion= 0.81; Inappropriate Adult Behavior= 0.90), with the exception of Interpersonal Relationships (ICC= 0.64).

PHASE FOUR — CONCURRENT VALIDITY

The purpose of Phase four was to test whether USES-P outcomes were associated with theoretically relevant constructs in a coherent manner. Within the sports literature, quality relationships between athletes and coaches have been described as paramount for PD outcomes to occur through sport (Turnnidge Evans, Vierimaa, Allan, & Côté, 2018). Moreover, recent research on adolescent coaches found that when coaches perceived having a high-quality relationship with their athletes that were close committed and complimentary, they also perceived greater development on PD outcomes such as teamwork, goal setting, social skills, problem solving, emotional skills, leadership, time management and communication (Camiré, Rathwell, Turgeon, & Kendellen, 2019). In Phase four, we hypothesized that high quality coach athlete relationships would be positively associated with the positive USES-P outcomes (i.e., initiative, basic skills, inter-personal relationships, teamwork and social skills, and adult networks and social capital) and negatively correlated with the negative USES-P outcomes (i.e., stress, social exclusion, and inappropriate adult behavior).

Method

Participants

961 university athletes were recruited from all regions of Brazil. The sample consisted of 492 male and 469 female athletes aged between 17 and 39 years old (M_{age}= 21.00 years; SD= 2.89 years), from four regions of Brazil: Midwest (198); North (66); Northeast (188); South (247) and Southeast (262). The athletes reported an average practice time of 10.28 hours (SD= 4.58) per week and were members of their current university team for an average of 2.80 years (SD= 2.02). Participants represented the following sports: athletics (104); badminton (20); basketball (154); 3x3 basketball (29); beach volleyball (21); chess (13); handball (125); indoor football (122); judo (65); swimming (97); table tennis (13); taekwondo (29); tennis (6); volleyball (161).

Measures

To assess university athletes' PD, the 39 items 8 correlated factor USES-P established in Phase two was used. ESEM with target rotation (oblique) was used to test the fit and factor structure of the USES-P. Summary statistics showed good model fit: CFI= 0.929, SRMR= 0.024, RMSEA= 0.043 (90%CI= 0.041– .046), and χ^2/df= 2.816. The descriptive for each USES-P scale were as followed: Initiative (M= 5.64, SD= 1.03, Skewness= -1.19, Kurtosis= 2.18), Basic Skills (M= 5.12, SD= 1.31, Skewness= -0.75, Kurtosis= 0.37), Interpersonal Relationships (M= 5.75, SD= 0.94, Skewness= -0.92, Kurtosis= 0.88), Teamwork and Social

Skills (M= 5.81, SD= 0.82, Skewness= -1.09, Kurtosis= 2.05), Adult Network and Social Capital (M= 4.94; SD= 1.36, Skewness= -0.64, Kurtosis= 0.23), Stress (M= 4.10; SD= 1.5 Skewness= -0.21, Kurtosis= 0.69), Social Exclusion (M= 2.67, SD= 1.58, Skewness= 0.76, Kurtosis= -0.30), and Inappropriate Adult Behavior (M= 2.56, SD= 1.54, Skewness= 0.94, Kurtosis= -0.22).

To assess the quality of the coach-athlete relationship, the Coach–Athlete Relationship Questionnaire (CART-Q)-Athlete Version validated for Brazil (Vieira et al., 2015). The instrument consists of 11 items divided into three subscales: closeness, commitment, and complementarity. The items are rated on a 7-point type Likert scale from 1 (strongly disagree) to 7 (strongly agree). ESEM summary statistics showed good model: CFI= 0.976, TLI= 0.948 SRMR= 0.020, RMSEA= 0.051 (90%CI= 0.040–0.063), and χ^2/df= 3.502. However, many items had problematic cross loadings on unintended factors. Our findings are consistent with previous research that found evidence of multicollinearity found between the subscales in the past (r> 0.90; Jowett & Ntoumanis, 2004), thus, we tested a one-factor 11 item structure that showed adequate model fit: CFI= 0.910, TLI= 0.888 SRMR= 0.046, RMSEA= 0.075 (90%CI= 0.067–0.083), and χ^2/df= 6.376. The descriptive for the one scale CART-Q were as followed: CART-Q (M= 6.02, SD= 1.02, Skewness= -1.62, Kurtosis= 3.35).

Path model

ESEM with target rotation (oblique) was used to test the cross-sectional relationships between the coach-athlete relationship and USES-P outcomes. ESEM summary statistics showed good model: CFI= 0.919, TLI= 0.892 SRMR= 0.029, RMSEA= 0.038 (90%CI= 0.036–0.041), and χ^2/df= 2.424.

Results

The coach-athlete relationship had significant positive relationships with all positive USES-P outcomes scales and significant negative relationships with all of the USES-P negative experiences scales (all p's< 0.01). For more information, see Table 4.

Table 4. Parameter estimates (standardized beta weights) derived from Exploratory Structural Equation Modeling path model.

Path	β	Standard error	*t* value	*p*-value
CARTQ→ IN	0.32	0.04	7.68	< 0.01**
CARTQ→ BS	0.23	0.04	5.46	< 0.01**
CARTQ→ IR	0.20	0.04	4.73	< 0.01**
CARTQ→ TW	0.29	0.04	7.18	< 0.01**
CARTQ→ AN	0.13	0.04	3.12	< 0.01**
CARTQ→ S	-0.17	0.04	-4.27	< 0.01**
CARTQ→ SE	-0.24	0.04	-6.18	< 0.01**
CARTQ→ IB	-0.23	0.04	-5.66	< 0.01**

β: standardized beta weights; CARTQ: coach athlete relestionship; IN: initiative; BS: basic skills; IR: interpersonal relationships; TS: teamwork and social skills; AN: adult networks and social capital; ST: stress; SE: social exclusion; IB: inappropriate adult behavior. * ≤ 0.05; ** ≤ 0.01.

Discussion

The purpose of this four-phase program was to create a version of the USES (Rathwell & Young, 2016) that could validly and reliably assess PD outcomes and negative experiences associated with university sport for Portuguese student athlete populations. Our findings related to the content, construct, concurrent validity, and temporal stability of the USES-P were promising. More specifically, we were able to:

(a) translate the original USES (Rathwell & Young, 2016) items into Portuguese while maintaining the meaning of each item;
(b) determine and confirm a factor structure that was similar to the original USES using two independent samples of Brazilian university athletes;
(c) confirm the stability of our new Portuguese measure over time;
(d) find cross-sectional relationships with a theoretically consistent construct (i.e., the coach-athlete relationship).

The advent of the USES-P is timely given the recent interest in the assessment and measurement of PD through sport in Brazil (Gaion Rigoni, Nascimento Junior, Belem, Vieira, & MacDonald, 2018) and offers the only validated scale in Portuguese that specifically targets PD attributed university sport.

When assessing university athletes' personal and psychosocial development, the USES-P addresses several gaps in the literature identified by Rathwell & Young (2016). For instance, Rathwell & Young (2016) cautioned that the fit and factor structure of USES might only be valid for Canadian university athletes and that more research was needed to test the external validity of the USES in other collegiate systems where student-athlete roles may reflect different realities than in Canada. In our current investigation, we explored the psychometric properties of the USES-P with two large samples of Brazilian university athletes. In general, we were pleased to find strong psychometric properties (all indices met criteria for good fit except some TLI scores, which fell

just shy of cutoff scores) for the USES-P, which maintained 39 of the 46 original USES items, and eight of the nine original factors. Having a high degree of overlap between the English and Portuguese versions of the USES is important because it will allow researchers to make cross-cultural comparisons between different university sport systems (e.g., Canada vs. Brazil).

On this note, the current findings allow us to provide the first profile of Brazilian university athletes' responses on each of the USES-P. In general, it appears the Brazilian student-athletes perceive clear benefits from their participation in university sport. On average, athletes "agreed" that they improved their initiative, interpersonal relationships, and teamwork, and social skills. The athletes "somewhat agreed" that they developed basic skills, as well as adult networks and social capital. On average, they were "uncertain" whether they experienced stress because of their university sports involvement. Brazilian student-athletes "somewhat disagreed" that they experienced social exclusion and inappropriate adult behavior. Our current findings mirror Rathwell & Young's (2016) study on Canadian athletes, whereby the average Brazilian university athlete perceived high levels of PD with relatively low levels of negative experiences. Although the findings are optimistic, it is important to note that there were athletes who had quite negative experiences. Thus, we caution people from making the interpretation that all university sports programs promote positive outcomes and that each program is equally viable in their pursuit of personal and psychosocial development.

Although there was a high degree of overlap between the USES-P and the USES, we were disappointed to lose the "negative peer interactions" scale from the USES-P. Interestingly, when compared to Canadian athletes, who perceived the items "I often do things that are morally inappropriate", "I often consume alcohol", and "I frequently take drugs" as an independent construct, Brazilian athletes associated morally inappropriate behaviours with stress (i.e., the item had a problematic cross loading on the stress factor), and drug and alcohol consumption with social exclusion (i.e., these items had problematic cross loadings on the social exclusion factor). The current findings may highlight a potential cultural difference between Canada and Brazil as it relates to how drugs and alcohol consumption is understood through sport participation. Unfortunately, our data does not allow us to explore this potential cultural difference in more detail, but it does highlight a prospective area for future research.

Another gap in the literature that Rathwell & Young (2016) outlined was a need to evaluate the relationships between theoretically-grounded concepts and USES outcome measures. In the current study, we explored the association between the coach-athlete relationship and USES-P outcomes. Within the PD through sports literature, quality relationships have been posited as a required foundation for personal and psychosocial development to occur through sport (Turnnidge et al., 2018). When considering the context of Brazilian university sport, our data suggest that when an athlete perceives to have a close, committed, and complementary relationship with their coach, they will also perceive high levels of positive outcomes related to:

(a) self-regulatory capacities;
(b) abilities related to finding information;
(c) personal relationships formed with athletes of different socioeconomic and ethnic backgrounds, abilities related to working with others;
(d) abilities related to building networks with important adults off-campus.

The current results align with past studies on adolescent athletes that demonstrate positive relationships between the coach athlete relationship and PD outcomes through sport (Camiré et al. 2019) and set the precedence for future researchers to begin to explore the process of PD in university sport in Brazil. For instance, future research may begin to explore different mediators and moderators to help explain how and why the coach-athlete relationship and PD outcomes of the USES-P are linked.

CONCLUSIONS

The purpose of this study was to validate a cross-cultural adaptation of the USES using data from a Portuguese-speaking population of university athletes. Although we are confident in the utility of the USES-P for assessing PD outcomes related to initiative, basic skills, interpersonal relationships, teamwork and social skills, adult networks and social capital, stress, negative social exclusion, and inappropriate adult behavior, the USES-P should not be seen as an exhaustive tool for evaluating all developmental outcomes that result from university sport participation in Brazil. Due to the fact that the USES-P outcome measures were constrained by the prior USES (Rathwell & Young, 2016) themes, the USES-P may be missing PD outcomes that are unique to the Brazilian context. Thus, we put forth that future research looking to evaluate PD in the Brazilian context should examine what needs to be added to the USES-P using both qualitative and quantitative methods.

From a qualitative perspective, researchers may explore the perception of the various stakeholders within the Brazilian context to gain more insight on the breadth of PD outcomes

associated with university sport. Conversely, from a quantitative perspective, one might test whether factors from the Youth Experience Scale (YES 2.0; Hansen & Larson, 2005) that were lost when creating the USES (Rathwell and Young, 2016) might converge when tested in Brazilian university sport contexts. For instance, Rathwell and Young (2016) were upset that they failed to retain the identity subscale borrowed from the YES 2.0 (Hansen & Larsen, 2005). Due to the high degree of relevance to emerging adulthood (Arnett, 2006), they made a call for future research to establish a psychometrically sound identity subscale. In the current study, we did not test whether Portuguese translated YES 2.0 items would converge using data from our Brazilian university athletes. However, it is possible that these items may be interpreted in a more succinct way within this new context. Moving forward, we encourage researchers within Portuguese-speaking countries to further explore the USES-P and provide insights about how university sport may help athletes develop.

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Appendix 1. University Sport Experience Scale — Portuguese.

Instruções: O seguinte questionário avaliará a experiência proporcionada a você através da sua participação no esporte universitário. Com base em sua participação atual ou recente, por favor, classifique o nível ao qual você concorda ou discorda com as seguintes instruções de como eles se relacionam com a sua participação em seu programa de esporte universitário.						
1 Discordo plenamente	2 Discordo	3 Discordo em partes	4 Incerto	5 Concordo em partes	6 Concordo	7 Concordo plenamente

Como resultado do meu envolvimento no esporte universitário:							
	1	2	3	4	5	6	7
1. Estou mais capaz de colocar toda minha energia em uma atividade que é importante para mim							
2. Estou mais empenhado							
3. Estou mais capaz de focar minha atenção							
4. Estou melhor em desenvolver planos para resolver um problema							
5. Estou mais capaz de organizar meu tempo e não adiar coisas que precisar ser feitas							
6. Estou melhor em estabelecer minhas prioridades							
7. Estou melhor em praticar autodisciplina							
8. Acredito que melhorei minhas habilidades de informática e de usar a internet							
9. Acredito que melhorei minhas habilidades criativas							
10. Acredito que minhas habilidades artísticas melhoraram							
11. Tenho melhor entendimento sobre o que tenho em comum com pessoas de diferentes origens							
12. Eu conheci melhor pessoas de diferentes grupos étnicos							
13. Fiz mais amigos que vem de diferentes classes sociais (mais ricos ou mais pobres)							
14. Eu falo sobre moral e valores com os outros com mais frequência							
15. Estou mais ciente dos diferentes obstáculos que outras pessoas enfrentam							
16. Eu valorizo mais os contextos sociais das outras pessoas							
17. Estou melhor em dar feedback							
18. Estou melhor em receber feedback							
19. Sei mais sobre os desafios de ser um líder							
20. Estou mais confiante que posso enfrentar desafios quando os outros estão contando comigo							
21. Estou melhor em ser responsável por um grupo de colegas							
22. Estou melhor em apoiar os outros							
23. Estou mais capaz de tomar uma posição quando não concordo com algo							
24. Acredito que conheci mais pessoas na comunidade fora do campus							
25. Me sinto mais apoiado pela comunidade fora do campus							
26. Me sinto mais parte da minha comunidade fora do campus							
27. Estou frequentemente impossibilitado de estudar o suficiente para os testes							
28. Estou impossibilitado de fazer coisas em família com mais frequência							
29. Estou frequentemente estressado							
30. Frequentemente me sinto com trabalho demais							
31. Frequentemente sinto que não pertenço aos grupos que estou envolvido							
32. Frequentemente me sinto deixado de lado							
33. Frequentemente estou exposto a "panelinhas"							
34. Estou frequentemente exposto a líderes que são controladores e manipuladores							
35. Estou frequentemente exposto a líderes que fazem comentários e piadas sexuais inadequados							
36. Estou frequentemente exposto a líderes que menosprezam minhas ideias							
37. Estou frequentemente exposto a líderes que me culpam por coisas que vão além o meu controle							
38. Estou frequentemente exposto a líderes que tem seus atletas favoritos							
39. Estou frequentemente exposto a líderes que me menosprezam							

Iniciativa: 1 a 7; habilidades básicas: 8 a 10; relações interpessoais: 11 a 16; habilidades sociais e trabalho em equipe: 17 a 23; rede de adultos e capital social: 24 a 26; estresse: 27 a 30; exclusão social: 31 a 33; comportamento adulto inapropriado: 34 a 39.

ORIGINAL ARTICLE

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Dietary intake of young portuguese handball players

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ABSTRACT

The aim of this study was to analyse dietary intake (macronutrients and micronutrients) in young female and male handball athletes. A transversal study was performed with young handball players from sub 16 and 18 Portuguese Handball Federation, who volunteered to participate in this study. Anthropometric (weight and height measure), nutritional intake (using food frequency questionnaire) and position in the game were evaluated. The final sample comprised 64 athletes (48.4% female and 51.6% male). The mean age was 16± 1 years, average body mass index was higher in females (24.1± 3.5kg/m²) than males (23.8± 3.0 kg/m²). Mean energy intake per day was significantly lower in females than males 2167.4± 1185.0 and 2952.9± 1315.8 kcal/day (p= 0.015, 95CI), respectively. According to the recommendations from food, most of the young handball athletes reported a generally higher dietary intake (protein intake was near to the upper recommendation limit; the carbohydrate intake was below and the fat intake higher) and a lower for some micronutrients. A process to identify the athletes that need nutritional support should be considered by handball coaches to optimise their performance and safeguard their health.

KEYWORDS: nutrition; food intake; handball; adolescents.

INTRODUCTION

As a collective game, handball involves two teams of seven players each, according to international handball federation rules. Handball is defined as an intermittent high-intensity exercise. Importantly, it also indicates that team handball may potentially result in widespread positive health and physical fitness effects due to the high demands imposed on the aerobic and anaerobic energy systems (Randers et al., 2010; Hornstrup et al., 2020).

Healthy food choices and adequate nutrition for team sports athletes is a challenge. Cultural, economic, and psychological factors can influence but are essential for supporting training and enhancing the physical performance of athletes (Holway & Spriet, 2011).

The players perform various activities such as running (speeding up, slowing down, changing direction and sprint), jumping (jumping and throwing and blocking), throwing balls (giving passes and pitching), and reciprocal physical struggle during the game (Povoas et al., 2012). Anthropometric characteristics of these athletes, such as height, weight and body composition (Ghobadi, Rajabi, Farzad, Bayati, & Jeffreys, 2013), and physical capacities such as speed, power, strength and endurance, and motor action, as the change of direction and jumping, are prerequisites which should be carried out (Molina-Lopez, Barea Zarzuela, Saez-Padilla, Tornero-Quinones, & Planells, 2020). Given its influence on performance, body composition should be appropriate, which depends to a large extent on proper eating habits (Hosseinzadeh et al., 2017).

Adequate food intake is crucial to capable growth and maturity and is associated with physical exercise (Cotunga, Vickery, & McBee, 2005; Bonci, 2010). According to sports nutrition guidelines, protein intake should be between 1.2g/kg/day and 1.7g/kg/day, carbohydrates (Kaur et al., 2006) ingestion

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may range from 3 to 12 g/kg/day depending on the duration and type of exercise (Burke, Hawley, Wong, & Jeukendrup, 2011), and fat should contribute to 20–35% of total energy value (Desbrow et al., 2014; Jenner, Buckley, Belski, Devlin, & Forsyth, 2019). Moreover, athletes should reach, at least, the dietary reference intakes for all micronutrients.

The studies of elite and young handball players' anthropometric nutritional intake tend to be inconsistent. And in a practical context, due to the few nutritional information, this work is a pioneer in assessing the food intake of this group.

As, due to specificity on training according to their position (wings, pivots and backcourt players and goalkeepers), that during the game consequential to field zones and phases of the game, each position player has specific technical and tactical requirements. Athletes from different positions differ in morphological parameters, especially in body weight (between backcourts and wings) and subcutaneous fat (goalkeepers and the other players) (Hermassi, Laudner, & Schwesig, 2019). However, according to the scarce information and competition and rest days in young athletes, it is essential to characterise this population regarding these variables.

This is the first transversal observational study, with the following objectives:

i) to analyse nutritional intake (macronutrients and micronutrients);
ii) to analyse nutritional intake (macronutrients) according to their position in the game and between female and male athletes.

It was hypothesised that nutritional intake (macronutrients and micronutrients) are according to the nutritional recommendations according to the age and regardless of position on the game, all athletes have adequate nutritional intake, being higher in males than in female athletes.

METHODS

This study is a transversal observational study.

Participants

Seventy young handball athletes from different Portuguese clubs volunteered to participate in this study between October and November of 2019. To be eligible for participation, the participants should play in sub 16 and 18 years old, be selected to play for the Portuguese Handball Federation and completed all questionnaires. Six were excluded due to unwillingness to continue participating in the study or missing the completion of the questionnaire. The final sample comprised 64 athletes [48.4% (n= 31) female and 51.6% (n= 33) male].

The study was approved by the research committee of the Portuguese Handball Federation. All participants, their coaches, and parents were informed of study purposes. And guardians signed the informed consent before the study, in accordance with the Declaration of Helsinki, regarding the ethical procedures of the study.

Anthropometric measures

A professional assessed the body composition, including body weight, height, and body mass index (BMI), using a bioelectrical impedance analyser. All anthropometric measurements were performed before the training session. Height was measured using a stadiometer with an accuracy of 0.5 cm (Seca 700, Germany). Bodyweight and BMI were determined using bioelectrical impedance analysis equipment (ioi 353 BIA) with an accuracy of 0.1 kg, 0.1 kg/m^2, 0.1%, respectively. Measurements were done with athletes wearing shorts and t-shirts.

Dietary assessment

Dietary intake was obtained by a semi-quantitative food-frequency questionnaire (FFQ), validated for the Portuguese adult population (Lopes, Aro, Azevedo, Ramos, & Barros, 2007). The participants filled out semi-quantitative FFQ that assessed information over the previous 12 months. The questionnaires were completed in the presence of a qualified and trained nutritionist from November 2019 to February 2020. The FFQ is an 86-item questionnaire that includes food groups and beverage categories and a frequency section with 9 possible responses, ranging from "never or less than 1 time per month" to "6 or more times per day". The food intake was calculated by weighting 1 of the 9 possibilities of frequency of consumption by the weight of the standard portion size of the food item. A seasonal variation factor was considered for foods where production and consumption were not regular over the year. Energy and nutrient intake with more sports relevance (proteins, carbohydrates, lipids, vitamins A, C, E, D, B6, and B12, thiamine, riboflavin, folate, magnesium, zinc, calcium, selenium, and iron) were estimated using the software Food Processor® SQL (ESHA Research Inc. Salem, OR, USA) with proven nutritional information from food composition tables from the United States Department of Agriculture, adapted to typical Portuguese foods and recipes.

Handball Game Position

Each coach was asked about the field position of the elite and young handball players. There are different positions, such as the goalkeeper, wings, pivots and backcourt players.

Statistical analysis

Data were checked for normal distribution using Kolmogorov-Smirnov test. The mean, standard deviation and 95% confidence interval were calculated as descriptive statistics. Independent samples t-test was used for quantitative variables comparison between the female and male. One-way ANOVA was used to analyse the differences in macronutrients between the players' positions (Wing athletes, pivots, backcourt athletes and goalkeepers). Amounts of macronutrients and micronutrients intake were adjusted for their daily energy consumption, using linear regression test and residual method. Differences were considered significant when $p< 0.05$. All statistical analyses were performed using Statistical Package for Social Sciences (SPSS) version 23.0 statistical software for Mac (IBM, Armonk, NY, USA).

RESULTS

Anthropometric characteristics

Of the 70 young handball athletes, 6 were excluded due to incomplete information. The final sample comprised 64 athletes (48.4% female and 51.6% male). Table 1 shows the characteristics of athletes (age and anthropometric characteristics) included in this study. The mean age was 15.5± 0.9 years, and dividing according to sex, the ages of male and female athletes were 16.1± 0.5 and 14.8± 0.9 years ($p= 0.001$), respectively. Male athletes were significantly heavier and taller than females, but the average BMI was higher in females (24.1± 3.5 kg/m^2) than males (23.8± 3.0 kg/m^2). Without significant difference between sex ($p= 0.66$). According to game position, the BMI of female and male pivots' athletes was 26.8± 4.7 kg/m^2 and 26.5± 3.8 kg/m^2 ($p= 0.923$), respectively. Female and male Goalkeepers' BMI was 25.7± 4.2 kg/m^2 and 24.3± 1.8 kg/m^2 ($p= 0.690$), respectively. Female and male backcourt' BMI was 22.8± 2.6 kg/m^2 and 23.6± 2.2 kg/m^2 ($p= 0.406$), respectively. female and male Wings' BMI was 22.6± 1.2 kg/m^2 and 21.1± 2.2kg/m^2 ($p= 0.338$), respectively.

Table 1. Mean values of age and body composition of young handball athletes and the comparison of the variables between female and male.

	Female (n= 31)	Male (n= 33)	*p*
Age (years)	14.8± 0.9	16.1± 0.5	**< 0.001**
Weight (kg)	63.9± 10.0	77.1± 12.1	**< 0.001**
Height (Hermassi et al., 2019)	1.6± 0.1	1.8± 0.1	**< 0.001**
BMI (kg/m^2)	24.1± 3.5	23.8± 3.0	0.66

All variables are present as mean± standard deviation. Statistical analysis with independent t-test, between female and male athletes, respectively: BMI: body mass index.

Nutritional intake

Energy, macronutrients, and micronutrients intake of athletes are provided in Table 2. female and male mean energy intake per day were 2,167.4± 1,185.0 and 2,952.9± 1,315.8 kcal/day ($p= 0.015$, 95CI), respectively. Average energy, protein, carbohydrate, fat, vitamin E, thiamin, folate, magnesium, calcium, zinc and iron intake in males was significantly higher than females ($p< 0.05$). None of these athletes was using nutritional supplements.

Nutritional intake according to game position

Energy and macronutrients intake of athletes, according to their playing position, are provided in Table 3. The mean energy intake per day of wing female and male players was 2,695.2± 1,538.1 and 2,898.9± 1,325.9 kcal/day, respectively. The mean energy intake per day of pivots female and male players were 1,984.9± 1,223.3 and 3,318.2± 1,656.6 kcal/day, respectively. Backcourt athletes' energy intake was 1,802.6± 798.1 kcal/day in females and 2,950.6± 1,116.8 kcal/day in males. Goalkeeper athletes' energy intake was 1,899.1± 711.1 kcal/day in females and 3,837.1± 1,537.8 kcal/day in males. In females, the average macronutrients, there were significant differences in protein intake (g/day) between wing and backcourt female athletes (1,17.7± 38.2 and 80.1± 37.6 kcal/day, $p= 0.045$, respectively).

DISCUSSION

This study assessed the nutritional intake (macronutrients and micronutrients) of young handball athletes as well according to their position in the game and between females and males. The main findings were that young female, and male handball athlete's energy intake is 2,167.4± 1,185.0 and 2,952.9± 1,315.8 kcal/day, respectively (Figure 1). Average energy, protein, carbohydrate, fat, vitamin E, thiamin, folate, magnesium, calcium, zinc and iron intake in males was significantly higher than that of females ($p< 0.05$). Regarding the position in the game, female athletes in wing position have a higher energy intake compared to the other positions. And according to macronutrients intake, wing athletes had a significantly higher protein intake (g/day) than other positions and carbohydrate and lipids intake (g/day). In male athletes, the goalkeepers had a higher energy intake

Table 2. Mean values of energy (kcal/day), macronutrients and micronutrients per day of young handball athletes and the comparison of the variables between female and male.

	Female (n= 31)	Male (n= 33)	*p*
Energy (kcal/day)	2,167.4± 1,185.0	2,952.9± 1,315.8	**0.015***
Macronutrients			
Proteins (g/kg/day)	1.6± 0.8	1.8± 0.9	0.324
Proteins (g/day)	100.2± 50.1	136.3± 64.0	**0.016***
Carbohydrates (g/kg/day)	4.3± 2.5	4.9± 2.8	0.385
Carbohydrates (g/day)	267.1± 144.4	366.4± 190.5	**0.023***
Lipids (g/day)	78.9± 49.1	109.9± 59.7	**0.027***
Omega 3 (g/day)	1.5± 1.0	1.8± 0.9	0.284
Omega 6 (g/day)	11.1± 6.6	14.3± 7.8	**0.085***
Micronutrients			
Vitamin A (ug/day)	2,759.5± 2,562.9	3,309.1± 2,402.1	0.379
Vitamin C (mg/day)	126.7± 104.1	172.5± 142.0	0.149
Vitamin E (mg/day)	9.3± 5.7	12.2± 5.8	**0.046***
Vitamin D (ug/day)	5.2± 4.1	5.4± 3.5	0.832
Vitamin B6 (mg/day)	2.6± 1.5	3.3± 1.7	0.092
Vitamin B12 (ug/day)	16.1± 17.6	18.5± 14.2	0.555
Thiamin (mg/day)	1.8± 0.8	2.4± 1.2	**0.014***
Folate (ug/day)	389.4± 245.3	546.2± 343.6	**0.041***
Magnesium (mg/day)	331.6± 184.4	450.8± 205.8	**0.018***
Calcium (mg/day)	886.9± 464.7	1,326.1± 854.7	**0.014***
Zinc (mg/day)	13.6± 7.1	18.0± 8.4	**0.027***
Iron (mg/day)	17.7± 9.8	23.2± 10.6	**0.035***

All variables are present as mean± standard deviation. *p*-value comparison of variables between female and male adolescents. *$p < 0.05$

Table 3. Mean values of energy (kcal/day), macronutrients per day of young handball athletes and the comparison of the variables between female and male and their position (Wing athletes, pivots, backcourt athletes and goalkeeper) in the game.

	Wing athletes	Pivots	Backcourt athletes	Goal keeper	*p*
Female (n= 31)	**(35.5%)**	**(16.1%)**	**(29.0%)**	**(19.4%)**	
Energy (kcal/day)	2,695.2± 1,538.1	1,984.9± 1,223.3	1,802.6± 798.1	1,899.1± 711.1	
Proteins (g/day)	117.7± 38.2*	105.5± 93.7	80.1± 37.6*	96.8± 35.3	***0.045**
Carbohydrates (g/day)	316.0± 192.9	257.2± 149.3	238.6± 102.95	228.4± 85.2	
Lipids (g/day)	104.4± 65.8	63.5± 34.7	62.4± 33.1	69.6± 29.2	
Male (n= 33)	**(50.0%)**	**(20.0%)**	**(23.3%)**	**(6.7%)**	
Energy (kcal/day)	2,898.9± 1,325.9	3,318.2± 1,656.6	2,950.6± 1,116.8	3,837.1± 1,537.8	
Proteins (g/day)	135.7± 59.9	168.8± 93.6	128.7± 59.5	145.2± 10.3	
Carbohydrates (g/day)	367.2± 187.7	370.0± 142.2	338.9± 126.8	660.6± 463.8	
Lipids (g/day)	102.4± 56.3	134.7± 84.6	124.9± 52.8	88.9± 17.8	

All variables are present as mean± standard deviation. *p*-value comparison of variables between position in the field (wing players and backcourt athletes). *$p < 0.05$.

and carbohydrate intake. Pivot's athletes have a higher protein and lipid intake compared to other positions.

According to our results, average body weight, height, and BMI of all athletes in the current study were normal or healthy weight but were higher than standard values for young athletes (Collaboration, 2017; Mascherini, Galanti, Massetti, Cala, & Modesti, 2019), and according to global age-standardised mean BMI of children and adolescents aged 5–19 years in 2016 was 18.6 kg/m^2 for females and 18.5 kg/m^2 for males (Collaboration, 2017). And consistent with

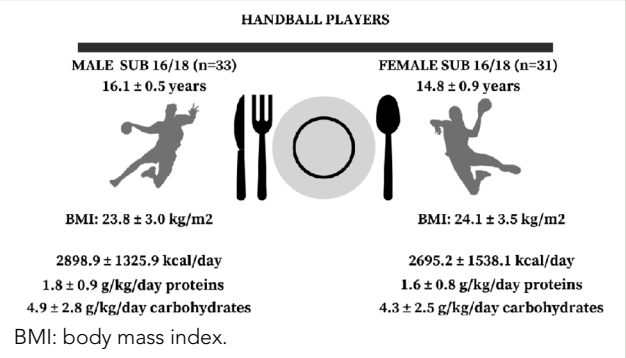

Figure 1. Mean values of energy (kcal/day), macronutrients (proteins and carbohydrates) per kg per day of young handball athletes between female and male.

physiological, there are differences between the sexes, since men are, in general, taller, heavier, have larger muscle mass, and are stronger than women (Michalsik & Aagaard, 2015).

Physical training in handball should be designed and performed to reflect the specific demands placed on male and female athletes, respectively. To the best of our knowledge, no previous study has examined the nutritional differences according to different sexes and positions in Portuguese athletes.

When comparing the ingestion of macronutrients between sex, the mean energy intake was significantly higher in males than in females (2,952.9± 1,315.8 kcal/day and 2,167.4± 1,185.0, respectively (p= 0.015)). The energy intake-adjusted to weight was 39.3± 19.3 kcal/kg/day for males and 34.8± 19.7 kcal/kg/day for females. According to other studies, handball players at the beginning of and during the sports season has been around 2,700–3,200 kcal/day and 3,100–3,600 kcal/day, respectively, for males and 1,800–2,400 kcal/day for women (Molina-Lopez et al., 2013). On the other hand, a study among 16 Brazilian female players had an energy intake of 1,883 per day (comparable with the 1,690 kcal per day found here), which was mentioned to be at least 220–440 kcal less than the recommended range (Hermassi et al., 2019).

The athlete's energy need will depend on the training and competition cycle, duration, frequency of matches, length of the season, training phase, and the number of players and substitutions. Energy balance, therefore, occurs when energy consumption is equal to total energy expenditure or the sum of the energy expended as the basal metabolic rate, the thermal effect of the food, the thermal effect of the activity (energy expended on planned physical activity), and thermogenesis of resting activity (Molina-Lopez et al., 2013).

The contribution of macronutrients (carbohydrates, proteins and lipids) in handball athletes is fundamental. The protein intake may be a priority in the diet of a handball player due to the difference in weight, height, fat percentage, and muscle mass according to different positions. According to recommendations from the American College of Sports Medicine (ACSM) and International Society of Sports Nutrition Position Stand (ISSN) organisations, the protein intake ranges from 1.2 to 2.0 g/kg/day (Thomas, Erdman, & Burke, 2016; Jager et al., 2017). In our study, the weight-adjusted protein intake found in females and males (1.6± 0.8 and 1.8± 0.9 g/kg/day, respectively), the male group's intake was near the upper recommendation limit (American Dietetic Association, Dietitians of Canada, & American College of Sports Medicine, 2009). And it is important to take into account that all of these intake values are according to food intake. This means that many of the incentives given to this population for supplementation have to be rethought and viewed individually if whether or not there is a need.

Regarding carbohydrate intake, young male athletes showed higher weight-adjusted ingestion, 4.3± 2.5 and 4.9± 2.8, respectively, being below the recommended for the studied sample: 6–10 g/kg/day (Thomas et al., 2016). According to different authors, male handball players reported ingesting an average of 4.1–4.8 g/kg/day, while female players consumed about 3.7–4.0 g/ kg/day (Molina-Lopez et al., 2013). The ACSM has estimated a range between 20% and 35% for fats total energy intake in athletes, and according to our study's data, women had a fat intake higher (37.3%) than men (33.5%). It exceeds the recommendations, while the fat intake by men is within the recommendations.

Therefore, these athletes might benefit from specific nutritional guidance to increase CHO ingestion and implement strategies to adjust protein and lipid intake.

Considering the game position, our study found that athletes in wing positions have a higher energy intake compared to the other positions. And according to macronutrients intake, wing athletes had a significantly higher protein intake (g/day) than other positions and carbohydrate and lipids intake (g/day).

Given the scarcity of information on dietary intake in athletes of different positions, it is not possible to relate these results with other works. Considering the demand of these athletes' work on the field and other informations about anthropometric measures, such as wing athletes are significantly smaller and have significantly lower body mass (Hermassi et al., 2019). Our study was in accordance with these results since female, and male athletes in this position have a lower BMI. This happens because the wings cover the largest field area and carry out most of the counterattacks, therefore they need lighter and faster bodies with the capacity for rapid changes of movement and agility (Hermassi et al., 2019).

Female goalkeepers are the heaviest of all players according to their position in the game (Hermassi et al., 2019), however, in the present study, the heaviest female players were the pivots. Considering that we only have the BMI value, we do not know which value corresponds to the percentage of fat mass or muscle mass. Pivots must catch the passes during an attack, and high defence players hinder them, therefore, high body height values can give them an advantage over those (Hermassi et al., 2019). In our study, the goalkeepers' male athletes had a higher energy intake and carbohydrate intake. Pivot's athletes have a higher protein and lipid intake compared to other positions.

Although macronutrient ingestion probably reflecting an adequate energy intake, several micronutrients were below the dietary reference intake, such as calcium and vitamin E in females and vitamin C and D in both sexes. Vitamins have also been widely studied to help athletes reduce stress damage, maintain a healthy immune system, and play a beneficial role in injury prevention and tissue repair in response to exercise (Walsh, 2019). These values were also found in other athletic groups, namely triathletes, runners, water polo players, and female junior and adolescents soccer players. Concerning vitamin D, that in our study in both sexes had an intake below dietary recommendation, is important in handball athletes due to its possible negative impact on bone health, immune function, inflammatory modulation, and muscle function and performance.

This study had some limitations, considering the time of evaluations, which did not permit the asessement of more parameters, such as the use of accelerometers to measure the physical activity, biochemical parameters, and body fat mass and skinfolds. Concerning the use of FFQ, although it has an acceptable validity, the interpretation of questions through young athletes was difficult, and the interpretation of the results should be made with caution. Nevertheless, this study allowed the collection of information regarding the young handball athletes' dietary intake.

CONCLUSIONS

In conclusion, this study is a big step in the future of handball because it allowed us to analyse young handball athlete's nutritional intake. According to the recommendations from food, most of the athletes reported a generally higher nutritional intake (protein intake was near to the upper recommendation limit; the carbohydrate intake was below and the fat intake higher) and a lower for some micronutrients. According to their positions in the game, energy intake is higher in wing female athletes and goalkeepers' male athletes. The female wing athletes have a higher significantly protein intake than other positions.

Considering these results, it seems plausible that specific nutritional training and education, especially with the involvement of experts in sports nutrition, would yield higher percentages of athletes fulfilling the recommendations according to their position and their expenditure in the game, since nutrition in these athletes may influence their future in the selection process and their professional life as handball athletes.

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ARTIGO ORIGINAL

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Análise fatorial confirmatória do tactical skills inventory for sports em jovens basquetebolistas brasileiros

Confirmatory factorial analysis of tactical skills inventory for sports in young brazilian basketball players

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RESUMO

O interesse da comunidade científica sobre as habilidades táticas de praticantes de esportes coletivos de invasão tem gerado a necessidade para o desenvolvimento de instrumentos capazes de mensurar tais habilidade. Na tentativa de contribuir nesse sentido, o objetivo do presente estudo foi traduzir e analisar as propriedades psicométricas (validade confirmatória e fidedignidade) do *Tactical Skills Inventory For Sports* para a língua portuguesa do Brasil em jovens basquetebolistas. Participaram do estudo 866 basquetebolistas brasileiros com média de idade 15,83± 1,25 anos. Foi produzida a versão brasileira do *Tactical Skills Inventory For Sports*. Foi realizado o alfa de *Cronbach* e a Análise Fatorial Confirmatória. Os valores de alfa de *Cronbach* apresentaram índices elevados para três dimensões do *Tactical Skills Inventory For Sports* e no somatório dos itens o alfa de *Cronbach* foi igual a 0,91. Os resultados da Análise Fatorial Confirmatória apresentaram valores: rácio do valor do qui-quadrado pelos graus de liberdade= 3,120; *Confirmatory Fit Index*= 0,925; *Tucker-Lewis index*= 0,914; *Standardized Root Mean Square Residual*= 0,039; *Root Mean Square Error of Aproximation*= 0,050 (90%IC= 0,045–0,054). Os resultados obtidos permitiram considerar que a versão brasileira do *Tactical Skills Inventory For Sports*, com 22 itens, constitui um questionário válido e fidedigno, para a utilização em jovens basquetebolistas brasileiros.
PALAVRAS-CHAVE: validação; jovens atletas; habilidades táticas; basquetebol.

ABSTRACT

The interest of the scientific community in the tactical skills of practitioners of collective invasion sports has generated the need for the development of instruments capable of measuring such skills in an attempt to contribute in this direction. The present study aimed to translate and analyse the psychometric properties (confirmatory validity and reliability) of the Tactical Skills Inventory for Sports into the Portuguese language in young Brazilian basketball players. A total of 866 basketball players with a mean age of 15.83± 1.25 years participated in the study. The Brazilian version of Tactical Skills Inventory for Sports was produced. Cronbach's alpha was calculated, and the Confirmatory Factor Analysis was performed. The Cronbach's alpha presented high indexes for 3 dimensions of Tactical Skills Inventory for Sports, and the sum of the items the Cronbach's alpha value was 0.91. The results of the Confirmatory Factor Analysis presented values= 3.120; *Confirmatory Fit Index*= 0.925; *Tucker-Lewis index*= 0.914; *Standardized Root Mean Square Residual*= 0.039; *Root Mean Square Error of Aproximation*= 0.050 (90% CI= 0.045–0.054). The obtained results allow us to consider the adapted Brazilian version of Tactical Skills Inventory for Sports, with 22 items, a robust and valid questionnaire, for use in young Brazilian basketball players.
KEYWORDS: validation; young athletes; tactical skills; basketball.

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INTRODUÇÃO

As exigências dos esportes coletivos de invasão (basquetebol, futebol, handball, futsal, hockey, rugby) requerem do atleta não somente atributos biológicos, fisiológicos, psicológicos e técnicos, mas sobretudo uma enorme capacidade de adaptação à oposição (Gréhaigne & Godbout, 1995; Catarino, Carvalho, & Gonçalves, 2017). Ao se defrontar com essa necessidade adaptativa, os jogadores precisam lidar com uma grande complexidade contextual do jogo, no qual exigem tomadas de decisão em situações instáveis e de rápidas mudanças (Williams, 2000).

Estes sistemas complexos exigem dos atletas capacidades para perceber e interpretar informações do ambiente de jogo relativas ao posicionamento da bola, seus companheiros e seus adversários (Praça et al., 2017; Silva, Conte, & Clemente, 2020). Com isso, os esportes coletivos de invasão necessitam de desenvolvimento simultâneo das habilidades técnicas (passe, drible e finalização) e das habilidades táticas (Davids, Araújo, Correia, & Vilar, 2013).

As habilidades táticas envolvem a qualidade de um jogador para desempenhar a ação correta no momento certo, tendo assim, uma dimensão operacional e individual (Kannekens, Elferink-Gemser, & Visscher, 2011). Além disso, distingue a habilidade que um determinado atleta possui em julgar e decidir a jogada certa no momento apropriado (Gréhaigne & Godbout, 1995; Quiñones et al., 2019). Em suma, Elferink-Gemser, Kannekens, Lyons, Tromp, & Visscher (2010) definem a habilidade tática como o conhecimento necessário às adaptações no jogo e às atividades de tomada de decisão. Isto significa que ler a jogada corretamente, ou, realizar a tarefa certa no momento certo, assim, saber o que fazer e como fazer, envolvem dois tipos de conhecimento, denominados como: declarativo e processual (Kannekens et al. 2011).

O conhecimento declarativo (CD) inclui a noção das regras e dos objetivos do jogo (French & Thomas, 1987), enquanto o processual implica a seleção de uma resposta (ação) adequada ao contexto da jogada e do jogo. A avaliação da interação entre o CD e o processual, refere-se em:

1) diferenciar a seleção e execução dos jogadores durante o momento competitivo;
2) avaliar o nível de aprendizagem;
3) observar o processo de resolução de uma situação-problema;
4) observar o desempenho na execução de uma tarefa.

Com isso, de acordo com McPherson (1994), é indicado realizar esta avaliação a partir "autorrelato".

Esses conhecimentos, frente as situações do jogo, são determinantes para o sucesso, sobretudo nas ações de posicionamento e tomadas de decisão. Assim, faz-se necessário avaliar esses conhecimentos de maneira sistemática, organizada e periódica durante as categorias de formação esportiva (Kannekens et al. 2009; Praça et al. 2017).

Alguns instrumentos foram propostos ao longo do tempo para avaliar os conceitos de desempenho tático, capacidade tática, desempenho técnico-tático, conhecimento tático, comportamento tático e habilidades táticas, e suas relações com os conhecimentos declarativo e processual nos esportes coletivos de invasão. Costa, Garganta, Greco, Mesquita, & Maia, (2011) desenvolveram o Sistema de avaliação tática no futebol (FUT-SAT). Gréhaigne, Godbout, e Bouthier, (1997) desenvolveram o *Time Sports Assessment Performance* (TSAP) e Oslin, Mitchell e Griffin, (1998) criaram o *Game Performance Assessment Instrument* (GPAI), ambos associados à avaliação do *Teaching Games for Understand* (TGFU). O teste de conhecimento tático processual para orientação esportiva (TCPP:OE) foi desenvolvido para avaliar crianças e jovens de jogos esportivos coletivos de invasão (Greco et al., 2015).

Com especificidade a modalidade basquetebol, verificou-se os instrumentos desenvolvidos por Folle et al. (2014) no qual busca avaliar desempenho técnico-tático individual, a partir de observação indireta, com indicadores de observação das ações do jogo (ataque e defesa), e três componentes: adaptação, tomada de decisão e eficácia. No campo do conhecimento tático processual, Pérez-Morales, Greco, Lopes, Estevão, & Ibáñez (2018) validaram preliminarmente o *Procedural Tactical Kowledge Test for Basketball* (PTKT-Bb). Na temática do conhecimento tático declarativo, Reis, Morales, Gomes, Pereira, & Ibáñez (2021) construíram e validaram o Teste de Conhecimento Tático Declarativo – jovens basquetebolistas (TCTD-Bb). Por fim, Ibáñez, Martinez-Fernandez, Gonzalez-Espinosa, García-Rubio, & Feu, (2019) desenvolveram e validaram o *Basketball Learning and Performance Assessment Instrument* (BALPAI), para avaliar simultaneamente a tomada de decisão, execução e eficácia técnica.

Tais esforços da comunidade científica apontam para a continua necessidade de desenvolver instrumentos validos e confiáveis para analisar o nível de habilidades táticas dos praticantes de Jogos Esportivos Coletivos (Greco et al., 2015). Importante referir que dentre os instrumentos disponíveis nesse campo de análise, verifica-se que eles apresentam como características a avaliação direta (jogo propriamente dito) e indireta (filmagem) efetuada por peritos. Entretanto, na aplicabilidade prática do treinador, ao qual é preciso respostas rápidas para ajustar sua dinâmica de treino, suas constantes percepções da evolução dos jogadores e conduzir os atletas a mais altos níveis de desempenho, é preciso fazer-se uso de

um instrumento que seja prático, acessível, valido e confiável para a observação das habilidades táticas (Elferink-Gemser, Visscher, Richart, & Lemmink, 2004).

Com o intuito de oferecer um instrumento de fácil aplicação, capaz de avaliar as capacidades cognitivas e procedimental dos atletas, Elferink-Gemser et al. (2004) desenvolveram o questionário de habilidades táticas (*Tactical Skils Inventory for Sports* — TACSIS). A partir da opinião de treinadores experts em esportes coletivos de invasão foram criadas 34 itens no questionário, que após uma análise fatorial exploratória encontrou uma versão final de 22 itens Elferink-Gemser et al. (2004).

O TACSIS tem a função de quantificar a percepção que o jogador possuí sobre o seu nível de aprendizagem das habilidades táticas, a partir de um questionário baseado em autorrelato, constituído por quatro sub escalas: posicionamento e decisão (PD), conhecimento sobre as ações com bola (CSAB), conhecimento sobre os outros (CSO) e atuação em situações de mudança (ASM). Sendo as perguntas que compõem as sub escalas PD e ASM relacionadas ao conhecimento processual (CP), representando o conhecimento do jogo com elemento central e as perguntas que compõem as sub escalas CSAB e CSO relacionadas ao CD, sendo a seleção da ação mais adequada como elemento central (Kannekens et al., 2011).

A natureza das ações nos jogos coletivos de invasão, compreendem a diferença entre situações com posse de bola (ataque) e as ações sem a posse de bola (Oslin et al., 1998). Segundo Mitchel (1996), as habilidades táticas, bem como a manutenção da posse de bola, ataque ao alvo, criação de espaços no ataque, defender o espaço, evitar a progressão ao alvo e defender o alvo, são aspectos semelhantes nos esportes coletivos de invasão. Sendo assim, o TACSIS difere as sub escalas como: duas sub escalas relacionadas a interpretação das ações de ataque (PD e CSAB), onde a equipe está com a posse de bola, e duas sub escalas relacionadas a interpretação das ações de defesa (CSAB e CSO), em que a equipe não possui a posse de bola (Tabela 1).

A partir deste embasamento teórico, do desenvolvimento do instrumento para medir as habilidades táticas e de suas vantagens acerca da sua aplicabilidade no contexto esportivo, outros investigadores procuraram validar o TACSIS em diferentes contextos. Noronha (2011) a partir de estudo exploratório procedeu à tradução do TACIS (34 itens) para o português (Portugal) a partir de amostra de 300 atletas (basquetebol, handball, *rugby* futebol e polo aquático). Pereira (2018) propôs a adaptação do TACSIS (22 itens) em uma amostra com 153 basquetebolistas do sexo feminino em Portugal. Yarayan, Esentürk, & Illhan, (2019) desenvolveram uma adaptação para o idioma turco do TACSIS, com 225 atletas adultos (19–30 anos de idades) de quatro esportes coletivos de invasão (futebol, basquetebol, handebol e *rugby*). Viciana, Mayorga-Veja, & Blanco (2016), realizaram a adaptação/tradução para a língua espanhola do TACSIS, bem como a observação de suas propriedades psicométricas, em 540 jovens atletas (10–17 anos de idade) praticantes de esportes escolares.

De acordo com versões adaptadas do TACSIS em diferentes países e modaldiades, é possível encontrar investigações em importantes periódicos da área esportiva (Elferink-Gemser et al., 2010; Nortje *et al.*, 2014; Kannekens *et al.*, 2011Forsman et al., 2016a; Forsman et al., 2016b; Guimarães *et al.*, 2020). Nesse sentido, destacam-se os de: Elferink-Gemser et al. (2007), que utilizaram o TACSIS para monitorar o desenvolvimento de jogadores de hóquei de campo de elite e os resultados evidenciaram a importância do desenvolvimento de habilidades táticas dos jogadores de nível superior. Kannekens et al. (2009) utilizaram o TACSIS para comparar futebolistas juniores de dois países com *ranking* da FIFA distintos, e observaram que os atletas de melhor ranking apresentaram níveis de habilidades táticas superiores. Forsman et al. (2016a) utilizaram o TACSIS para medir, dentre diversas variáveis, a habilidade tática de 288 jovens futebolistas entre 12 e 14 anos. Mais recentemente, Guimarães et al. (2020) utilizaram o TACSIS para medir as habilidades táticas em um programa de identificação jovens talentos para o basquetebol em Portugal.

Tabela 1. Relação dos fatores *versus* efeitos das habilidades táticas.

Fatores	Efeitos			
	Conhecimento declarativo	Conhecimento processual	Ataque	Defesa
Posicionamento e decisão		X	X	
Conhecimento sobre as ações com bola	X		X	
Conhecimento sobre os outros	X			X
Atuando em situações de Mudança		X		X

Dito isto, verifica-se que o TACSIS vem sendo objeto de interesse da comunidade científica ao longo dos anos, tanto na sua aplicação, como sua adaptação a diferentes populações. Estes esforços talvez se justifiquem por sua capacidade de fácil aplicabilidade, retorno direto e rápido ao treinador, e por se propor a avaliar dimensões de ataque/defesa, tanto no "o que fazer", quanto o, "fazer de fato". O basquetebol ganha destaque nesta dimensão, e interesse na comunidade científica na busca de instrumentos que melhor descrevam as habilidades táticas dos atletas, e com isso, as características do TACSIS e suas aplicações se justificam nesta modalidade.

Porém, ainda existem poucos estudos que analisem as habilidades táticas de jovens basquetebolistas, bem como a adaptação do TACSIS ao contexto esportivo brasileiro. Sendo assim, o objetivo do presente estudo foi traduzir e analisar as propriedades psicométricas (validade confirmatória e fidedignidade) do TACSIS para a língua portuguesa do Brasil em jovens basquetebolistas.

METODOLOGIA

Participantes

Participaram do estudo 866 jovens basquetebolistas com média de idade 15,83± 1,25 anos, sendo 651 do sexo masculino e 215 do sexo feminino. A amostra apresentou um tempo médio de prática da modalidade de 3,64± 2,50 anos, com frequência de prática entre 2–4 vezes por semana. Foram adotados os seguintes critérios de inclusão:

1) ter idade compreendida entre 12 e 19 anos;
2) tempo de prática mínimo de dois anos na modalidade;
3) mínimo de duas sessões de treino por semana.

Os critérios estabelecidos buscam a máxima aproximação às características utilizadas no estudo original (Elferink-Gemser et al., 2004) buscando atender às confirmação dos critérios de estabelecidos na construção do instrumento. Os participantes foram selecionados de forma não probabilística e por conveniência.

As coletas dos dados foram realizadas em equipes de seis competições distintas do basquetebol: Campeonato Brasileiro de Seleções (Confederação Brasileira de Basquetebol), Campeonato de Categorias de Base da Federação de Basquetebol do estado do Rio de Janeiro, Copa Serrana nas categorias sub 13, Sub15 e Sub18 (torneio de equipes federadas e não federadas dos estados do Rio de Janeiro e Minas Gerais), Jogos Escolares Brasileiros (Confederação Brasileira de Desporto Escolar), Jogos escolares de Minas Gerais (JEMG) e Jogos Intercolegiais Municipais.

Procedimentos de coleta dos dados

Como procedimento para aplicação do questionário foram seguidos os seguintes padrões:

1) apresentação dos objetivos da pesquisa junto aos treinadores ou responsáveis pelas equipes na competição;
2) preenchimento e assinatura do Termo de assentimento no caso de menor de 18 anos e/ou um Termo de consentimento livre esclarecido, tendo sido este procedimento aprovado pelo Conselho Científico da Faculdade de Ciências do Desporto e Educação Física da Universidade de Coimbra em 17/03/2010;
3) explicação e orientação sobre a forma de preenchimento do questionário onde foi salvaguardada a confidencialidade dos dados juntamente com sua única utilização para fins de investigação;
4) aplicação do questionário de forma presencial realizada em locais fechados (salas e/ou auditórios) com uma equipe por vez;
5) para análise da fidedignidade foram selecionados 50 participantes de forma não probabilística e por conveniência (participantes de equipes com proximidade geográfica ao centro de investigação).

Esse subgrupo preencheu o questionário em um segundo momento (teste-re-teste) com período compreendido entre duas e quatro semanas após a aplicação inicial do questionário (Rousseau, Vallerand, Ratelle, Mageau, & Provencher, 2002).

Instrumento

O questionário "*Tactical skills Inventory for Sports*" original tem uma estrutura final (após Análise fatorial exploratória) composta por 22 itens agrupados em quatro dimensões da seguinte forma: PD composto por nove itens (e.g.: *As decisões que eu tomo sobre minhas ações durante uma partida são geralmente*); CSAB composto por cinco itens (e.g.: *Eu sei exatamente quando passar a bola a um companheiro ou quando não passar*); CSO composto por quatro itens (e.g.: *Eu percebo rapidamente como o adversário está jogando*); ASM composto por quatro itens (e.g.: *Se nosso time perde a bola, eu rapidamente assumo minha função de defensor*). Sendo assim, a avaliação do nível de aprendizagem das habilidades táticas se dá através da média entre os itens que compõem cada dimensão (PD, CSAB, CSO e ASM), além da média das quatro dimensões, proporcionando assim o valor de escore total das habilidades táticas. Os itens são respondidos através de uma escala tipo *Likert* de seis pontos, sendo 1 (*very poor* – muito fraco) e 6 (*excelente* – excelente), ou alternativamente (para outros itens) entre 1 (*almost never* – quase nunca) e 6 (*always* – sempre).

Tradução do instrumento

Com o objetivo de proporcionar ao instrumento, versão brasileira do *Tactical Skills Inventory for Sports* – TACSIS-br (Elferink-Gemser et al., 2004), uma adequação linguística e conceitualmente apropriada para aplicação em jovens esportistas. Foram seguidos os procedimentos de tradução que seguem a metodologia proposta por Vallerand (1989) para validação transcultural da versão em português (Brasil) do TACSIS em modalidades esportivas, e também adotada nos estudos de Pelletier et al. (1995). Nesse seguimento, inicialmente efetuou-se a preparação da versão preliminar em português (Brasil) do TACSIS, no qual obedeceu ao processo paralelo de tradução por dois técnicos especializados em língua inglesa e dois investigadores em ciências do esporte com titulação de doutorado, familiarizados com a língua inglesa. Mediante as quatro frases obtidas para o título, orientações, escala *likert* e cada item do questionário (perguntas), um painel final de peritos procedeu à escolha da frase que, na sua opinião, melhor correspondia ao item inicial. A partir da versão resultante da etapa anterior, um nativo dos Estados Unidos da América, residente no Brasil e qualificado com técnicas de tradução, voltou a produzir a versão do instrumento em língua inglesa (*back-translation*), sem que lhe tenha sido proporcionado qualquer contato com os itens do instrumento original. Os autores do presente trabalho procederam ao ajuste dos termos na versão traduzida, remetendo a retro-tradução (em inglês) para a autora original do instrumento. Por fim, realizou-se um pré-teste do instrumento em 15 jovens atletas. Os sujeitos realizaram a leitura dos itens e poderiam indicar dúvidas quanto a construção e/ou interpretação das sentenças. Como não houve qualquer questionamento ou dúvida, ficou assim estabelecida a versão brasileira (TACSIS-br).

Análise dos dados

Inicialmente foram calculadas as estatísticas descritivas que incluíram a média (*M*), desvio-padrão, assimetria (*As*) e achatamento (*Ac*). Itens com *As* superior a 3 e *Ac* superior a 7, em valores absolutos, indicam violações à distribuição Normal. Foi calculado, também, o alfa de *Cronbach* (α) para estimar a fiabilidade (consistência interna), sendo considerado adequado um valor maior ou igual a 0,70 (Kline, 2012).

Posteriormente, realizou-se a Análise Fatorial Confirmatória (AFC) através da estimação dos parâmetros por máxima verossimilhança. A adequação dos modelos foi avaliada através dos seguintes índices de bondade do ajustamento: rácio do valor do qui-quadrado pelos graus de liberdade (χ^2/df) sugeridos por Wheaton, Muthen, Alwin, & Summers (1977), onde valores entre 3 e 1 indicam um bom ajuste do modelo (Arbuckle, 2015, p. 623). Além disso, foi considerado o *Comparative Fit Index* (CFI) e o *Tucker-Lewis index* (TLI) cujo valores superiores a 0,90 são considerados adequados (Bentler & Bonett, 1980). Também foram analisados os valores do *Standardized Root Mean Square Residual* (SRMR) e *Root Mean Square Error of Aproximation* (RMSEA), para esses estimadores de ajuste do modelo foram consideradas valores abaixo de 0,08 para o SRMR e 0,06 para o RMSEA indicam uma adequação aceitável do modelo (Hu & Bentler 1999). A validade convergente do instrumento foi estimada através da variância extraída média (VEM). Valores de VEMj maiores ou igual a 0,5 indicam validade convergente aceitável (Byrne, 2010). A validade discriminante foi analisada e estabelecida quando a VEM para cada fator foi superior ou igual ao quadrado da correlação entre esses fatores (Byrne, 2010).

Com o intuito de avaliar a estrutura do modelo em atletas de diferentes níveis competitivos foi realizada uma análise multigrupos (análise de invariância). Para tal procedimento estatístico, foram adotados os procedimentos compostos pelo conjunto de testes sugeridos por Byrne (2010) para verificar a equivalência. Inicialmente os atletas foram agrupados de acordo com o nível da competição mais importante que já disputaram, dando origem aos seguintes grupos: nacional (n= 361), estadual (n= 317) e regional (n= 179). Como parâmetro para a existência da invariância entre os modelos, adotou-se como valores de referência as diferenças do *Confirmatory Fit Index* (ΔCFI), sendo que uma variação inferior ou igual a 0,01 foi considerada como indicadora da equivalência do modelo (Byrne, 2010).

Por fim, para a análise da fidedignidade (estabilidade temporal) realizou-se o teste de correlação intraclasse. As análises foram realizadas no *software* IBM SPSS AMOS (v.25, *SPSS An IBM Company,* Chicago, IL).

RESULTADOS

Os itens resultantes do procedimento de tradução estão apresentados na Tabela 2.

Os valores das estatísticas descritivas estão apresentados na Tabela 3. Os resultados indicaram que a escala *likert* de seis pontos foi utilizada em todos os itens, conforme demonstrado pelos valores mínimos e máximos. No que diz respeito à distribuição univariada das respostas aos itens os valores de *Ac* e *As* indicaram valores próximos a zero sugerindo uma distribuição normal dos dados.

A fiabilidade dos dados, a validade convergente e validade discriminante podem ser estimadas a partir dos resultados

Tabela 2. Título, orientações, escala *likert* e itens resultantes do procedimento de tradução.

Título	Inventário de habilidades táticas para esportes
Orientações / escala likert	Responda as questões a seguir considerando os itens classificados em uma escala de seis pontos, sendo o menor deles 1= muito fraco, e o maior 6= excelente, ou 1= quase nunca e 6= sempre, fazendo a comparação de um jogador ao melhor jogador da mesma categoria e faixa etária.
Dimensão / item	Item após procedimentos de tradução
PD	
Item 1	As decisões que eu tomo sobre minhas ações durante uma partida são geralmente
Item 2	Eu sei como me desmarcar durante a partida
Item 4	Meu posicionamento durante a partida é geralmente
Item 5	Minha visão geral (quando tenho a posse da bola ou quando meu time tem a posse da bola) é
Item 6	Minha antecipação (quanto às ações a serem realizadas) é
Item 7	Sou bom em tomar as decisões certas nos momentos certos
Item 8	Na opinião do meu treinador, o meu entendimento do jogo é
Item 9	Minha desmarcação e meu posicionamento é
Item 10	Na opinião do meu treinador, meu posicionamento é
CSO	
Item 11	Minha avaliação da jogada do adversário é
Item 15	Eu percebo rapidamente como o adversário está jogando
Item 20	Mesmo sem ver meus adversários, eu sei para onde eles estão indo
Item 21	Sem ver meus companheiros, eu sei para onde eles estão indo
Item 22	Se o adversário recebe a bola, eu sei exatamente o que ele irá fazer
CSAB	
Item 16	Eu sei exatamente quando passar a bola a um companheiro ou quando não passar
Item 17	Se meu time ganha a posse de bola, eu sei exatamente o que fazer
Item 18	Enquanto executo uma ação no jogo, eu sei exatamente o que fazer em seguida
Item 19	Se eu estou com a bola, sei exatamente para quem devo passá-la
ASM	
Item 3	Minha interceptação da jogada do adversário é
Item 12	Minha interceptação da bola é
Item 13	Se nosso time perde a bola, eu rapidamente assumo minha função de defensor
Item 14	Eu rapidamente reajo a mudanças, como quando recuperamos a posse de bola

PD: posicionamento e decisão; CSO: conhecimento sobre os outros; CSAB: conhecimento sobre as ações com bola; ASM: atuação em situações de mudança.

apresentados na Tabela 4. A partir da qual, é possível destacar que os valores de α encontrados nas análises apresentaram índices acima do recomendado pela literatura para três dos fatores do instrumento: PD, CSO e CSAB. Ao analisar todos os itens juntos o valor de α foi igual a 0,91. No entanto, fica evidenciado valores abaixo dos recomendados para as validades convergente e discriminante.

Os resultados da AFC apresentaram os seguintes índices de bondade de ajustamento do modelo: χ^2/df= 3,120; CFI= 0,925; TLI= 0,914; SRMR= 0,039; RMSEA= 0,050 (90%IC= 0,045–0,054). Os valores das correlações e das cargas fatoriais dos itens podem ser verificados na Figura 1.

Os resultados da análise de invariância do modelo entre os atletas de diferentes níveis competitivos são apresentados na Tabela 5, através da qual confirma-se a invariância configuracional, de medida e escalar do modelo proposto.

Os resultados da estabilidade temporal estão apresentados na Tabela 6. Os valores da CCI estão acima de 0,70 para o fator PD e para a média dos somatórios das escalas. Para as outras escalas, o CCI encontra-se abaixo, porém próximo do valor de 0,70.

Tabela 3. Estatística descritiva dos itens do *Tactical Skills Inventory For Sports* da versão brasileira

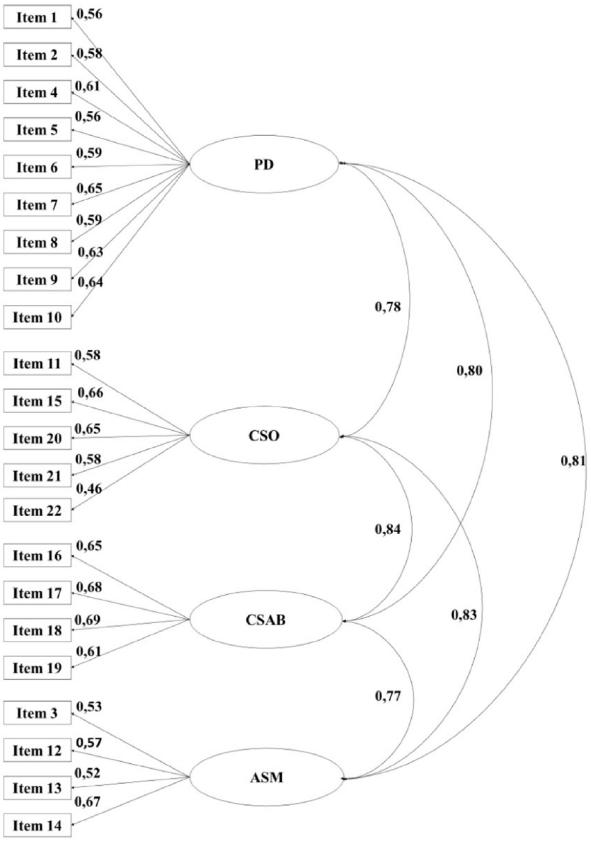
	Média	DP	Mín	Máx	As	Ac
PD						
Item 1	3,93	1,04	1,00	6,00	-0,19	0,24
Item 2	4,25	1,12	1,00	6,00	-0,21	-0,51
Item 4	4,29	1,04	1,00	6,00	-0,28	-0,33
Item 5	4,25	1,16	1,00	6,00	-0,41	-0,33
Item 6	3,92	1,12	1,00	6,00	-0,10	-0,39
Item 7	3,73	1,18	1,00	6,00	-0,07	-0,49
Item 8	4,04	1,20	1,00	6,00	-0,38	-0,22
Item 9	4,19	1,05	2,00	6,00	-0,27	-0,17
Item 10	4,05	1,06	1,00	6,00	-0,17	-0,34
CSO						
Item 11	4,00	1,16	1,00	6,00	-0,22	-0,37
Item 15	4,10	1,23	1,00	6,00	-0,21	-0,61
Item 21	3,85	1,27	1,00	6,00	-0,09	-0,69
Item 22	4,19	1,21	1,00	6,00	-0,40	-0,33
Item 23	3,54	1,35	1,00	6,00	0,09	-0,69
CSAB						
Item 16	4,15	1,21	1,00	6,00	-0,33	-0,55
Item 18	4,52	1,18	1,00	6,00	-0,52	-0,28
Item 19	4,12	1,16	1,00	6,00	-0,23	-0,30
Item 20	4,42	1,18	1,00	6,00	-0,49	-0,16
ASM						
Item 3	3,88	1,11	1,00	6,00	-0,13	-0,30
Item 12	4,03	1,21	1,00	6,00	-0,20	-0,64
Item 13	4,62	1,26	2,00	6,00	-0,70	-0,25
Item 14	4,40	1,17	1,00	6,00	-0,40	-0,45

PD: posicionamento e decisão; CSO: conhecimento sobre os outros; CSAB: conhecimento sobre as ações com bola; ASM: atuação em situações de mudança; DP: desvio padrão; Min: mínimos; Máx: máximos; As: assimetria; Ac: achatamento.

Tabela 4. Consistência interna, validade convergente, validade discriminante matrizes de variâncias e covariância (matriz superior) quadrado das correlações (matriz inferior) entre os fatores da amostra geral.

	α	VEM	1	2	3	4
1-PD	0,83	0,36	**0,59**	0,41	0,48	0,37
2-CSO	0,72	0,35	0,61	**0,46**	0,44	0,35
3-CSAB	0,75	0,43	0,64	0,71	**0,61**	0,33
4-MAS	0,67	0,33	0,66	0,69	0,59	**0,35**

PD: posicionamento e decisão; CSO: conhecimento sobre os outros; CSAB: conhecimento sobre as ações com bola; ASM: atuação em situações de mudança; α: alfa de *Cronbach*; VEM: variância extraída média.



PD: posicionamento e decisão; CSO: conhecimento sobre os outros; CSAB: conhecimento sobre as ações com bola; ASM: atuação em situações de mudança.

Figura 1. Cargas fatoriais dos itens e correlações entre os fatores.

DISCUSSÃO

O objetivo do presente estudo foi traduzir e analisar as propriedades psicométricas do TACSIS para a língua portuguesa do Brasil (TACSIS-br). Ao avaliarmos os aspectos gerais dos resultados, verificou-se valores plausíveis para a fiabilidade (consistência interna), para os índices globais de ajustamento do modelo, para as invariâncias dos modelos entre atletas com experiência competitiva em diferentes níveis e para a estabilidade temporal. Além disso, verificou-se que o instrumento de autorrelato em análise apresentou resultados similares quando confrontados com o instrumento original (Elferink-Gemser et al., 2004) e com o utilizado em outros contextos (Viciana et al., 2016; Yarayan et al., 2019).

Inicialmente, para obtenção desse instrumento aplicável ao contexto brasileiro, foram utilizados diferentes procedimentos e etapas recomendados por investigadores para a adaptação transcultural de questionários na área esportiva.

Tabela 5. Invariância do modelo para atletas de diferentes níveis competitivos – nacional (n= 361), estadual (n= 317) e regional (n= 179).

	χ2/df	TLI	SRMR	RMSEA	CFI	ΔCFI
Invariância configuracional – modelo sem restrições	1,99	0,88	0,51	0,34	0,90	-
Invariância de medida – cargas fatoriais fixas	1,95	0,89	0,53	0,33	0,90	0,00
Invariância escalar – cargas fatoriais e interceptos fixos	1,92	0,89	0,57	0,33	0,90	0,00

TLI: *Tucker-Lewis index*; SRMR: *Standardized Root Mean Square Residual*; RMSEA: *Root Mean Square Error of Aproximation*; CFI: *Comparative Fit Index*; ΔCFI: *Confirmatory Fit Index*; χ^2/df: valor do qui-quadrado pelos graus de liberdade.

Tabela 6. Média, desvio padrão e coeficiente de correlação intraclasse medidos em dois momentos.

Fator	Mt1	DPt1	Mt2	DPt2	Mt1-Mt2 (IC95%)	p-valor	CCI	IC95% CCI
PD	3,92	0,59	3,86	0,76	0,06 (-0,12–0,24)	0,49	0,73	0,53–0,85
CSO	3,69	0,64	3,62	0,70	0,07 (-0,14–0,27)	-0,51	0,68	0,43–0,82
CSAB	4,34	0,76	4,18	0,88	0,16 (-0,08–0,40)	0,19	0,62	0,34–0,78
ASM	4,16	0,66	4,08	0,67	0,08 (-0,12–0,28)	0,42	0,63	0,34–0,79
Σ*	4,03	0,51	3,93	0,57	0,09 (-0,05–0,23)	0,19	0,74	0,55–0,85

*média do somatório das escalas; PD: posicionamento e decisão; CSO: conhecimento sobre os outros; CSAB: conhecimento sobre as ações com bola; ASM: atuação em situações de mudança; M: média; DP: desvio padrão; t1: momento 1; t2: momento 2; CCI: coeficiente de correlação intraclasse.

A primeira delas consistiu na tradução através da qual buscou-se uma equivalência semântica e de conteúdo de cada um dos 22 itens que após análise fatorial exploratória definiu o questionário original. Enfatiza-se que os instrumentos de avaliação estão associados ao ambiente cultural e linguístico no qual foram desenvolvidos, sendo necessário um processo rigoroso de tradução para ser aplicado e testado em diferentes ambientes.

Após cumprir a etapa inicial de tradução, verificou-se a fiabilidade para medir o grau de concordância dos respondentes a cada um dos itens. No que se refere aos valores de fiabilidade medidos através do α, os resultados encontrados foram acima de 0,70 para todos os fatores exceto o ASM, cujo valor foi de 0,68. Em outros contextos onde o TACSIS foi aplicado, os valores desses coeficientes ficaram entre 0,72 e 0,89 na validação do instrumento original (Elferink-Gemser et al., 2004), entre 0,72 e 0,86 na versão espanhola do instrumento (Viciana et al., 2016), além de valores 0,70 a 0,88 na versão turca (Yarayan et al., 2019).

Os resultados similares para os diferentes contextos podem ser considerados aceitáveis, mesmo com o valor de 0,68 para o ASM. Nesse sentido, importa referir que os maiores valores do α foram encontrados no fator PD e os menores no ASM tanto no presente estudo como nas outras validações (Elferink-Gemser et al., 2004; Viciana et al., 2016; Yarayan et al., 2019). A referida similaridade entre os instrumentos possivelmente sofreu influência dos números de itens por fator conforme explicações encontradas na literatura (Cronbach, 1951).

Sobre os resultados referentes aos pesos fatoriais ajustados dos itens, os valores variaram entre 0,46 e 0,69, indicando de uma maneira geral índices abaixo da versão espanhola do TACSIS. Porém, ao contrário da proposta espanhola para o TACSIS, no presente estudo optou-se por uma versão que preservasse o modelo original proposto por Elferink-Gemser et al. (2004). Nesse sentido, na versão brasileira não foram removidos itens, ao contrário do realizado na versão espanhola, cuja estrutura final proposta excluiu os itens 11, 13, 18 e 22. Há de se referir que desses quatros itens, foi observado que o item 22 (e.g.: Se o adversário recebe a bola, eu sei exatamente o que ele irá fazer) excluído na versão espanhola coincidiu com o menor valor de carga fatorial ajustado no modelo proposto no presente estudo.

A opção pela manutenção de todos os itens na versão brasileira resultou em bons índices globais de ajustamento do modelo para a amostra estudada. Esses índices não podem ser comparados com versão original do instrumento uma vez que a análise realizada por Elferink-Gemser et al., (2004) foi fatorial exploratória. Todavia, ao comparar os índices do presente estudo com as versões espanholas e turcas (Viciana et al., 2016; Yarayan et al., 2019), verificou-se resultados positivos em todos os modelos.

Na continuidade da análise dos resultados e das comparações entre a aplicação do TACSIS em diferentes contextos,

verificou-se que valores das correlações inter-fatores do presente estudo ficou entre 0,77 e 0,84. O resultado dessas correlações no estudo original de validação do instrumento ficou entre 0,37 e 0,59. Com valores mais próximos do encontrado no presente estudo, a versão espanhola apresentou valores entre 0,77 e 0,91 e a versão turca entre 0,56 e 0,86. Portanto, excetuando a versão original do instrumento aplicado em atletas holandeses, as outras versões do TACSIS apresentaram valores de correlações entre os fatores acima do esperado o que pode sugerir problemas de validade discriminante em alguns fatores do instrumento.

No que se refere a invariância do modelo entre os atletas que competiram pelo menos uma vez em nível nacional, estadual ou regional, verificou-se uma equivalência na estrutura fatorial dos modelos, ou seja, os itens utilizados para explicar os fatores do TACSIS-br não diferem estruturalmente nos atletas de diferentes níveis competitivos. Outra investigação que procurou testar a invariância entre diferentes grupos foi realizada por Viciana et al. (2016), no qual compararam o grupo de atletas escolares praticantes e não praticantes de esportes de invasão fora do contexto onde foi realizado a pesquisa. Apesar dos autores utilizarem outros índices para analisar a invariância, o ΔCFI para a amostra com atletas espanhóis foi similar ao encontrado no presente estudo ($\Delta CFI_{TACSIS-BR}$= 0,00; $\Delta CFI_{TACSIS-ES}$= 0,01), comprovando as invariâncias dos modelos.

Por fim, foi testada a estabilidade temporal do modelo. Os resultados indicaram valores do Coeficiente de Correlação Intraclasse um pouco abaixo do recomendado, principalmente para os fatores CSAB e ASM. No entanto, ao compararmos com o instrumento original, verificou-se maiores valores no presente estudo para o fator CSAB ($CCI_{TACSIS-BR}$= 0,62; CCI_{TACSIS}= 0,53). A respeito desses resultados, assim como no instrumento original, não foi possível estabelecer uma causa. De todo modo, importa referir que não houve qualquer problema em relação a estabilidade temporal na amostra com espanhóis (Viciana et al., 2016).

Tais resultados não deixam de suscitar novas investigações sobre a utilização desse tipo de instrumento tanto em amostras no contexto esportivo brasileiro como em outros contextos. Há de se salientar também, que futuros estudos deverão efetuar validações cruzadas do TACSIS com outros instrumentos de avaliação das habilidades táticas no intuito de validar e verificar a validade desse tipo de instrumento no contexto esportivo (Teoldo et al., 2015).

Para além desses resultados, importa referir alguns pontos não tão favoráveis a utilização do instrumento. Dentre eles estão as altas correlações entre os fatores encontrados que, associados a outros índices, resultaram em valores abaixo do esperado para a validade convergente e discriminante. De forma similar ao presente estudo, as versões espanhola e turca do TACSIS também apresentaram problemas nessas validades. Esses resultados sugerem que novas versões deverão ser propostas na tentativa de uma melhor validade para o construto, além de se considerar alguns aspectos teóricos que podem estar associados a formulação do instrumento.

De todo modo e apesar de alguns resultados não satisfatórios, importante referir que se trata de um instrumento útil, na qual poderá contribuir para a prática de diferentes profissionais. Esses resultados comparados com outras versões do instrumento indicaram que através do TACSIS é possível avaliar o nível de percepção de aprendizagem das habilidades táticas, a partir de autorrelato em jovens basquetebolistas brasileiros. Naturalmente que se torna importante promover a continuidade de estudos a partir da tradução e adaptação do TACSIS-br, que possam identificar sua relação com outros esportes de invasão, com indicadores de desempenho em jogo, por características de posições em jogo, em diferentes níveis competitivos, na continuidade da carreira, bem como estabelecer uma tabela de valores de referência nas quatro escalas do TACSIS-br em diferentes faixas etária.

CONCLUSÃO

Conclui-se que a versão do TACIS-br constituída por 22 itens aplicadas a jovens basquetebolistas apresenta uma estrutura aceitável para a versão brasileira do instrumento analisado. Sendo um instrumento de fácil aplicação cujos resultados são obtidos de maneira simples e prática para o dia a dia do treinador. O TACSIS-br poderá ser uma ferramenta útil e capaz de proporcionar informações importantes a profissionais e pesquisadores para o treino e aperfeiçoamento das habilidades táticas. Ao comparar as dimensões de ataque/defesa e sua relação com o conhecimento declarativo e processual, os treinadores e pesquisadores, a partir dos valores obtidos nas escalas do TACSIS, poderão comparar o nível de aprendizagem ao longo do processo de formação esportiva entre os pares, além de utilizar este instrumento como indicador do nível de habilidades táticas em estudos de abordagens multidimensionais.

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ORIGINAL ARTICLE

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Effects of age and experience on the development of aquatic competence in children aged 36 to 72 months

Efeitos da idade e da experiência no desenvolvimento da competência aquática em crianças de 36 a 72 meses

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ABSTRACT

Considering age and experience as possible constraints to the development of aquatic skills, this study sought to analyse the effect of both on the aquatic competence of 368 children aged between 36 and 72 months using the Erbaugh Scale. Children were categorised according to age and previous aquatic experience in swimming lessons. The results of the two-factor ANOVA indicate that aquatic competence values increase from the lowest to the highest age group and the values found for the different levels of experience in swimming lessons. A regression model was applied and proved to be significant. According to the model, age and previous aquatic experience together were responsible for explaining 46% of the variance in aquatic competence. When applied in each group, the regression analysis indicated that age starts to exert less influence and the experience a greater influence on aquatic competence the older the age groups become. In addition, as the experience increases, the difference in aquatic competence increases between older and younger children. Therefore, the analysis of the contribution of these variables allows professionals to be guided in planning teaching strategies for the development of aquatic competence.

KEYWORDS: constraints; children; aquatic competence.

INTRODUCTION

To move in the aquatic environment, a child needs to coordinate a set of complex multi-articular actions in an environment that strongly restricts body movements (Guignard et al., 2017). Water is approximately 830 times denser than air, 829 times heavier and 55 times more viscous (Mackay, Shiu, Ma, & Lee, 2006; Castro, Correia, & Wizer, 2016). Due to the physical properties of water, to move in a competent way in this environment, to just generate propulsion is not enough, it is also necessary to minimise the drag forces produced by the environment in response to the body movements in the water. Looking at it in this way, it is possible to understand this interaction as a dynamic system.

The term "competence", when related to the aquatic environment, refers to a set of skills, behaviour and knowledge that expand the relationship between humans and the aquatic environment and help to reduce the risk of drowning (Moran et al., 2012; Langendorfer, 2015; Quan, Ramos, Harvey, Kublick, & Langendorfer, 2015). Nonetheless, there is still no consensus on the concept and the skills that comprise the aquatic competence construct. Langendorfer (2011) applied the Model of Constraints by Newell (1986) to the development of aquatic competence. According to Langendorfer (2011), the degree of aquatic competence is dependent on the relationship between the characteristics of the individual, the characteristics of the environment in which the task will be performed and the task. To enable new patterns of movement to emerge, changes must occur in at least one of the elements of the organism–environment–task triad (Newell, 1986). In this case, the system needs to adapt to the new conditions imposed by the constraints in a process called "self-organisation." This new state of behavioural organisation, revealed from the process of self-organisation, arises as older forms of behaviour lose stability (Kamm, Thelen, & Jensen, 1990). This loss of stability is, in humans, influenced by the individual's constraints, the environment and the task.

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Age, understood in this study as a constraint of the individual and related to maturation, has been questioned as to its importance in the acquisition of aquatic abilities. Langendorfer and Bruya (1995) proposed the concept of aquatic readiness, relating the age of children to the characteristics of the process of acquiring aquatic skills. As to the relevance of age in this process, Franklin et al. (2015) sought to identify the main factors that impact the learning process of swimming in children aged 5 to 12 years. The study showed that there is a linear increase in the level of aquatic abilities with increasing age. A similar result was found by Michielon, Scurati, Roione, and Invernizzi (2006), which also showed that age seems to be an important factor in the development of aquatic skills in children aged 4 to 36 months. Langendorfer (1987) participated in the discussion, emphasising that if the development sequence depended only on maturation, then all adults would reach advanced levels of ability; however, there is evidence indicating that without proper stimulation, it is not possible to achieve a mature level of performance (Halverson, Roberton, & Langendorfer, 1982).

In terms of the importance of experience in the development of aquatic skills, Erbaugh (1986a) evaluated the aquatic competence of children with different levels of experience. Those with previous experience in swimming classes maintained higher scores in all evaluations during an eight-month period than children without previous experience in swimming lessons. Zelazo and Weiss (2006) and Olaisen, Flocke, and Love (2018) also evidenced the strong influence of experience in improving the organisation of aquatic skills in children of different ages. Considering the high degree of complexity required to move in the aquatic environment and the factors of age and experience as possible constraints to the development of aquatic abilities, the aim of this study was to identify and understand the contribution of both (age and experience) to the aquatic competence of children aged between 36 and 72 months.

METHODS

Participants

The study included 368 children participating in swimming classes, aged between 36 and 72 months of both genders. The sample size was based on an adequate number that guarantees statistical procedures, the availability of the population (children aged from 36 to 72 months, all swimming practitioners) and on the result of the F test for four groups (calculations performed using the GPower 3.1 application). Thus, a sample number of 180 children per sex was reached, totalling 360 individuals. Data on the children participating in the study, such as age and previous aquatic experience (PAE), were obtained through a form completed by the parents/guardians of the children and were categorised as shown in Table 1.

This research project was duly submitted for evaluation by the Research Ethics Committee of UFRGS (RS, Brazil) and approved under opinion number 2.532.306; in addition, it follows the determinations of resolution 466/2012 of the National Health Council (Brazil). Anonymity and confidentiality of data were guaranteed.

Procedure

Data collection took place between March 2018 and September 2019 in swimming schools, clubs and condominiums with swimming pools at a time previously agreed with those responsible and with the educational establishments. For this, prior contact was made with the establishments to inform the objectives and procedures of the research. Upon obtaining the consent of each educational establishment, each child's parents were informed about the purpose of the research and the activities that would be carried out. When parents agreed to participate, they signed the Free and Informed Consent Form they had been given. In addition to parental consent, the child's verbal consent was obtained.

The Erbaugh Scale was used to assess the children's aquatic competence (AC) in the study. The Erbaugh Scale was previously validated (article in preparation) for Brazilian children to assess their AC accurately. The Erbaugh Scale is an ordinal scale composed of 47 items, which are subdivided into 6 tasks. The Scale tasks correspond to the skills required in the aquatic environment and include details of the distance covered, body position, and movement of arms and legs (Erbaugh, 1981). Items are organised and numbered in order

Table 1. Characterisation of the sample.

Age range (months)	Previous aquatic experience (months)	n
I (36–47)	I (< 1)	21
	II (1–6)	17
	II (6–12)	11
	IV (> 12)	26
II (48–59)	I (< 1)	28
	II (1–6)	42
	III (6–12)	24
	IV (> 12)	44
III (60–72)	I (< 1)	21
	II (1–6 months)	36
	III (6–12 months)	35
	IV (> months)	63

of difficulty. Thus, for the first task of the Scale corresponding to the "Entry: Jump Tasks" in the water, there are 5 items. The first, and the simplest, receives a score of 1, while the last and most difficult item receives a score of 5. In addition to this, the following tasks are evaluated by the Scale: Locomotion: Tasks in the prone position (10 items), Locomotion: Tasks in the supine position (10 items), Locomotion: Leg movement (9 items), Diving tasks (6 items) and Tasks of searching for objects at the bottom of the pool (7 items). The score on the Erbaugh Scale ranges from 0 to 47.

Regarding aquatic competence, the differential of this scale lies in the fact that it considers the distance travelled by the child and the characteristics of the performed movement. This aspect highlights the author's concern with aquatic safety. Therefore, the instrument is able to provide information about the characteristics of the movement pattern, as well as how much the child can sustain this movement pattern over the distance covered.

For the application of the Erbaugh Scale, 2 evaluators were needed. One of them, who had experience teaching aquatic skills to children, remained in the pool and was responsible for applying the instrument to each child. The other evaluator remained on the edge and was responsible for operating a video camera to obtain the images for each test applied. All evaluations were recorded for later analysis.

In tasks that required control of the distances covered, coloured E.V.A. bands, measuring 0.5 m, were used side by side until reaching 6 m at the side edge of the pool. The E.V.A. bands colour differences enabled the visualisation of the distance travelled by the child during the observation of the videos. It was decided to add 1 meter between the place where the child started the test and the beginning of the E.V.A. bands. The objective was to disregard the child's height and minimise the edge impulse's effects at the beginning of the task. Subsequently, the evaluator analysed the images obtained and scored the child's performance in each Erbaugh Scale task.

Data analysis

Means, standard deviations and 95% confidence interval limits were calculated. Two-factor ANOVA was applied to the data to compare the AC of children of different age groups (36 to 47 months, 48 to 59 months and 60 to 72 months) and with different PAE (up to 1 month of experience, up to 6 months of experience, 6 months to 12 months of experience and more than 12 months of experience). Blanca, Alarcón, Arnau, Bono, and Bendayan (2017) showed that the robustness of ANOVA is maintained even in conditions of non-normal data. Levene's test was used to verify the homoscedasticity of the data. Tukey's post hoc test was applied to locate the differences between the clusters. The age and experience effect sizes were identified, respectively, by the η^2 statistic (small: ≤ 0.02, medium: > 0.02 and ≤ 0.08 or large: > 0.08) (Cohen, 1988).

Multiple regression analysis was applied to verify the predictor behaviour of age (in months) and PAE (in months) on AC. This procedure was performed with the whole study sample. Later, to deepen the results, the sample was divided by age groups and PAE, then the multiple regression analysis was applied to the groups in isolation. The objective of this procedure was to compare the predictor behaviour of independent variables in different age ranges and with different PAE.

Among the methods of entry of independent variables in the multiple regression model, the present study opted for the stepwise method. Tabachnick and Fidell (2013) point out that the methods differ from each other in relation to what occurs with the shared variance between the variables and how the order in which the variables enter the equation is determined. The stepwise method allows each variable to be considered for inclusion before developing the equation, and the independent variable with the highest contribution is added first (Hair, Black, Babin, & Anderson, 2014). It is important to highlight that the child's age in months was used for regression analysis, while the PAE was categorised as shown in Table 1. The data were analysed using SPSS version 21.0, and a significance level of 0.05 was adopted.

RESULTS

Figure 1 shows the AC means and standard deviations for each age group. AC values increased from the lowest to the highest age group [$F(2,356)= 73.99$; $p< 0.001$; $\eta^2= 0.29$, large effect size]. The mean values and limits of confidence for each age group were: (I) 17.4 [15.3 to 19.4], (II) 24.6 [23.0 to 26.2], (III) 32.9 [31.5 to 34.3] points.

Figure 2 shows the AC means and standard deviations for the groups by PAE. AC values increased as the experience increased [$F(3,356)= 27.90$; $p< 0.001$; $\eta^2= 0.19$, large effect size]. However, Group III (6 to 12 months of experience) showed no difference when compared to Group II (up to 6 months of experience) ($p= 0.185$) and when compared to Group IV (more than 12 months of experience) ($p= 0.190$). The mean values and limits of confidence for each group by PAE were: (I) 17.8 [15.6 to 20.0], (II) 25.3 [23.2 to 27.5], (III) 28.4 [26.2 to 30.6], (IV) 31.3 [29.6 to 32.9] points. There was no interaction between age groups and experience levels [$F(6,356)= 1.47$; $p= 0.185$; $\eta^2= 0.02$, small effect size].

Multiple linear regressions were used to verify whether age and PAE in swimming classes (independent variables) could predict the AC of the child (dependent variable).

Both age and PAE showed a positive and significant correlation with AC (age= 0.57; $p< 0.001$ and PAE= 0.43; $p< 0.001$). The analysis resulted in a statistically significant model [F(2,365)= 155.61; $p< 0.001$; R2= 0.46] and age and PAE were responsible for explaining 46% of the variance of AC. According to the model, both age (ß= 0.52; t= 13.52; $p< 0.001$) and PAE (ß= 0.36; t= 9.43; $p< 0.001$) can be considered predictor variables of AC. Even if a positive and significant correlation was found between age and PAE (r= 0.13; $p< 0.001$), both variables entered the model.

Therefore, the regression equation that predicts the AC (points), based on the age (months) and PAE (months), is:

AC= -15.34+ (0.577× age)+ (3.46× PAE)

Regression analyses were also applied to the data when separated by age ranges and PAE. Significance levels and correlation values between independent and dependent variables for each age range and PAE are shown in Table 2 and Table 3.

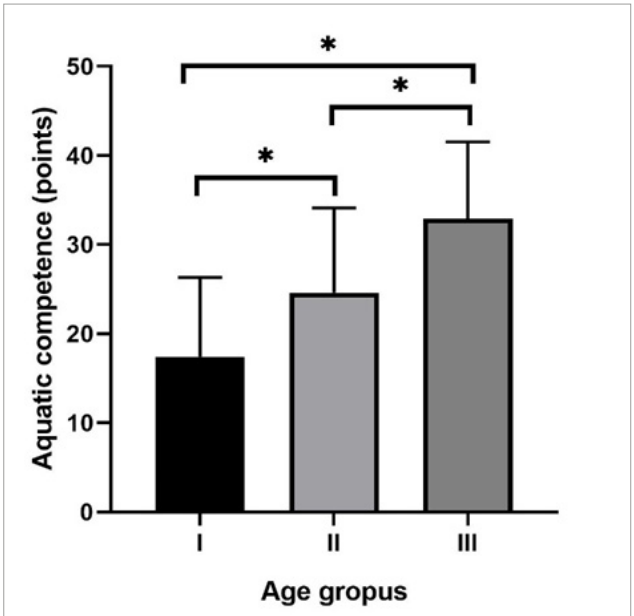
All analyses performed for the different clusters (age and PAE) resulted in a statistically significant model. According to the resulting models, both age and PAE were considered predictors of AC, except for Group II, per age group (48 to 59 months). Regression analysis for this grouping resulted in a model in which only PAE was considered a predictor of AC. Table 4 presents the values of R^2, the results of ANOVA, and ß and T-test values for the regression models resulting from age groupings, with the significance levels.

Table 5 shows the values of R^2, the result of ANOVA, as well as ß and T-test values for the regression models resulting from clusters by PAE, with the significance levels.

DISCUSSION

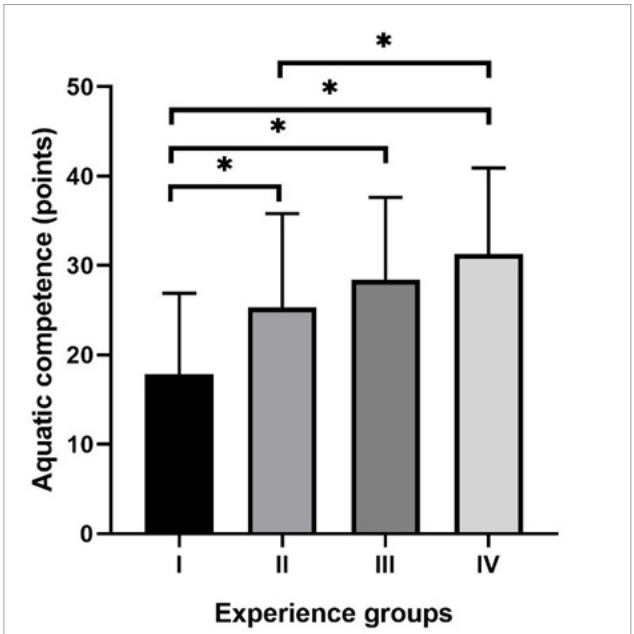
Considering the high degree of complexity required to move in the aquatic environment, this study sought to understand the effect of age and experience in the development of AC in children aged between 36 and 72 months, as well as to investigate the predictive character of these two variables in relation to AC. In general, both age and PAE were able to distinguish the AC of children from 36 to 72 months of age; thus, both were predictors of AC. Together, age and PAE were responsible for explaining up to 46% of the AC variance.

This result was expected since studies conducted over the years have shown the relevance of age and experience in the development of motor skills in childhood (Halverson et al., 1982; Cleland & Gallahue, 1993; Saraiva, Rodrigues, Cordovil, & Barreiros, 2013), but it is unprecedented to show these effects over different age groups and experience levels early in swimming. Malina (2004) highlighted that development and motor proficiency occur due to the relationship between the experience of an individual and the growth and



*$p< 0.001$. I: 36 to 47 months (n= 75), II: 48 to 59 months (n= 138); III: 48 to 59 months (n= 155).

Figure 1. Aquatic competence values for age groups.



*$p< 0.001$. I: up to 1 month (n= 70), II: 1 to 6 months (n= 95); III: 6 to 12 months (n= 70), IV: more than 12 months (n= 133).

Figure 2. Aquatic competence values for age groups.

Table 2. Correlation between age and previous aquatic experience and the aquatic competence for different age groups.

Age range		AC
		r (*p*)
I (n= 75)	Age	0.33 (*p*= 0.002)
	PAE	0.36 (*p*= 0.001)
II (n= 138)	Age	0.14 (*p*= 0.043)
	PAE	0.46 (*p*< 0.001)
III (n= 155)	Age	0.17 (*p*= 0.014)
	PAE	0.46 (*p*< 0.001)

AC: aquatic competence; PAE: previous aquatic experience.

Table 3. Correlation between age and the aquatic competence for different clusters of previous aquatic experience.

PAE		AC
		r (*p*)
I (n= 70)	Age	0.52 (*p*< 0.001)
II (n= 95)		0.52 (*p*< 0.001)
III (n= 70)		0.58 (*p*< 0.001)
IV (n= 133)		0.64 (*p*< 0.001)

AC: aquatic competence; PAE: previous aquatic experience.

Table 4. Regression analyse results for age ranges 1, 2 and 3.

Age range	Regression model	Coefficient
I	[F(2,72)= 9.59; *p*< 0.001; R^2= 0.21]	Age (ß= 0.28; t= 2.68; *p*= 0.009)
		PAE (ß= 0.32; t= 3.04; *p*= 0.003)
II	[F(1,136)= 37.79; *p*< 0.001; R^2= 0.21]	Age -
		PAE (ß= 0.46; t= 6.14; *p*< 0.001)
III	[F(2,152)= 25.62; *p*< 0.001; R^2= 0.25]	Age (ß= 0.19; t= 2.76; *p*= 0.006)
		PAE (ß= 0.47; t= 6.70; *p*< 0.001)

AC: aquatic competence; PAE: previous aquatic experience; t: T test; ß: value.

Table 5. Regression analyse results for different clusters of previous aquatic experience.

PAE	Regression model	Coefficient
I	[F(1,68)= 25.84; *p*< 0.001; R^2= 0.27]	Age (ß= 0.52; t= 5.08; *p*< 0.001)
II	[F(1,93)= 35.07; *p*< 0.001; R^2= 0.27]	Age (ß= 0.52; t= 5.92; *p*< 0.001)
III	[F(1,68)= 34.39; *p*< 0.001; R^2= 0.33]	Age (ß= 0.58; t= 5.86; *p*< 0.001)
IV	[F(1,131)= 91.68; *p*< 0.001; R^2= 0.41]	Age (ß= 0.64; t= 9.57; *p*< 0.001)

AC: aquatic competence; PAE: previous aquatic experience; t: T test; ß: value.

maturation process, which in the present study is represented by the child's age. Olaisen et al. (2018) evaluated the effects of an intervention in the aquatic environment and the influence of age and number of classes on the aquatic abilities of 149 children aged 3 to 14 years. To perform the evaluation, the authors used the instrument entitled "The Hoover Curriculum Checklist". The authors found significant effects from the intervention, and the differences between groups of different ages and with different amounts of experience in aquatic environments were also significant.

Although both variables (age and PAE) entered the model as predictors of AC, the regression analysis indicated that age (ß= 0.52) was the highest predictor when compared to the PAE (ß= 0.36). The influence of age is related to several changes in the body, both from the structural and functional point of view, especially when it comes to children. Increased age is associated with changes resulting from maturation of executive function, working memory and speed of information processing (Luna, Garver, Urban, Lazar, & Sweeney, 2004; Best & Miller, 2010). These functions, when combined, lead to faster reaction times, improved dexterity, increased speed and precision of movement, and lower movement variability (Savion-Lemieux, Bailey, & Penhune, 2009). These factors optimise the performance of motor skills and increase the relevance of age in the acquisition of AC.

It is important to bear in mind that, although the "status" of the central nervous system has been overvalued as a constraint of the individual, other characteristics also interfere with development (Newell, 1986). Structural changes related to height, body mass and relative size of body parts also represent constraints for an individual and have repercussions on the process of acquiring motor competence. According to Newell (1986), these changes in body size lead to changes in the biomechanical constraints of the system. Although age offers a possibility for representing the maturational state of a child, Erbaugh (1986b) pointed out that characteristics such as the child's body mass have greater potential for predicting aquatic abilities.

Erbaugh (1986b) analysed two aquatic abilities of 117 children aged three to six years old: displacement in (i) prone and (ii) in supine positions. In addition, other information was collected, such as age, height, body mass and aquatic

experience. Multiple regression analysis was applied to the data, and the child's body mass was the best predictor of their ability in the aquatic environment. Age was also important, however, in the absence of information on body mass. Both variables showed a high correlation (r= 0.73) with each other. In regard to these results, it is possible to infer that body mass can be a variable used to predict AC, possibly due to its relationship with the maturational state of the child. Then, the correlation values between age and body mass, as well as the importance attributed to age in the absence of body mass information presented in Erbaugh's study (Erbaugh, 1986b), suggest that age can also be used as being indicative of the maturational state of the child.

The results of the regression also showed a positive correlation between age and PAE. Although the value was low (r= 0.13), the correlation was significant (p< 0.001), suggesting a tendency that the older the child, the higher the experience concerning the aquatic environment. In other words, age is able to reflect not only the biological and neurological maturity of the child but also the accumulated effects of environmental stimuli, reflecting on the quality of the movement performed (Saraiva et al., 2013).

For Langendorfer (1987) and Savion-Lemieux et al. (2009), if the acquisition of motor skills were dependent only on age or maturational processes, then all adults would reach advanced levels of any motor skills. However, evidence indicates that without adequate and practical stimulation, it is not possible to reach a mature level of performance (Halverson et al., 1982). Moreover, although the younger child has biological limitations, which make it challenging to perform high-complexity motor actions, the experience gained in swimming lessons greatly contributes to the acquisition of AC, albeit to a lesser degree in terms of complexity of movements.

To assess the influence of experience in the acquisition of aquatic skills, Erbaugh (1986a) evaluated the AC of children with different levels of experience. Those with previous experience in swimming lessons maintained higher AC values in all evaluations over an eight-month period than children from the group without previous experience in swimming lessons, and even without considering age, this result points to, in line with the results of the present study, the relevance of experience in the development of AC. The role of experience in the acquisition of motor skills was also investigated by Logan, Robinson, Wilson, and Lucas (2011). The authors sought, through a meta-analysis, to analyse the effectiveness of motor intervention programs in children. The study provided evidence that the implementation of motor intervention programs is an effective strategy to develop fundamental motor skills in children.

It is important to mention another result from the present study concerning the non-distinction between groups with close PAE. As in the case of the group of children with 6 to 12 months of experience who did not present any difference when compared to the group of children with up to 6 months of experience (= 0.185), and when compared to the group of children with more than 12 months of experience (= 0.190). It is known that AC is related to other variables that are capable of interfering in the process of acquiring aquatic skills, such as fear of water, motor experiences in general, motor experiences in the aquatic environment and characteristics of the classroom environment (Anderson & Rodriguez, 2014). Consequently, a more substantial difference between the groups was necessary for the PAE to assume significant relevance in the development of AC, differentiating the groups even under the influence of other factors.

Regarding the regression analysis performed for each age group, the results presented in Table 2 suggest a balance in the contribution of independent variables on AC in the age range I (36 to 47 months), which corresponds to the youngest children. In ranges II and III, the increased contribution of experience and the reduction of the contribution of age to AC are evident. The results presented in Table 4 also suggest that the child's age starts to exert less influence, while the PAE starts to exert a greater influence on the results of AC with the increase of age ranges. In this regard, Newell (1986) proposed that the younger the child, the more susceptible to individual restrictions they are, such as age, for example.

In the study conducted by Michielon et al. (2006), the authors analysed the effect of an aquatic motor intervention program consisting of spontaneous exploration movements in three groups of children of different ages: 4–12 months, 12–24 months and 24–36 months. No differences were found between the pre and post-test in each group; however, statistical differences were found in the comparison between groups of different ages, suggesting that the development of aquatic abilities in children in this age group (4–36 months) depends predominantly on age. The results found in the present study corroborate the results of Michielon et al. (1986) and show the greater relevance of age in the acquisition of AC in younger children.

As for the increase in the contribution of experience with the increase in age evidenced in the regression models by age range, it is important to highlight that in early childhood, the sequence of development of motor behaviours manifests itself more predictably (Newell, 1986). The influence of environmental and task constraints becomes more evident

over time since the passage of time focuses on increasing the child's interactions with the surrounding environment and its influence on the development process.

The correlation results (Table 3) associated with the results of the regression analysis (Table 5) for each group of PAE indicate that with the increase in the experience, there is also an increase in the correlation between age and AC; that is, the more experience in the aquatic environment a child has, the greater the difference in the level of AC of that child when compared to another younger child with equal PAE. These results indicate the existence of an age-limiting aspect in the process of developing AC with the increase in the PAE. It is interesting to relate this result to the discussion about critical periods for swimming learning.

In terms of critical periods for swimming learning, Blanskby, Parker, Bradley, and Ong (1995) and Anderson and Rodriguez (2014) found that the later children are inserted into swimming programs, fewer classes are required to learn how to swim. So, variations in the pace of learning can happen due to the age of the child. Studies also suggest that the critical period for swimming learning occurs after five years of age. Although such evidence seems to challenge the importance of starting aquatic skills teaching programs before the age of five, Anderson and Rodriguez (2014) and Blanksby et al. (1995) also pointed out that children who started aquatic programs at early ages reached levels of proficiency established in the study at earlier ages. In addition, it is important to point out that in the present study, the effects of experience were perceived even in children under five years of age, suggesting that, regardless of the existence of critical periods for swimming learning, the evolution of AC levels occurs at all ages.

To exemplify the occurrence of learning aquatic skills before the age of five, it is important to mention the studies by Rocha, Marinho, Garrido, Morgado, and Costa (2018) and Wizer, Meira Júnior, and Castro (2016). Rocha et al. (2018) investigated the effect of aquatic intervention programs in shallow-pool and deep-pool environments, and Wizer et al. (2016) investigated the effects of the use of floats on the process of acquiring aquatic skills. Although the objectives of the studies were to compare the learning in environments with different characteristics, all described situations contributed positively to the process of acquiring aquatic skills in children under five years of age. A study by Zelazo and Weiss (2006) verified the effects of four months of intervention in infants on aquatic behaviour. According to the authors, babies evolved rapidly from disorganised movements to the acquisition of movements with a greater degree of organisation and complexity, further strengthening the role of experience in acquiring AC.

Despite the importance of experience in the aquatic skills acquisition process, it is important to highlight that the experience in the present study was evaluated only from the quantitative point of view. It was not possible to make inferences about the quality of the teaching programs experienced by the children in the study. Finally, we emphasise the importance of developing studies from the perspective of mapping other factors involved in the development of aquatic competence, such as the characteristics of swimming teaching programs.

CONCLUSIONS

Between age and PAE, age presented a greater potential for aquatic competence prediction than PAE because age includes not only part of the maturity of the individual but also the amount of experience acquired over time. In this case, it is suggested that there is an increased influence of environmental factors in the development process with increasing age. Therefore, the identification and level of contribution of the variables studied, age and experience, allow the professional to be guided in the planning and application of teaching strategies to develop aquatic competence.

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ARTIGO DE REVISÃO

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Análise de processo da tarefa de levantar-se do solo em idosos saudáveis

Supine-to-stand task analysis in healthy older adults

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RESUMO

A tarefa de levantar-se do solo é considerada um marco desenvolvimental e um meio útil, válido e confiável para rastreio da competência motora funcional. Em idosos, a diversidade de protocolos usados para a análise dessa tarefa exige exame rigoroso. O objetivo deste estudo foi determinar o protocolo com maior vantagem metodológica para análise de processo da tarefa de levantar-se do solo em idosos, ambos os sexos e idade ≥ 60 anos. Foi realizada uma revisão sistematizada da literatura sobre os protocolos de análise do processo da tarefa de levantar-se do solo; posteriormente, a aplicação de critérios (clareza na linguagem, isenção de efeito piso e teto, reprodutibilidade e confiabilidade satisfatória, detalhamento da tarefa, tempo de codificação) e a atribuição de escores que somados permitiram classificar os protocolos de acordo com o nível de vantagem metodológica: maior (∑≥ 10), mediana (∑ entre 6–9) ou menor (∑≤ 5). Os resultados mostraram que todos os protocolos foram considerados pelo menos de vantagem mediana. O protocolo proposto por Manini et al. apresentou maior vantagem metodológica (∑= 10). Conclui-se que este protocolo é o mais indicado para análise de processo do levantar-se do solo em idosos, por apresentar excelente desempenho na clareza da linguagem, baixo tempo para codificação, ser isento de efeito piso ou teto, ser reprodutível e confiável.

PALAVRAS-CHAVE: atividades cotidianas; habilidade motora; avaliação geriátrica; idoso fragilizado; idoso.

ABSTRACT

Supine-To-Stand task is considered a developmental milestone, useful, valid, and reliable means of tracking functional motor competence. Concerning the elderly, the diversity of protocols used for Supine-To-Stand analysis requires rigorous examination. This study aimed to determine the protocol with the greatest methodological advantage for analyzing the Supine-To-Stand task process of older adults, both sexes and aged ≥ 60 years. A systematic review was carried out on the process analysis protocols of the Supine-To-Stand task. The application of criteria (clarity of language, exemption from floor and ceiling effect, reproducibility and satisfactory reliability, detail of the task, coding time) and the attribution of scores that added together allowed to classify the protocols according to the level of methodological advantage: greater (∑≥ 10), median (∑ between 6–9) or less(∑≤ 5), allowed the selection of the protocol with the greatest methodological advantage. The results showed that all protocols were considered to be at least of medium advantage. The protocol proposed by Manini et al. presented greater methodological advantage (∑= 10), allowing us to conclude that this protocol is the most suitable for analyzing the Supine-To-Stand process in the elderly, especially for presenting excellent performance in language clarity, low coding time, being free of floor or ceiling effect, being reproducible and reliable.

KEYWORDS: activities of daily living; motor skills; geriatric assessment; frail elderly; aged.

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INTRODUÇÃO

O envelhecimento proporciona adaptações em todos os domínios humanos (biopsicossociais), principalmente, em função da interação do sujeito idoso com o seu meio. Declínios no desempenho de realização de Atividades Básicas da Vida Diária (ABVD) são esperados da fase adulta para a velhice (Guidet et al., 2019; Yoshino, Sakurai, Hasegawa, & Yokono, 2011). Na fase final da vida, este comportamento está associado à dependência física, especialmente, devido à diminuição das capacidades coordenativas e físicas do idoso e, portanto, da sua competência funcional motora (Cattuzzo et al., 2020; Freitas et al., 2014; Robinson et al., 2015). Compreender a natureza, as características e as manifestações destas atividades, desvelará padrões de movimentos que permitem apontar deficiências neuro-motoras que influenciam negativamente fatores relacionados à saúde, como aumento do risco de quedas e internações.

O levantar-se do solo a partir da posição deitada em decúbito dorsal, em inglês Supine-To-Stand (STS), é uma ABVD integrada ao repertório motor em todo o ciclo vital, reconhecido como marco desenvolvimental das habilidades motoras (Cattuzzo et al., 2020; Duncan, Lawson, Walker, Stodden, & Eyre, 2017; VanSant, 1990), além de ser uma tarefa capaz de exigir mais dos recursos energéticos quando comparado à outros movimentos básicos relacionados com a vida diária (Didier et al., 1993). O desempenho nessa tarefa tem associação com diversas capacidades físicas e coordenativas como a força muscular, resistência cardiovascular, flexibilidade e equilíbrio, além de apresentar correlações com variáveis de saúde e composição corporal (Bohannon & Lusardi, 2004; Cattuzzo et al., 2020; Costa, Cattuzzo, Santana, Hua, & Safons, 2019; Didier et al., 1993; King & VanSant, 1995; Klima et al., 2016; Manckoundia et al., 2008; Naugle, Higgins, & Manini, 2012). Outro aspecto que emerge é a possibilidade de obter duas medidas independentes e complementares na tarefa STS: o *produto* do movimento, que é resultado da ação motora, medido em termos quantitativos como o tempo de execução e o *processo* do movimento que é medido por meio dos padrões de movimento realizados durante a tarefa, que são comparados com listas de checagem previamente estabelecidas (Nesbitt et al., 2017, 2018).

De modo geral, os protocolos que usam a medida de processo da tarefa STS apresentam algumas divergências. Fatores como o número de tentativas analisadas, a instrução sobre a de velocidade de execução, ou ainda, as características das listas de checagem para descrição, análise e codificação do movimento diferem amplamente (Cattuzzo et al., 2020). Não há evidências que demonstrem o efeito da fadiga em função de um número elevado de tentativas dessa tarefa, porém VanSant (1988) usando um protocolo com 10 tentativas em adultos jovens encontrou importante variação de desempenho (a F. VanSant, 1988) e acredita-se que o desempenho na tarefa STS pode ser ainda mais afetado pela fadiga em sujeitos mais velhos. Em adição, a instrução dada com relação à velocidade do movimento tem sido descrita na literatura de duas formas: confortável ou máxima. Nesse caso, independente da faixa etária da amostra, essa variável parece interferir significativamente no desempenho, com um melhor desempenho sendo apresentado quando a instrução exige a velocidade máxima de execução da ação, independente da faixa etária (Alexander, Ulbrich, Raheja, & Channer, 1997). Portanto, esses e outros fatores precisam ser considerados, pois interferem tanto na validade interna quanto externa dessa medida.

Em sua maioria, os protocolos de análise de processo da tarefa STS descrevem movimentos específicos estratificados por segmentos corporais (membros superiores, região axial e membros inferiores) (Bohannon & Lusardi, 2004; Haywood, Haywood, Roberton, & Getchell, 2012; a F. VanSant, 1988) ou posições intermediárias, isto é, posições padronizadas e identificadas entre o momento inicial e final da tarefa (Manini, Cook, Vanarnam, Marko, & Ploutz-snyder, 2006; Ulbrich, Raheja, & Alexander, 2000), ou por modelos de padrões de movimento previamente determinados (Klima et al., 2016), ou ainda por identificação de padrões motores sequencialmente identificados (Schwickert et al., 2015).

Fatores como o nível de detalhamento das informações contidas na descrição dos protocolos, a clareza da linguagem e as condições de saúde da amostra evitam efeitos do tipo piso ou teto e aumentam a confiabilidade intra e entre avaliadores. Além destes, o nível de reprodutibilidade destes protocolos deve ser considerado para determinar de modo geral vantagens e desvantagens, em termos de rigor metodológico e aplicação prática.

O apontamento dos protocolos de análise mais e menos vantajosos permite uma tomada de decisão mais confiável tanto em termos de aplicações práticas quanto no desenvolvimento de propostas de validação, caracterização da competência funcional motora a determinação de pontos de corte de idosos mais frágeis e o levantamento de padrões de normalidade de idosos. Portanto, o objetivo principal deste estudo foi determinar o protocolo com maior vantagem metodológica para análise de processo da tarefa STS em idosos.

MÉTODOS

Este pode ser denominado de um estudo metodológico misto que foi desenvolvido em duas etapas, bem definidas e complementares. A primeira etapa foi uma revisão sistematizada da literatura (Grant & Booth, 2009) sobre os

protocolos de análise do processo de movimento da tarefa STS seguindo os parâmetros para elaboração de revisões sistemáticas PRISMA-P (Moher et al., 2016) e está registrada na plataforma PROSPERO (CRD42017055693).

Foi utilizada a estratégia PICOS para desenvolvimento de perguntas de pesquisa por meio de revisões de literatura: (P) População/Paciente/Problema — sujeitos idosos ≥ 60 anos de ambos os sexos; (I) Intervenção de Interesse — protocolo para mensuração da competência funcional motora usando a análise de processo da tarefa STS; (C) Controle/Comparação — nos protocolos foram investigadas as seguintes características: clareza da linguagem, efeito piso ou teto, reprodutibilidade e confiabilidade, detalhamento da tarefa e tempo de codificação; (O) Desfecho — nível de vantagem metodológica (Galvão & Pereira, 2014; Mancini et al., 2014; Moher et al., 2016; Santos, Pimenta, & Nobre, 2007). A partir daí a pergunta de pesquisa que se deseja responder é: Qual é o nível de vantagem metodológica de cada um dos protocolos que usam a análise de processo da tarefa STS para diagnosticar a competência funcional motora de idosos?

A segunda etapa pode ser denominada como um estudo exploratório (Sampieri, Collado, & Lucio, 1998) da aplicabilidade dos protocolos encontrados na literatura, realizando uma análise crítica e comparativa entre eles.

Estudo de revisão — critérios de seleção

A busca de artigos científicos foi realizada nos bancos de dados MEDLINE, Scielo, EMBASE, Scopus, ERIC/ ProQuest), e também foram utilizadas as ferramentas de busca (PubMed, Web of Science — Main Collection, Science Direct, EBSCO, Cochrane). Descritores intra-grupos foram combinados com expressões boleanas OR, assim como, descritores entre-grupos foram combinados com a expressão boleana AND, como mostrado no Quadro 1 (Cattuzzo et al., 2020).

Os critérios de inclusão foram: estudos originais (artigos, teses, dissertações) avaliando a tarefa STS por meio de medidas objetivas, língua inglesa, indivíduos saudáveis com desenvolvimento típico e publicações realizadas até 2019. Os critérios de exclusão foram: duplicatas, estudos que não coincidem com o histórico desta revisão e artigos não disponíveis em texto completo. Um capítulo de livro com relevante descrição metodológica do protocolo e um artigo precursor do tipo de análise foram indicados por experts na área e considerados literatura cinzenta e, portanto, foram incluídos para análise. O Quadro 2 descreve todas as etapas da seleção dos estudos que foram revisados.

Extração dos dados

Foram extraídos os seguintes dados dos estudos: nome dos autores, ano de publicação, sexo, idade da amostra, massa corporal e Índice de Massa Corporal (IMC) (Tabela 1). A análise do risco de viés metodológico foi feita usando o formulário *Critical Review Form* (Form & Studies, 2007) e cada artigo foi analisado a partir de 15 itens sobre a qualidade do estudo (Tabela 2). Se a qualidade do item era considerada satisfatória, ele pontuava um (1), caso contrário, zero (0). A soma dos pontos dos itens oscila entre zero e 15 pontos. Estudos com pontuações menores ou igual a sete (≤ 7) foram classificados como de alto risco de viés; estudos que obtiveram pontuações entre oito e 11 pontos foram classificados como risco moderado de viés; estudos que alcançam pontuação igual ou superior à 12 foram considerados como de baixo risco de viés. Dois autores (FSS & CSM) conduziram a extração dos dados de forma independente e, em caso de divergência, um terceiro pesquisador resolveu a discordância (MTC).

Quadro 1. Descritores usados na revisão sobre o desempenho na tarefa STS de acordo com as ferramentas de pesquisa nas bases de dados.

Web of Science — Main Collection	TOPIC: ("functional assessment" OR "task performance and analysis" OR movement OR posture) AND TOPIC: ("supine position" OR lifting OR "ris* from the floor" OR "ris* from supine" OR "stand* from supine" OR "ris* from the ground" OR "supine to stand" OR "stand up" OR "supine position to erect stance" OR "ris* from a supine position" OR "get* up from the floor" OR "supine-to-stand task" OR "right* task" OR "right* skill" OR "stand upright" OR "lying backwards to stand") Refined by: LANGUAGES: (ENGLISH) Timespan: All years. Indexes: SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI.
PubMed/ MEDLINE	(MeSH Terms)) OR movement [MeSH Terms]) OR exercise therapy [MeSH Terms]) OR physical therapy [MeSH Terms]) OR physical therapy [MeSH Terms] AND floor and floorcoverings [MeSH Terms])) OR lifting from the floor OR rising from the floor OR standing up from the floor) OR supine-to-stand task) OR supine-to-stand task)
Scielo/ Science Direct/ EMBASE/ Scopus/ ERIC/ EBSCO/ Cochrane	("functional assessment" OR "task performance and analysis" OR movement OR posture) AND ((standing) OR "rising from the floor" OR "supine-to-stand task" OR "getting up from the floor" OR "standing up")

Fonte: Cattuzzo et al., (2020).

Quadro 2. Critérios para determinação das vantagens metodológicas dos protocolos de análise de processo da tarefa Supine to Stand.

Critério 1	Ruim	1
Clareza de linguagem	Regular	2
	Bom	3
Critério 2	Não	0
Isento de efeito piso ou teto	Sim	1
Critério 3	Não	0
Reprodutibilidade satisfatória	Sim	1
Critério 4	Não	0
Confiabilidade satisfatória	Sim	1
Critério 5	Menos de 10 itens	1
Detalhamento da tarefa	10 a 20 itens	2
	Mais de 20 itens	3
Critério 6	> 3 minutos: lento	1
Tempo de codificação*	= 3 minutos: moderado	2
	< 3 minutos: rápido	3

*dados proveniente da aplicação prática dos protocolos.

Tabela 1. Dados descritivos gerais dos estudos (média ± desvio-padrão ou amplitude).

Autores	Sexo/n	Idade (anos)	Massa corporal (kg)	IMC (kg/m²)
VanSant (1988)	Fem = 17; Mas = 15	28.6 ± 20–35	NI	NI
Ulbrich et al. (2000)	Fem = 12; Mas = 12	INI:73 ± 6	NI	INI : 23 ± 3 (19 a 30)
	Fem = 29	II : 81 ± 7		II : 26 ± 5 (19 a 39)
Bohannon et al. (2004)	Fem = 38; Mas = 14	64.6 ± 9.5	NI	NI
Manini et al. (2006)	Fem = 61; Mas = 21	74.4 ± 8.2	NI	NI
Haywood et al. (2012)	NI	6 a 71	NI	NI
Schwickert et al. (2015)	Fem = 5; Mas = 5	INI : 74 ± 62.3-77.5	INI : 72 (57 a 85)	INI : 24.8 (21.2 a 32.1)
Klima et al. (2015)	Fem = 36; Mas = 17	78.5 ± 8.5	NI	26.9 ± 4.5

IMC: índice de massa corporal; kg/m²: quilogramas por metro quadrado; kg: quilogramas; Fem: feminino; Mas: masculino; NI: não informado; INI: idosos não-institucionalizados; II: idosos institucionalizados.
Fonte: elaborado pelos autores.

A seguir, uma nova extração de dados foi feita baseada em critérios específicos para examinar a vantagem de análise do processo da tarefa STS (Quadro 2). Isso permitiu que a análise comparativa entre os protocolos pudesse se tornar mais clara e objetiva. As informações extraídas trataram da validade interna e externa dos protocolos.

Estudo exploratório

Adicionalmente, os autores CSM e FSS conduziram uma análise de vídeos de idosos (dados não publicados) e estimaram o tempo de uso de cada protocolo como critério da aplicabilidade. Os voluntários assinaram o termo de consentimento livre e esclarecido e o estudo aprovado pelo comitê de ética e pesquisa número 1830185.

Análise dos dados

As características das amostras foram apresentadas descritivamente por meio da média e mediana, amplitude e desvio-padrão, além da frequência absoluta e relativa (%). Foi desenvolvido pelos autores um sistema de classificação da vantagem metodológica dos protocolos: os critérios com possibilidade de categorização binária dicotômica — não ou sim — receberam,

Tabela 2. Análise do risco de viés metodológico.

QUESTÕES*/ AUTOR (ano)	VanSant (1988)	Ulbrich et al. (2000)	Bohannon et al. (2004)	Manini et al. (2006)	Schwickert et al. (2015)	Klima et al. (2016)	Total	%
(1) O objetivo estava claro?	1	1	1	1	1	1	6	100
(2) A revisão da literatura foi relevante para este tópico?	1	1	1	1	1	1	6	100
(3) O desenho foi adequado à questão da pesquisa?	1	1	1	1	1	1	6	100
(4) A amostra foi descrita em detalhes?	0	1	1	1	1	1	5	83
(5) Havia justificativa para o tamanho da amostra?	0	0	0	0	0	0	0	0
(6) Os sujeitos assinaram o termo de consentimento? (Se não descrito, assuma que não)	1	0	1	1	1	1	5	83
(7) As medidas de resultado foram confiáveis? (Se não descrito, suponha que não)	1	1	1	1	1	1	6	100
(8) As medidas de resultado foram válidas? (Se não descrito, assuma que não)	1	1	1	1	1	1	6	100
(9) A intervenção foi descrita em detalhes?	NA	NA	NA	NA	NA	NA	NA	NA
(10) Os resultados foram relatados em termos de significância estatística?	0	1	1	1	1	1	5	83
(11) Os métodos de análise foram adequados?	1	1	1	1	1	1	6	100
(12) A importância clínica foi relevante?	1	1	0	1	1	1	5	83
(13) As conclusões foram consistentes com os métodos e resultados do estudo?	1	1	1	1	1	1	6	100
(14) Existem implicações nos resultados da pesquisa para a prática clínica?	1	1	1	1	1	1	6	100
(15) As limitações do estudo foram reconhecidas e descritas pelos autores?	0	1	0	1	1	1	4	67

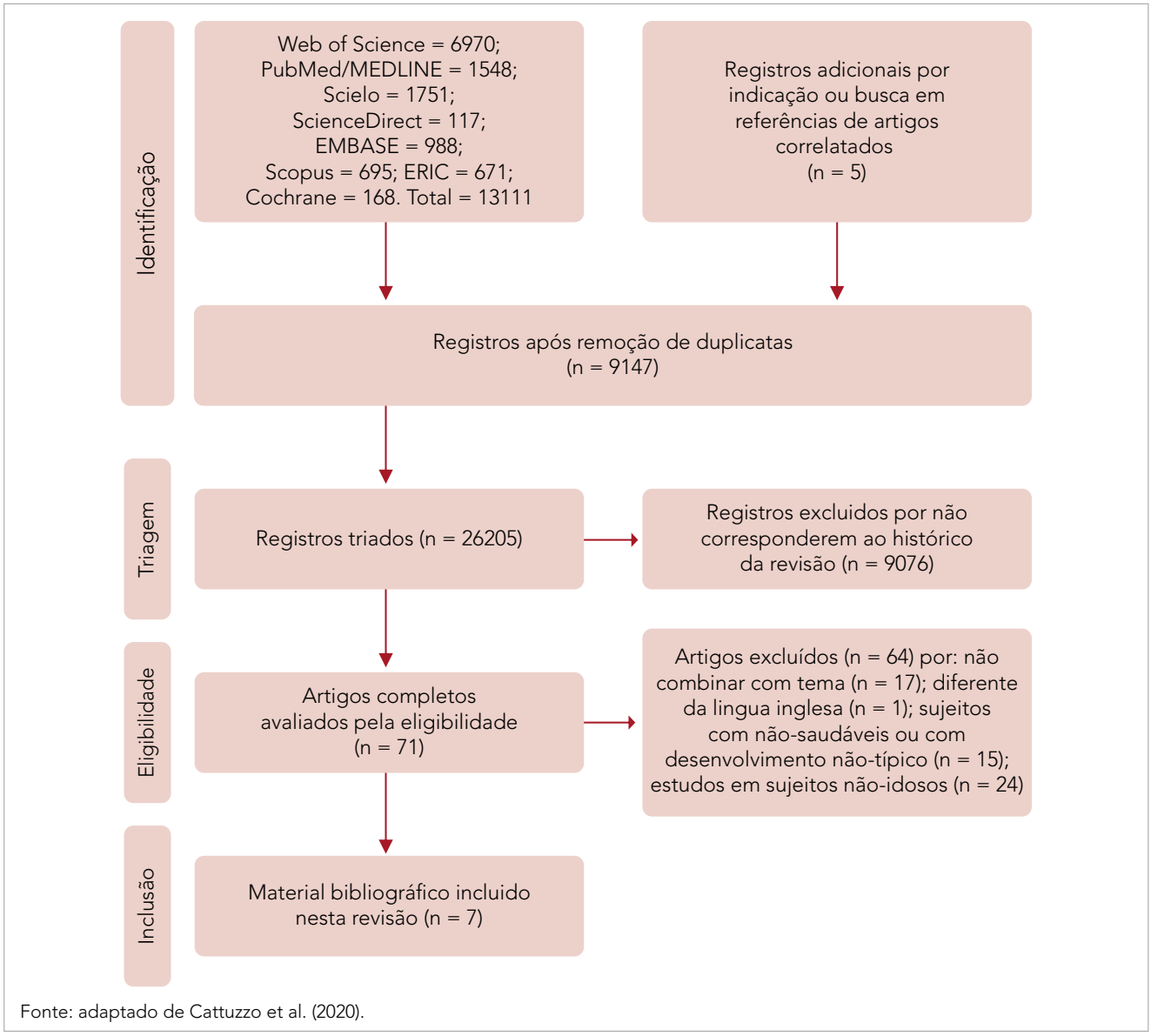
* adaptado do *Critical Review Form* (22); NA: não aplicável.

respectivamente, valores zero ou um (critérios dois a quatro); para os critérios um, cinco e seis foram criadas três categorias cada (Quadro 2). O somatório dos escores obtidos em cada critério foi julgado para a determinação em três níveis: maior vantagem ($\Sigma \geq 10$), vantagem mediana (Σ entre 6 e 9) ou menor vantagem ($\Sigma \leq 5$), considerando que a amplitude possível para o somatório é três e 12 e, quão maior o valor do somatório obtido, maior o nível de vantagem.

RESULTADOS

O processo de seleção do material bibliográfico finalizou com sete registros incluídos: seis artigos científicos de natureza observacional, um deles com amostra de indivíduos adultos e um capítulo de livro, ambos incluídos pela relevância e indicados por especialistas na área, como mostrado na Figura 1.

A Tabela 1 informa que todos os artigos selecionados apresentaram elevada qualidade metodológica, cumprindo a maioria dos critérios propostos pelo *Critical Review Form* (exceto o protocolo descrito em capítulo de livro, que não se aplica ao caso). Destaca-se que o critério 5 (justificativa sobre o tamanho amostral) esteve ausente em todos os estudos investigados, assim como, a técnica de amostragem não-probabilística (intencional ou de conveniência) foi a única utilizada. Também, o critério 15, sobre o reconhecimento das limitações dos estudos só foi atendido por 67% dos artigos revisados (Ulbrich, Raheja, & Alexander, 2000;



Fonte: adaptado de Cattuzzo et al. (2020).

Figura 1. Fluxograma descrevendo o processo de inclusão de artigos na revisão de acordo com o protocolo PRISMA-P.

Manini, Cook, VanArnam, Marko, & Ploutz-Snyder, 2006; Schwickert *et al.* 2015; Klima *et al.* 2016).

O artigo mais antigo e precursor da análise de processo na tarefa STS foi publicado por VanSant (1988) nos EUA. Além do objetivo de descrever os movimentos da tarefa STS em três regiões corporais: membros superiores, região axial e membros inferiores, a pesquisadora identificou a sequência desenvolvimental mais frequente em jovens adultos. A partir daí, foram publicados aproximadamente um artigo a cada quatro anos, com uma frequência um pouco maior no último quadriênio, como mostrado na Tabela 2. Com relação ao sexo dos participantes, todos os artigos investigaram ambos os sexos e a faixa etária das amostras dessas pesquisas variou bastante. Porém, apresentaram distinção entre os grupos de jovens adultos e idosos, assim como, idosos não-institucionalizados ou institucionalizados, estes últimos normalmente com idade mais elevada.

Manini, Cook, VanArnam, Marko e Ploutz-Snyder (2006) foi o estudo que apresentou o protocolo com maior vantagem metodológica (Σ= 10). Os protocolos restantes apresentaram vantagem metodológica mediana, segundo os critérios previamente estabelecidos, conforme Tabela 3. Além disso, 86% dos protocolos foram considerados de rápida codificação ou com tempo de codificação moderado (os avaliadores levaram entre 0,5 e 5 minutos, aproximadamente).

Tabela 3. Classificação dos protocolos da tarefa de levantar-se do solo em adultos e idosos por critério de análise metodológica.

Autor (ano)/ critério	VanSant (1988)	Ulbrich et al. (2000)	Bohannon et al. (2004)	Manini et al. (2006)	Haywood et al. (2012)	Schwickert et al. (2015)	Klima et al. (2016)
Clareza da linguagem	3	2	1	3	3	3	3
Isento de efeito piso ou teto	1	1	1	1	1	1	0
Reprodutibilidade satisfatória	0	0	0	1	0	0	0
Confiabilidade satisfatória	1	1	1	1	0	1	1
Detalhamento da tarefa	2	2	3	1	2	1	1
Tempo de codificação	2	3	1	3	2	3	3
∑	9	9	7	10	8	9	8

Com relação à clareza da linguagem na descrição, 14% dos protocolos foram considerados ruins. Efeito piso foi observado apenas no trabalho de Klima *et al.* (2016). Os critérios três e quatro contemplam itens de validação dos protocolos, reprodutibilidade e confiabilidade, respectivamente. A reprodutibilidade foi pouco considerada, mas a confiabilidade intra-avaliador foi determinada em dois estudos (VanSant, 1988; Bohannon & Lusardi, 2004) e a confiabilidade entre-avaliadores calculados em cinco estudos (Ulbrich et al., 2000; Manini et al., 2006; Schwickert et al., 2015; Klima et al., 2016). Por fim, Bohannon e Lusardi (2006) foi o estudo cujo protocolo apresentou maior detalhamento da tarefa, conforme mostrado na Tabela 3.

DISCUSSÃO

O objetivo deste estudo foi determinar o protocolo de maior vantagem metodológica para análise de processo na tarefa STS em idosos. Os resultados mostraram que todos os protocolos podem ser considerados pelo menos de vantagem mediana visto que a soma dos escores previamente definidos foi superior a quatro, cumprindo satisfatoriamente a maioria dos critérios. O principal resultado foi que o protocolo de Manini et al. (2006) obteve a maior vantagem metodológica considerando especificamente à tarefa STS, visto que quatro tarefas foram usadas para desenvolver sua escala (*MOD Scale*).

Com exceção do estudo de Bohannon et al. (2004), todos os protocolos revisados apresentaram em comum um curto tempo de codificação e clareza da linguagem. Considerando a aplicação clínica e científica em estudos com grandes populações, essas variáveis se adéquam de forma satisfatória, possivelmente dispensando o registro filmográfico em alguns casos. Neste sentido, destaca-se o protocolo usado por Ulbrich et al. (2000) que, ao investigar apenas as posições intermediárias da STS, identificou um perfil de desempenho capaz de distinguir a competência funcional motora de idosos saudáveis e frágeis.

Por outro lado, o nível de detalhamento da STS foi determinado pela quantidade de itens a serem analisados que variou entre três e 31, sendo que quão maior o nível de detalhamento, maior a capacidade do mesmo distinguir sujeitos pelos níveis de desempenho. O protocolo mais detalhado e exigente foi o de Bohannon et al. (2004) em virtude da riqueza de recursos, ideal em termos de diagnóstico e intervenção, especialmente em contextos de maior dificuldade motora. Com nível de detalhamento intermediário, num capítulo de livro técnico-didático, Haywood et al. (2012) apresentaram sequências desenvolvimentais para a STS fundamentadas no artigo seminal de VanSant (1988).

Com relação à validação dos protocolos da STS, um pouco mais de um terço dos estudos realizaram análises de reprodutibilidade e de confiabilidade intra e entre-avaliadores. Mesmo assim, todos os níveis de reprodutibilidade e confiabilidade realizados foram considerados estatisticamente satisfatórios. O efeito piso foi encontrado no estudo de Klima et al. (2016) provavelmente porque o número de itens de checagem é muito pequeno e pouco discriminatórios.

A diversidade de padrões metodológicos de instrução pode diminuir as possibilidades de comparações de desempenho entre os protocolos. Este é o caso da instrução sobre a velocidade de execução (confortável ou máxima) que pode interferir no desempenho. Alexander et al. (1997) mostraram diferenças significativas de desempenho quando comparadas velocidades diferentes em idosos sob a ótica do produto (tempo em segundos), porém à luz do processo ainda há uma lacuna. Em adição, os resultados do artigo de Schwickert et al. (2015) mostraram que as estratégias de movimento não foram influenciadas pelo cenário de aplicação da STS, numa perspectiva naturalística e padronizada.

Como limitações deste estudo, pode-se apontar que outros critérios poderiam ser elencados para diferenciar os protocolos e a literatura foi revisada até o ano de 2019. Como pontos fortes pode-se apontar que ele traz contribuições importantes para profissionais que trabalham com movimento humano (terapeutas ocupacionais, médicos fisiatras, fisioterapeutas, profissionais de Educação Física). O estudo oferece uma síntese capaz de distinguir um instrumento útil, válido e prático para avaliar idosos em uma das principais tarefas da competência funcional motora. Pesquisadores da área da motricidade humana podem se beneficiar termos de fundamentação de qualquer investigação sobre a análise de processo de movimento na STS, visto que todas as ferramentas já utilizadas na literatura foram criteriosamente analisadas. Portanto, os resultados do presente estudo podem ser usados como guia tanto na prática cotidiana quanto no cenário científico.

CONCLUSÕES

De acordo com os resultados, o protocolo de Manini et al. (2006) apresentou maior vantagem metodológica, permitindo concluir que ele é o mais indicado para análise de processo na tarefa STS em idosos. Além disso, deve-se também considerar que todos os outros protocolos apresentaram pelo menos vantagem mediana.

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ARTIGO DE REVISÃO

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Carreiras duais no alto rendimento desportivo na europa: uma revisão sistemática da literatura

Dual careers in high sporting performance in europe: a systematic literature review

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RESUMO

O desporto de alto rendimento é hoje reconhecido na Europa como um importante fator de desenvolvimento desportivo dos vários Estados-membros, mas as suas exigências são um problema, para os estudantes-atletas, que procuram compatibilizar os estudos com a prática desportiva de alto rendimento numa carreira dual. Esta revisão sistemática da literatura procura, identificar barreiras e facilitadores à carreira dual relatados em investigações pertinentes, realizadas na Europa nos últimos anos (2015–2020), selecionadas a partir da combinação das palavras-chave "dual career", "student-athlete", "elite-athlete" e "school". A pesquisa foi realizada nas bases de dados Scopus, Science Direct, Medline, Sportdiscus e PsycArticles entre os dias 1 e 21 de junho de 2020. Os resultados permitem identificar, barreiras (o ensino universitário, a adaptação cultural associada à transição cultural, o uso de substâncias, o stress, o *burnout* desportivo e a gestão do horário) e facilitadores (motivações) que se refletem no sistema escolar, no sistema desportivo, em ambos ou no abandono de uma das carreiras. Os estudos revelam, ainda, uma necessidade de maiores investimentos na compreensão do fenómeno complexo da carreira dual, através de estudos internacionais, com amostras representativas e métodos mistos de investigação, de forma a colmatar dificuldades e encontrar soluções junto de todos os que têm responsabilidade no sucesso da carreira dupla.

PALAVRAS-CHAVE: barreiras; facilitadores; estudante-atleta; alto rendimento; escola.

ABSTRACT

High-performance sport is now recognised in Europe as an important factor in member states' sports development. Still, its demands are a problem for student-athletes who seek to make their studies compatible with high-performance sports in a dual career. This systematic review of the literature aims to identify barriers and facilitators to the dual-career reported in relevant investigations carried out in Europe in recent years (2015–2020) selected from the keywords: "dual career" AND "student-athlete", "elite-athlete" AND "school". The research was carried out in the databases Scopus, Science Direct, Medline, Sportdiscus and PsycArticles between the 1st and the 21st of June 2020. The results allow identifying barriers (university education, cultural adaptation associated with cultural transition, substance use, stress, sports burnout, and time management) and facilitators (motivations) that are reflected in the school system, in the sports system, in both or the abandonment of one of the careers. The studies also reveal a need for greater investments in understanding the complex phenomenon of dual careers, through international studies, with representative samples and mixed methods of investigation, to overcome difficulties and find solutions with all those who have responsibility in the field of double career success.

KEYWORDS: barries; facilitators; student-athlete; elite athlete; school.

INTRODUÇÃO

Os direitos à educação e à prática desportiva são fundamentais e estão consagrados na legislação da União Europeia, que reconhece aos seus Estados-membros, o respetivo exercício.

A par de uma escolaridade obrigatória diferenciada nos vários Estados-membros, existe uma prática desportiva também ela distinta. Na verdade, o fenómeno desportivo é encarado pela União Europeia como uma área de interesse dos cidadãos europeus, com um enorme potencial, independentemente da idade ou origem social dos seus praticantes,

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importante para a definição de objetivos estratégicos de solidariedade e prosperidade dentro da União Europeia, mas também para o estabelecimento de relações externas fora da Europa (European Commission, 2007a).

O tratado de Lisboa definiu o desporto como uma área de competência da União Europeia, que deverá a apoiar, coordenar e complementar ações dos seus Estados-membros, de forma a desenvolver a dimensão europeia do desporto (European Comission, 2007b).

A possibilidade de um jovem ser simultaneamente estudante e atleta foi referida pela primeira vez na Europa no documento *White Paper On Sport* (European Commission, 2007a, p. 6) referindo-se à "carreira dual" (DC). Aqui, entende-se a DC como a possibilidade de um atleta de alto rendimento combinar, sem esforços pessoais desproporcionados, a carreira desportiva com a educativa, de forma flexível, salvaguardando os seus valores, interesses educacionais e profissionais.

Nas conclusões do Conselho dos Estados-membros e dos representantes dos vários Governos sobre as carreiras duais (Official Journal of the European Union, 2013) foram apresentadas recomendações que consolidaram a carreira-dual. Passa a incluir-se o "atleta talentoso", como um dos beneficiários da DC, desde que reconhecido por uma organização desportiva, um organismo dirigente ou pelo Estado, como sendo um atleta com potencial para desenvolver uma carreira desportiva de elite. Por "atleta de elite" passou a entender-se um atleta que tem um contrato profissional com um empregador do setor do desporto ou com uma organização desportiva ou cujo estatuto de atleta de elite seja reconhecido por uma organização desportiva, por um organismo dirigente ou pelo Estado com base nos resultados e êxitos comprovados.

Segundo as referidas recomendações, deve ser possível combinar uma prestação desportiva de alto nível com a educação, permitindo aos atletas colocar as suas capacidades ao serviço da sociedade, dando o melhor de si próprios, enquanto indivíduos (Wylleman & Lavallee, 2004; Wylleman & Reints, 2010; Lupo et al., 2015; Isidori, 2016).

A introdução do talento desportivo veio valorizar a DC, torná-la mais lata, ao identificar estudantes-atletas que desde muito cedo evidenciam uma excelência ao nível da prática desportiva que, de acordo com uma correta orientação poderá culminar numa prática de alto rendimento, numa determinada modalidade desportiva. Isto mesmo é explicado pelo modelo de DC proposto por vários autores (Wylleman, Alfermann, & Lavallee, 2004; Willeman & Reints, 2010; Stambulova & Wylleman, 2015) que explicam e identificam diferentes estágios de desenvolvimento dos atletas, ao longo da vida, desde o começo da prática desportiva, com várias transições em termos individuais, psicossociais e académicas, com tomadas de decisão e possíveis consequências, até ao fim da carreira desportiva e o assumir uma nova profissão.

Pela sua natureza multidisciplinar, a DC de estudante-atleta representa, desde sempre, um conjunto de desafios, quer do ponto de vista educativo, quer do ponto de vista desportivo, o que faz com que muitas das vezes o indivíduo tenha de escolher uma das carreiras: ou a de estudante ou a de atleta (Wylleman & Reints, 2010; Baron-Thiene & Alfermann, 2015; Gustafsson, Hill, Stenling, & Wagnsson, 2015; Ryba, Kalaja, Selainne, Ronkainen, & Nurmi, 2016; Sorkkila, Aunola, & Ryba, 2017).

Ainda que se saiba que uma combinação bem-sucedida de educação e treino ou treino e trabalho pode permitir a um indivíduo atingir o seu pleno potencial na vida (European Comission, 2015), são vários os desafios que os atletas de alto rendimento dos estados da União Europeia enfrentam, tentando combinar o alto rendimento com a educação ou o trabalho (Wylleman & Reints, 2010; Stambulova & Wylleman, 2015).

No sentido de criar mecanismos de apoio por forma a conciliar estas duas carreiras,a União Europeia tem implementado algumas políticas que, tendo em consideração as diferenças entre os vários países, políticas e modalidades desportivas (European Comission, 2012), permitem aos estudantes-atletas manter o foco no alto-rendimento e na escola ou no alto-rendimento escolar e no trabalho (Stambulova & Wylleman, 2014).

Note-se que no espaço da União Europeia não existe um modelo único de apoio à DC. Existem, sim, tal como referem vários estudos europeus (Aquilina & Henry, 2010; Caput-Jogunica, Curkovic, & Bjelic, 2012; Henry, 2013; European Comission, 2015), diversas abordagens relativamente à DC, que podemos sintetizar em quatro tipos:

a) centrada no estado apoiada pela legislação (França, Hungria, Luxemburgo, Polónia, Portugal e Espanha);
b) tendo o Estado como um facilitador/patrocinador do processo, promovendo acordos entre a educação e as organizações desportivas (Bélgica, Dinamarca, Estónia, Finlândia, Alemanha, Letónia, Lituânia e Suécia);
c) uma abordagem em que as Federações Desportivas representam os atletas em nome individual e são facilitadoras e mediadoras perante as entidades educativas (Grécia e Reino Unido);
d) por último, uma abordagem "laissez faire", onde não há estruturas formais envolvidas no processo de apoio à carreira dupla (Malta, Áustria, Chipre, República Checa, Irlanda, Itália, Holanda, Eslováquia e Eslovénia).

Vários trabalhos de investigação (Wylleman, Alfermann, & Lavallee, 2004; Capranica & Millard-Stafofford, 2011; Aquilina, 2013; Stambulova & Wylleman,2015) inspiraram as linhas europeias orientadoras que procuram dar resposta a questões identificadas pelos vários países europeus, sugerindo recomendações para apoiar estes estudantes-atletas de alto rendimento, considerando a importância da DC e a representatividade que estes atletas dão aos seus países de origem. Neles, reconhecem-se, potenciais benefícios à DC, na aquisição de conhecimentos e competências que perduram ao longo da vida (Petitpas, Brewer, & Van Raalte, 2009; Price, Morrison, & Arnold, 2010; Tekavc, Wylleman, & Cecić, 2015; Torregrosa, Ramis, Pallarés, Azocar, & Selva, 2015), tais como assumir um papel na sociedade, tornar-se financeiramente independente, desenvolver uma identidade ou desenvolver uma relação entre pares, mas também desafios em conciliar a carreira de estudante, com a carreira desportiva ou com o trabalho (European Commission, 2015; Lupo, et al., 2015).

Os sucessivos planos de trabalho da União Europeia (2011–2014, 2014–2017, 2017–2020) definiram ações políticas relativamente à educação e formação de jovens atletas de alto rendimento, contribuindo para os objetivos da estratégia 2020 (Official Journal of the European Union, 2011; Official Journal of the European Union, 2014; Official Journal of the European Union, 2017). A promoção das carreiras duais releva que todas as organizações desportivas e todos os governos têm a responsabilidade de possibilitar aos atletas o êxito numa DC (Official Journal of the European Union, 2013).

A partilha de boas práticas e de experiências em matéria de carreiras duais entre os Estados-membros, a nível local, regional e nacional é referida como uma mais valia para a carreira-dual (European Commission, 2015). Assim, investigar a DC poderá contribuir para melhorar as formas de apoio a estes estudantes que são simultaneamente atletas de exceção. De Bosscher (2008) reforça esta ideia ao afirmar que os países estão a tornar-se cada vez mais estratégicos relativamente à forma como encaram os atletas de alto rendimento, para além do treino e das questões associadas ao desempenho desportivo, reconhecendo o alto rendimento como um sistema de *inputs* e *outputs* (De Bosscher, 2006) que importa compreender.

O objetivo desta revisão sistemática da literatura é identificar barreiras e fatores facilitadores à DC relatados em investigações científicas realizadas na Europa nos últimos anos, contribuindo para uma atualização do conhecimento nesta temática, amplamente estudada e que continua a gerar interesse para académicos, responsáveis por políticas públicas desportivas e atores e *stakeholders* envolvidos nestes processos. Ao identificarmos e compreendermos as barreiras e os fatores facilitadores da DC estaremos, certamente, a contribuir para que os agentes envolvidos no subsistema de carreiras duais possam decidir sobre os mecanismos de apoio mais adequados à melhoria do próprio sistema.

MÉTODO

Pela natureza multidisciplinar e complexidade que a DC representa, elaborámos um protocolo de investigação que permitirá posterior replicação desta pesquisa. Na senda de Weed (2006), assumimos que, embora a cobertura abrangente de um campo de estudo seja uma característica fundamental da revisão sistemática, ela é uma atividade de pesquisa primária por si só replicável e sistemática.

Esta revisão sistemática pretende identificar, selecionar e analisar estudos científicos originais relevantes, realizados na Europa e publicados entre janeiro de 2015 e maio de 2020 sobre o tema das carreiras duplas. A recolha de dados para constituir o *corpus* de textos a analisar foi feita a partir da combinação das palavras chave: "dual career" AND "student-athlete", "elite athlete" AND "school". Foram seguidas as diretrizes e recomendações contidas na declaração PRISMA (Moher et al., 2009).

A pesquisa realizada no dia 21 de junho de 2020, a partir da combinação das palavras chave: "dual career" AND "student-athlete", "elite athlete" AND "school", nas bases de dados Scopus, Science Direct, Medline, Psyarticles e Sportdiscus, demonstrada pelo fluxograma do processo de pesquisa (Figura 1), identificou 163 estudos publicados, entre 1 de janeiro de 2015 e 30 de maio de 2020, tendo em conta os critérios de inclusão e exclusão definidos.

Os artigos foram selecionados de acordo com os seguintes critérios de inclusão:

a) estar relacionado com a DC;
b) estudos realizados na Europa;
c) artigos científicos publicados entre e de janeiro de 2015 e 30 de maio de 2020;
d) artigos produzidos nas línguas inglesa, portuguesa, espanhola e francesa;
e) textos submetidos a um processo de revisão por pares;
f) incluir o termo "carreira dupla" ou "estudante-atleta" nas palavras-chave ou pelo menos uma vez no texto.

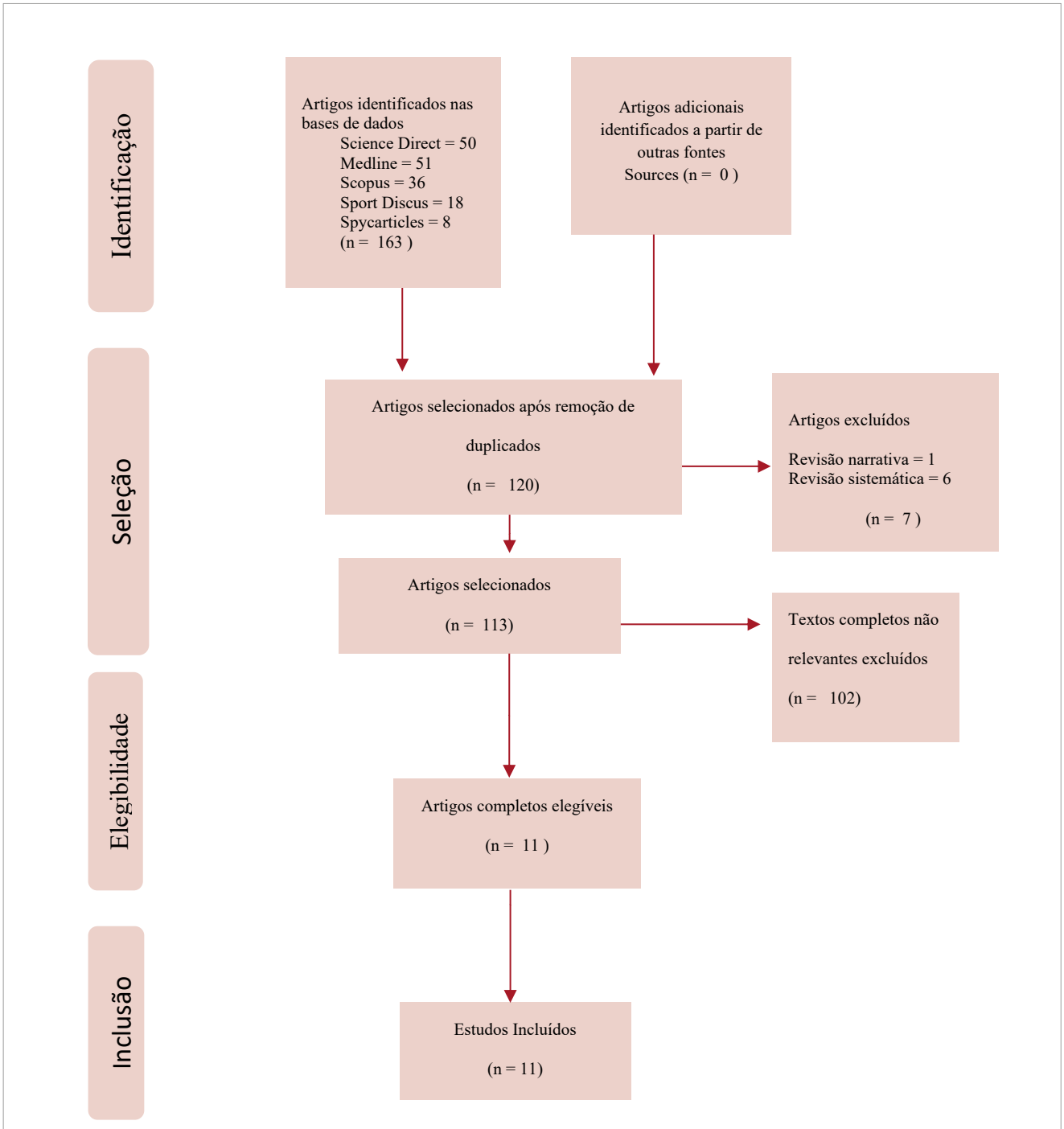
Para maximizar a eficácia da pesquisa foram realizadas diferentes combinações de palavras-chave.

Não foram impostos limites às características das amostras e desenhos de pesquisa.

Foi feita a remoção dos artigos duplicados antes da análise dos artigos selecionados.

Foi feita a leitura dos vários artigos pelos co-autores e discutida a pertinência dos estudos. Os estudos selecionados receberam um código bibliográfico.

Para minimizar o *risk of bias*, (imparcialidade na condução da investigação), a pesquisa foi replicada pelos dois co-autores (JS e MT) que analisaram os resumos dos artigos identificados previamente. Sempre que houve discordância entre os co-autores JS e MT o terceiro autor SP serviu de critério de desempate. As divergências entre os co-autores foram resolvidas por consenso.



Fonte: Moher, Liberati, Tetzlaff, Altman, & The PRISMA Group (2009).

Figura 1. Fluxograma do processo de pesquisa realizado no dia 21 de junho de 2020.

RESULTADOS

Os resultados evidenciam o interesse que a DC continua a suscitar em toda a comunidade científica.

Todos os estudos se centraram nos estudantes-atletas. O quadro resumo (Quadro 1), identifica os principais detalhes das pesquisa: autores, tipo de estudos, objetivos dos estudos, metodologias, instrumentos de pesquisa utilizados, características da amostra e principais resultados ou conclusões.

A revisão evidencia que os estudantes-atletas, maioritariamente, frequentam o ensino universitário (Quadro 2). As temáticas abordadas (Quadro 3) revelam preocupações que vão para além da questão do desempenho escolar e do desempenho desportivo.

Identificaram-se (Quadro 4), como barreiras à carreira--dual, o ensino universitário, a adaptação cultural associada à transição cultural de estudantes atletas que têm que se deslocar para outros países que não o seu país de origem, o uso de substâncias como suplementos alimentares, hormonas, vitaminas, minerais, cafeína, creatina, medicamentos ou drogas por parte dos estudantes-atletas, o stress provocado pelas exigências da DC, o *burnout* desportivo e a gestão do horário, quer do treino, quer da escola.

Como facilitadores identificou-se as motivações dos estudantes-atletas que beneficiam deste mecanismo de apoio.

Nos últimos cinco anos, os estudos internacionais predominam, (Gráfico 1) o que demonstra a preocupação partilhada e a cooperação estabelecida entre os vários Estados-membros para a compreensão do fenómeno da carreira-dual.

DISCUSSÃO

Na primeira revisão sistemática realizada sobre a DC, desde a introdução do termo DC em 2007 (Guidotti, Cortis, & Capranica, 2015) foram identificadas quatro dimensões da DC: individual, interpessoal, social/organizacional e política, sugerindo os autores que as relações entre as várias dimensões deveriam ser estudadas para uma melhor compreensão da DC. Mais recentemente, Stambulova e Wylleman (2019) numa revisão sistemática em que analisaram de forma crítica o estado da arte do discurso europeu na área da psicologia em relação à DC afirmaram, que a pesquisa une e conecta o discurso europeu. Os autores identificam lacunas em termos de pesquisa (a DC no desporto e trabalho, os "custos" da DC, os ambientes que envolvem a DC, a saúde mental e bem-estar dos atletas, mecanismos de apoio à carreia dual e de apoio ao treino) que devem ser tidas em conta.

A presente revisão sistemática procura acrescentar conhecimento a esta temática ao identificar barreiras e facilitadores à DC, tendo em conta as últimas tendências de investigação europeias que poderão contribuir para uma reflexão crítica por parte de todos os responsáveis pela DC, e, desta forma, para melhorar os mecanismos de apoio já existentes e, consequentemente, o sucesso desta DC.

Estudos anteriores destacam a motivação dos estudantes-atletas perante a DC, em conseguir combinar ambas as carreiras com sucesso (Lupo et al., 2015; Stambulova et al., 2015; Ryba et al., 2017), mas há evidências que nos remetem para a necessidade de investigação mais específica, de acordo com os vários contextos sociais (Lupo et al., 2015).

Esta revisão evidencia uma predominância de estudos internacionais realizados nos últimos cincos anos (2015–2020), demonstrativa da preocupação partilhada e da cooperação estabelecida entre os vários Estados-membros para a compreensão do fenómeno complexo da DC. O aumento do número de estudantes-atletas, atletas internacionais e a facilidade da mobilidade entre os vários Estados-membros (Capranica & Guidotti, 2016) tem contribuído para a realização de estudos internacionais. Seria, portanto, útil dispormos de uma ferramenta digital, considerando o potencial das novas tecnologias, à escala Europeia, que permitisse a inscrição e monitorização destes atletas, facilitando a comunicação entre os vários intervenientes (federações desportivas, sistemas educacionais, famílias, entre outros) dentro de um sistema a larga escala (Condello, Capranica, Doupona, Varga, & Burk, 2019).

A maioria dos estudos que mapeámos foram realizados a partir e sobre estudantes-atletas do ensino universitário (Quadro 2) — uma tendência de pesquisa, justificada pela persistente inexistência de um modelo ou mecanismo de apoio único implementado na Europa, para este nível de ensino superior, isto apesar das evidências demonstrarem, quer a elevada exigência do alto rendimento, quer a exigência do desempenho académico neste nível de ensino, que, sem mecanismos de apoio, faz com que os alunos acabem por abandonar uma das carreiras (Ryba et al., 2016; Sorkkila, Aunola, & Ryba, 2017; Bastianon & Ginevra, 2018).

Num dos estudos elegíveis, o primeiro internacional sobre a temática, (Erickson, Stanger, Patterson, & Backhouse, 2019) aborda-se a questão do consumo de substâncias, que representa não apenas um risco para a saúde dos estudantes-atletas, mas também para o seu desempenho desportivo. Segundo os autores, é necessário realizar pesquisas internacionais específicas sobre questões como: quem consome substâncias, as razões que levam ao consumo, identificar os contextos do consumo, só assim será possível promover medidas educativas que esclarecem e previnam o seu consumo. Para os autores, é importante estudar os diferentes grupos etários e géneros, para além do ponto de vista conceptual com a intenção de

Quadro 1. Resumo dos estudos elegíveis.

Código	Autores	Estudo	Ano	Tipo de estudo	Objetivo	Amostra	Resultados	Referências Bibliográficas
01	Henriksen, K., Storm, L., Kuettel, A. Linnér, L. & Stambulova, N.	A holistic ecological approach to sport and study: The case of an athlete friendly university in Denmark	2019	Estudo caso. Método Misto (entrevista, observação e documentação)	Fornecer uma abordagem holística de uma universidade dinamarquesa no apoio à carreira dupla.	2 estudantes-atletas, 2 treinadores, 1 professor, 2 elementos de apoio à dupla carreira e o Vice-Chanceler da universidade.	Dois modelos empíricos (Dual career developments (DCDE) e DC-ESF) resumem 4 ambientes de desenvolvimento da dupla carreira (DC): a) centrado numa equipa de apoio à carreira dupla (DC) para apoiar a comunicação e coordenação entre o desporto, estudo e vida privada; b) centrado em fornecer soluções individuais para cada atleta; c) promotor do ensino a alunos-atletas para planificar, priorizar, comunicar e assumir a responsabilidade pelo equilíbrio dos seus esforços perante a CD e d) um ambiente que coloca o desporto em primeiro lugar e reconhece que os alunos-atletas devem ser vistos como um todo.	Henriksen, K., Storm, L., 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 & Exercise, 47*. https://doi.org/10.1016/j.psychsport.2019.101637
18	Ryba, T., Elbe, A-M., & Darpatova-Hruzewicz, D.(	Development and first application of the athlete adaptation inventory: An exploratory study	2020	Estudo exploratório quantitativo	Identificar questões associadas à transição cultural através da Aplicação do questionário, "Athlete Adaptation Inventory"(AAI)	143 (69 mulheres, 74 homens) atletas de alto rendimento: migrantes profissionais (86), semi-profissionais (24), amadores (26) e amadores com bolsa de estudo (6)	Os dados sugerem que as transições culturais podem ser desafiadoras. O estudo revela diferenças significativas na adaptação intercultural com base no género, tipo de desporto, idade e experiência migratória anterior. Atletas do sexo feminino, são mais propensas a enfrentar desafios no contexto desportivo, enquanto os atletas do sexo masculino e atletas de desportos coletivos se esforçam mais num contexto não desportivo. O processo de aculturação não tem necessariamente que ser responsável pela diminuição do desempenho desportivo. A transição cultural pode melhorar o crescimento pessoal. Atletas que não gerem a transição com sucesso, podem revelar uma diminuição no desempenho, stresse psicológico e riscos em termos de saúde. Os resultados revelam uma consciencialização sobre a necessidade de fazer um esforço para socializar os atletas recém-chegados e orientá-los sobre os recursos disponíveis que reduziriam o fardo da carga da aculturação em atletas transnacionais, especialmente em áreas onde o apoio psicossocial é particularmente necessário.	Ryba, T., Elbe, A-M., & Darpatova-Hruzewicz, D. (2020). Development and first application of the athlete adaptation inventory: an exploratory study. *Performance Enhancement and Health, Elsevier B.V., 8*(1). https://doi.org/10.1016/j.peh.2020.100164

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Quadro 1. Continuação.

Código	Autores	Estudo	Ano	Tipo de estudo	Objetivo	Amostra	Resultados	Referências Bibliográficas
21	Erickson, K,. Stanger, N., Patterson, L., & Backhouse, S.	Substance use in university sport: A cross-national study of student-athlete substance use behaviors and perceived responses to witnessing substance use	2019	Estudo transnacional com aplicação de questionário	Pesquisar o uso de substâncias entre as populações de estudantes-atletas universitários em vários países.	568 estudantes-atletas (US – n= 208; UK – n= 201; Canada – n= 159)	Os atletas masculinos relataram usar a maioria dos suplementos além de vitaminas e minerais e suplementos dietéticos face às atletas femininas. Os atletas do Canadá e EUA relataram que iriam "confrontar o indivíduo" se testemunhassem um colega atleta tomando suplementos, medicamentos prescritos e substâncias proibidas para melhorar a aparência e o desempenho mais do que os atletas do Reino Unido. Mais mulheres do que de homens relataram que "se reportariam a outra pessoa" (por exemplo, treinador, órgão regulador do desporto) se testemunhassem colegas tomando substâncias proibidas.	Erickson, K,. Stanger, N., Patterson, L., & Backhouse, S. (2019). Substance use in university sport: A cross-national study of student-athlete substance use behaviors and perceived responses to witnessing substance use. *Performance Enhancement & Health. 7*(1-2). https://doi.org/10.1016/j.peh.2019.100151
51	Davis, P., Halvarsson, A., Lundström, W., & Lundqvist, C.	Alpine Ski Coaches and Athletes Perceptions of Factors Influencing Adaptation to Stress in the Classroom and on the Slopes.	2019	Estudo com Métodos mistos (entrevistas semi-estruturadas e questionário)	Explorar fatores e perceções de atletas e treinadores de ski alpino relativamente a fatores que influenciam a adaptação ao stress psicológico na sala de aula e no local de prática.	173 estudantes-atletas juniores (78 homens, 93 mulheres, 2 não responderam)+ 6 treinadores alto rendimento	Os níveis de stress psicológico e organizacional relatados pelos atletas são relativamente baixos na escala "Multidimensional Training Distress Scale". O estudo sugere que a otimização de mecanismos de suporte entre domínios pode promover adaptações positivas a potenciais fontes de stress.	Davis, P., Halvarsson, A., Lundström, W., & Lundqvist, C. (2019). Alpine Ski Coaches' and Athletes' Perceptions of Factors Influencing Adaptation to Stress in the Classroom and on the Slopes. *Frontiers in psychology*, *10*, 1641. https://doi.org/10.3389/fpsyg.2019.01641
52	Lupo, C., Guidotti, F., Goncalves, C., Moreira, L., Doupona, T., Bellardini, H.,Tonkonogi, M., Colin A., & Capranica L.,	Motivation towards dual career of European student-athletes.	2015	Estudo transnacional com aplicação de questionário	Investigar motivações para a dupla carreira de estudantes-atletas europeus que vivem em países prestação de diferentes serviços educacionais para atletas de elite: regulação centrada no Estado; Estado como patrocinador/facilitador; Federações/Institutos Nacionais de Dsportos como intermediários (Federação) e Laisser Faire, sem estruturas formais (sem estrutura), através da aplicação do questionário European Student-athletes' Motivation Towards Sports and Academics Questionnaire (SAMSAQ-EU)	524 estudantes-atletas	O conhecimento universal sobre 'atletas em geral' tem que ser considerado inadequado, especialmente na Europa, onde existem sistemas desportivos, normas sociais e tradições culturais diferenciados. O questionário SAMSAQEU demonstrou ser uma ferramenta preliminar interessante para investigar a motivação perante a carreira dupla dos estudantes-atletas europeus e perante contextos sociais específicos sublinha a necessidade de novas pesquisas nesta área. Considerando as limitações do estudo e amostra muito heterogénea será necessária mais investigação para implementar o Instrumento SAMSAQ-UE. De acordo com as recomendações europeias, (European Commission, 2012), são considerados necessários estudos qualitativos e quantitativos transnacionais para fornecer valiosas informações para orientar este multi-setor (governos, organizações desportivas e entidades educacionais) na gestão do desporto e da educação para os futuros cidadãos, europeus, tornando mais fácil aos atletas combinar o treino desportivo com estudo ou trabalho.	Lupo, C., Guidotti, F., Goncalves, C., Moreira, L., Doupona, T., Bellardini, H., Tonkonogi, M., Colin A., & Capranica L. (2015). Motivation towards dual career of European student-athletes, *European Journal of Sport Science*, 15(2), 1-10. https://doi.org/10.1080/17461391.2014.940557

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Quadro 1. Continuação.

Código	Autores	Estudo	Ano	Tipo de estudo	Objetivo	Amostra	Resultados	Referências Bibliográficas
53	Sorkkila, M., Ryba, T., Selänne, H., & Aunola, K.	Development of School and Sport Burnout in Adolescent Student-Athletes: A Longitudinal Mixed-Methods Study.	2020	Um estudo longitudinal com métodos mistos (aplicação de questionário e entrevista)	Investigar o desenvolvimento do burnout escolar e desportivo em estudantes-atletas adolescentes no primeiro ano do ensino médio usando uma abordagem orientada para a pessoa, para obter indicadores como atletas adolescentes de elite com perfis de risco de burnout diferem de atleats sem perfil de burnout	391 atletas-estudantes	Este estudo abordou o fenómeno do burnout adolescente de maneiras metodologicamente inovadoras. Examinou-se o desenvolvimento simultâneo do esgotamento desportivo e escolar entre os alunos-atletas e, assim, complementando o modelo cognitivo-efetivo de R. E. Smith (1986) nos contextos da educação e do desporto, que representam os principais domínios diários dos alunos-atletas. Os resultados indicam que o burnout se torna mais generalizado ao longo do tempo, em vez de ser específico do contexto. Os atletas de elite que correm o risco de esgotamento podem sofrer particularmente na escola sintomas de esgotamento, que então se disseminam para o contexto desportivo. Os dados obtidos fornecem indicadores e recursos experimentados por estudantes-atletas de elite, que poderão ser usados para a melhor forma de apoiar o seu bem-estar.	Sorkkila, M., Ryba, T., Selänne, H., & Aunola, K. (2020). Development of School and Sport Burnout in Adolescent Student-Athletes: A Longitudinal Mixed-Methods Study. *Journal of Research on Adolescence, 30*(S1), 115-133. https://doi.org/10.1111/jora.12453
59	González, J., Rodríguez, A., & Fernández, J.	Dual Career of the U-23 Spanish Canoeing Team.	2019	Estudo com métodos mistos (entrevista e questionário)	Verificar como a equipa espanhola de canoagem em águas calmas com menos de 23 anos percebe as carreiras atléticas e académicas.	21 estudantes-atletas (11 mulheres e 10 homens)	Os resultados demonstram que os atletas têm dificuldade em assistir às aulas e que a planificação das disciplinas geralmente é baseada nas suas programações de treino. Na última parte do curso, é stressante para os atletas combinar ambas as atividades e alguns acabam por abandonar a escola. Durante o curso, os atletas apreciam ter outra atividade que permite escapar da rotina do treino. Os atletas revelam sentir falta de não ter um tutor académico para orientá-los e aconselhá-los. Os alunos-atletas estão cientes de que o seu desporto faz com que percam muitos momentos com a família e amigos devido a treino ou competição, no entanto, é compensado, facilitando a obtenção de bolsas que proporcionam apoio económico.	González, J., Rodríguez, A., & Fernández, J., (2019). Dual Career of the U-23 Spanish Canoeing Team, *Frontiers in Psychology, 10*, 1-11. https://doi.org/10.3389/fpsyg.2019.01783

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Quadro 1. Continuação.

Código	Autores	Estudo	Ano	Tipo de estudo	Objetivo	Amostra	Resultados	Referências Bibliográficas
74	Rosenvinge, J., Sundgot-Borgen, J.,Pettersen, G., Martinsen, M., Stornæs, A., & Pensgaard, A.	Are adolescent elite athletes less psychologically distressed than controls? A cross-sectional study of 966 Norwegian adolescents.	2018	Estudo randomizado com aplicação de questionário	Investigar a prevalência de sofrimento psicológico entre jovens atletas de alto rendimento e verificar se a prevalência pode ser atribuída ao perfeccionismo e problemas alimentares.	966 atletas adolescentes	Os dados contabilizam cerca de 20% de sofrimento psicológico acentuado e até cerca de 40% da variação nos pontos de stresse geral evidenciando a necessidade de explorar novas variáveis fisiológicas, psicológicas e psicossociais e, de preferência em projetos longitudinais que devem cobrir a transição da adolescência à idade adulta, considerando o fato de que a angústia entre os adultos atletas de alto rendimento poderem subir aos mesmos níveis da população geral. Os resultados mostram níveis mais baixos de sofrimento psicológico entre os jovens atletas de elite. Em ambas as amostras, a associação mais fraca entre comer problemas e angústia podem indicar que tais problemas não implicam um risco psicológico de desenvolvimento clínico grave distúrbios alimentares. Em ambos os grupos verificou-se que níveis mais altos de atividade física podem aumentar o risco de sofrimento psicológico acentuado em não atletas, enquanto níveis mais baixos de atividade física parecem aumentar esse risco entre os atletas.	Rosenvinge, J., Sundgot-Borgen, J.,Pettersen, G., Martinsen, M., Stornæs, A., & Pensgaard, A. (2018). Are adolescent elite athletes less psychologically distressed than controls? A cross-sectional study of 966 Norwegian adolescents. *Journal Sports Medicine*, *25*(9), 115-123. https://doi.org/10.2147/OAJSM.S156658.
102	Brustio, P., Rainoldi, A., Lupo, C., Mosso, C., & Subijana, C.	Italian student-athletes only need a more effective daily schedule to support their dual career	2019	Estudo quantitativo com aplicação de questionário	Investigar questões na dupla carreira de estudantes-atletas italianos de acordo com variáveis: género, idade, tipo de desporto, nível de competição, percurso universitário e ano de frequência, para realçar os seus principais problemas e soluções.	711 estudantes-atletas universitários	A maioria dos itens mostrou que os atletas mais jovens estão mais envolvidos no seu papel de estudantes-atletas. Os estudantes-atletas italianos destacaram que melhores horários de aulas e exames poderiam representar as melhores soluções para combinar efetivamente o desporto e as exigências acadêmicas.	Brustio, P., Rainoldi, A., Lupo, C., Mosso, C., & Subijana, C. (2019). Italian student-athletes only need a more effective daily schedule to support their dual career. *Sport Sciences for Health*, https://doi.org/10.1007/s11332-019-00594-6

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Quadro 1. Continuação.

Código	Autores	Estudo	Ano	Tipo de estudo	Objetivo	Amostra	Resultados	Referências Bibliográficas
103	Linnér, L.; Stambulova, N.B.; Lindahl, K.; & Wylleman, P.	Swedish university student-athletes dual career scenarios and competences	2019	Estudo quantitativo com aplicação de questionário	Explorar cenários e competências na carreira dupla de estudantes-atletas universitários suecos destacando: (a) a necessidade percebida pelos estudantes-atletas em desenvolver competências na dupla carreira para combinar com sucesso o desporto e o estudo, (b) a vivência e forma de lidar com cenários específicos de dupla carreira e c) a magnitude da associação entre a posse de competências para cada cenário.	71 estudantes-universitários (49 homens, 22 mulheres)	Fraca associação encontrada entre competências priorizadas e o enfrentamento bastante eficaz de quatro cenários de dupla carreira (DC). A nível nacional, este estudo promoveu um tipo de pensamento direcionado por competência de estudantes-atletas e partes interessadas em DC, contribuiu para as Diretrizes Nacionais Suecas para DCs de atletas de elite (2018) e expandiu a base de pesquisa para a continuação desenvolvimento do sistema DC sueco.	Linnér, L, Stambulova, N., Lindahl, K., & Wylleman, P. (2019). Swedish university student-athletes' dual career scenarios and competences, *International Journal of Sport and Exercise Psychology*. https://doi.org/10.1080/1612197X.2019.1611898
142	Bastianon S., & Greco, G.	The italian approach to the dual careers of university student-athletes	2018	Estudo quantitativo com aplicação de inquérito por email	Este estudo procura: a) identificar Universidades que adotaram (ou estão prestes a adotar) um programa de apoio à dupla carreira; b) avaliar a distribuição geográfica dos programas de apoio à dupla carreira no território italiano (Norte, Sul e Centro); c) definir as principais características dos programas de apoio à dupla carreira, especialmente em termos dos tipos de serviços de suporte oferecido; d) classificar as universidades com base no número de serviços de apoio oferecidos e fornecer uma visão geral inicial dos resultados alcançados no primeiro ano de ativação da dupla programa de carreira na Universidade de Bergamo.	71 universidades italianas	As universidades italianas mostram uma consciência crescente sobre a importância de permitir que os alunos-atletas devem combinar a educação com a carreira desportiva e uma atitude proativa para adotar regras internas e programas ad hoc para traduzir essa consciência em termos concretos.	Bastianon S., & Greco, G. (2018). The italian approach to the dual careers of university student-athletes, *Kinesiologia Slovenica, 24*, 3, 5-18.

DC: carreira dual; SAMSAQ-EU: European Student-athletes' Motivation Towards Sports and Academics Questionnaire.

Quadro 2. Características da amostra/nível de ensino.

Código	Amostra	Nível de ensino
1	2 estudantes-atletas, 2 treinadores, 1 professor, 2 elementos de apoio à dupla carreira e o Vice-Chanceler da universidade	Ensino universitário
18	143 (69 mulheres, 74 homens) atletas de alto rendimento migrantes profissionais (86), semi-profissionais (24), amadores (26) e amadores com bolsa de estudo (6)	Omisso
21	568 estudantes-atletas (US – n= 208; UK – n= 201; Canada – n= 159)	Ensino universitário
51	173 estudantes-atletas juniores (78 homens, 93 mulheres, 2 não responderam)+ 6 treinadores alto rendimento	Ensino secundário
52	524 estudantes-atletas	Ensino universitário
53	391 atletas-estudantes	Ensino secundário
59	21 estudantes-atletas (11 mulheres e 10 homens)	Ensino secundário
74	966 atletas adolescentes	Ensino secundário
102	711 estudantes-atletas universitários	Ensino universitário
103	71 estudantes-atletas (49 homens, 22 mulheres)	Ensino universitário
142	71 universidades italianas	Ensino universitário

Quadro 3. Temáticas estudadas.

Código	Temática	Nível de ensino
1	Abordagem holística da dupla carreira	Ensino universitário
18	Adaptação cultural associadas à transição cultural	Omisso
21	Uso de substâncias em estudantes universitários	Ensino universitário
51	Adaptação ao stress psicológico na sala de aula e no local de prática desportiva	Ensino secundário
52	Motivações para a dupla carreira na europa	Ensino universitário
53	Burnout escolar e desportivo em estudantes-atletas adolescentes no primeiro ano do ensino médio	Ensino secundário
59	Perceção da carreira atlética e académica	Ensino secundário
74	Stress psicológico	Ensino secundário
102	Gestão de horário	Ensino universitário
103	Competências adquiridas na dupla carreira	Ensino universitário
142	Abordagens da dupla carreira	Ensino universitário

Quadro 4. Temáticas estudadas – barreiras e facilitadores da carreira dual.

Código	Temática	Barreira	Facilitador
1	Abordagem holística da dupla carreira	x	x
18	Adaptação cultural associadas à transição cultural	x	x
21	Uso de substâncias em estudantes universitários	x	--
51	Adaptação ao stress psicológico na sala de aula e no local de prática desportiva	x	--
52	Motivações para a dupla carreira na europa	--	x
53	Burnout escolar e desportivo em estudantes-atletas adolescentes no primeiro ano do ensino médio	x	--
59	Perceção da carreira atlética e académica	-	x
74	Stress psicológico	x	--
102	Gestão de horário	x	--
103	Competências adquiridas na dupla carreira	x	x
142	Abordagens da dupla carreira	x	x

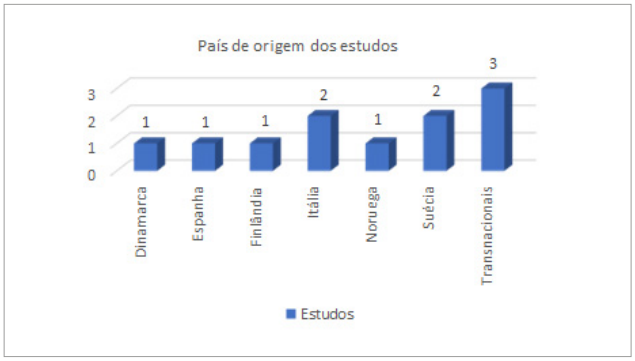

Gráfico 1. País de origem dos 11 estudos analisados na revisão sistemática.

capacitar os estudantes-atletas para reconhecerem potenciais situações de doping e abordá-las da forma adequada, de forma a não pôr em causa o sucesso da DC. Consideramos que o uso de substâncias é mais uma das barreiras à DC que deverá ser tida em conta. Esta temática poderia ser uma das temáticas obrigatórias a abordar no ensino obrigatório pela sua complexidade e relação, quer com a saúde, quer com o desempenho desportivo, ao longo de toda a DC. Ao concluir o ensino obrigatório os estudantes já teriam algum conhecimento e capacidade de lidar com esta temática.

Consideramos que a multiplicidade de abordagens relativamente à DC no ensino superior (Bastianon & Ginevra, 2018) limita a recolha de dados concretos sobre atletas europeus (Capranica & Guidotti, 2016) e, consequentemente, a compreensão das suas formas de atuação.

Tendo em conta o processo de implementação da DC na Europa, no ensino obrigatório desde as primeiras *Guidelines* Europeias (European Comission, 2012) e a experiência adquiria pelos vários Estados-membros ao longo dos anos, já se justificava a implementação deste mecanismo de apoio, ao nível de ensino superior, quando se espera que os atletas europeus do alto rendimento realizem simultaneamente a sua formação educacional superior, decisiva para capacitar estudantes-atletas para a vida em sociedade e no trabalho, sem esquecer o fim da sua carreira competitiva (Bastianon, 2014; Capranica & Guidotti, 2016; Condello, Capranica, Doupona, Varga, & Burk, 2019).

A emigração, associada ao nível do ensino superior, será um outro fenómeno que deve ser compreendido, de forma a permitir criar mecanismos de apoio a estes estudantes-atletas, que, além da pressão causada pela dupla carreira, sofrem também a pressão acrescida de estarem fora da sua zona de conforto habitual, face à diversidade de culturas que encontram (Stambulova & Ryba, 2013; Stambulova & Ryba, 2014). Se considerarmos que o número de competições internacionais tem vindo a aumentar e a migração atlética internacional temporária ou de longo prazo se tem generalizado (Capranica & Guidotti, 2016; Stambulova, Ryba, & Henriksen, 2020), a emigração é um fenómeno a estudar. O questionário *Athlete Adaptation Inventory* (AAI) do estudo de Ryba, Elbe e Darpatova-Hruzewiczc (2020) poderá constiuir-se uma ferramenta valiosa para os diferentes intervenientes que trabalham com os estudantes-atletas abrangidos pela emigração, permitindo-lhes identificar as áreas mais desafiadoras na adaptação cultural destes estudantes-atletas.

O conceito de alto-rendimento, os requisitos, do acesso a programas de apoio ao alto rendimento, as diferenças existentes nos vários países, influenciam tratamentos desiguais nos países de origem e nos países de acolhimento, quer no campo do treino de alto rendimento, quer na educação (Lupo et al., 2015; Capranica & Guidotti, 2016). Importa definir estratégias de cooperação entre os vários Estados-membros para partilhar experiências que permitam implementar um modelo Europeu que reúna algum consenso que, para além de permitir conciliar a DC, permita capacitar estudantes-atletas e aumentar seu nível internacional de competitividade nas duas carreiras (Capranica & Guidotti, 2016).

As questões associadas à adaptação cultual, relacionadas com a emigração dos estudantes-atletas de alto rendimento são questões emergentes e uma lacuna em termos de pesquisa que importa colmatar (Ryba, Elbe, & Darpatova-Hruzewicz, 2020). A emigração no alto rendimento constitui uma barreira à DC pouco conhecida ainda que possa condicionar o desempenho desportivo, o stresse psicológico e riscos relacionados com a saúde (Ryba, 2014; Demes & Geeraert, 2015; Schinke et al., 2019). No entanto ela poderá ser tida em conta também como um facilitador, para estudantes-atletas que já tenham acumulado experiências anteriores e que por isso já lidam melhor com a sua mobilidade e diferenças culturais (Ely & Ronkainen, 2019).

Como sabemos, a DC não decorre sempre num percurso ascendente. Não raras vezes, surgem questões que relevam para um ajustamento necessário, quer em relação às exigências do alto rendimento e possíveis retrocessos desportivos, quer em relação a desempenhos escolares negativos. Lesões, questões psicológicas, psicossociais, assunção de responsabilidades individuais, desenvolvimento de novos relacionamentos entre pares, manutenção de um relacionamento familiar, estas são algumas das questões que podem pôr em causa o sucesso da DC, conduzindo a doenças como stress, *over training* ou *burnout* (Gustafsson, Kenttä, Hassmén, & Lundqvist, 2007; Baron-Thiene & Alfermann, 2015; Stambulova and Wylleman, 2015; Ryba et al., 2016; Sorkkila, Aunola, & Ryba, 2017; Kristiansen, 2017; Ivarsson, Stambulova, & Johnson, 2018).

Se estes estudantes-atletas estiverem munidos de habilidades que lhe permitam lidar com estas questões, será mais fácil fazer essa gestão ao longo da sua potencial carreira, longa ou não (Wylleman, Alfermann, & Lavallee, 2004; Willeman & Reints, 2010; Stambulova & Wylleman, 2015).

Torna-se ainda necessário considerar o estudo de barreiras associadas a questões psicológicas, sociais, financeiras (MacNamara & Collins, 2010; Brown et al., 2015; Tekavc, Wylleman, & Cecić Erpič, 2015), questões associadas à gestão do tempo, considerada um dos grandes desafios da gestão para os estudantes-atletas (Davis, Halvarsson, Lundstrom, & Lundqvist, 2019), que fazem com que o estudante atleta tenha muitas vezes que gerir a sua própria carreira. Na verdade, a DC é demasiado complexa, pelo que é necessário compreendêla no quadro de uma abordagem holística (Stambulova & Ryba, 2014) que evolua para uma nova abordagem ecológica (Henriksen, Stambulova, & Roessler, 2019) que considere o estudante-atleta como um todo, em que os ambientes de desenvolvimento de carreira dupla (Henriksen et al., 2020), podem variar em termos de estrutura, processos, filosofia e grau de eficiência. Assim, as questões associadas à DC não devem focar-se apenas no estudante-atleta e nas suas questões individuais, mas no seu todo, considerando todo um ambiente que o envolve.

As temáticas abordadas (Quadro 3) evidenciam também preocupações na área da psicologia, relacionadas com o bem-estar dos atletas (Erickson, Stanger, Patterson, & Backhouse, 2019).

Apesar da identificação de formas de apoio à DC diferenciadas por toda a Europa, cermos que importa realizar pesquisas internacionais que avaliem modelos já implementados e que poderão expor evidências de sucesso passíveis de replicação em vários países.

Esta revisão identifica barreiras como, o ensino universitário, a adaptação cultural associada à transição cultural de estudantes atletas que têm que se deslocar para outros países que não o seu país de origem, o uso de substâncias como suplementos alimentares, hormonas, vitaminas, minerais, cafeína, creatina, medicamentos ou drogas por parte dos estudantes-atletas, o stress provocado pelas exigências da DC, o *burnout* desportivo e a gestão do horário, quer do treino, quer da escola.

Como facilitadores identifica as motivações dos estudantes-atletas para conseguir combinar ambas as carreiras com sucesso (Lupo et al., 2015; Stambulova et al., 2015; Ryba et al., 2017) mas há evidências que nos remetem para a necessidade de mais investigação, considerando a complexidade da DC e a multiplicidade de temáticas que constituem barreiras ao sucesso na conciliação da carreira de estudante ou trabalhador, com a carreira de atleta de alto rendimento, lacunas a ser estudadas de forma mais específica, de acordo com os contextos sociais, (Lupo et al., 2015) ambientes que envolvem a DC, a saúde mental e bem-estar dos atletas, mecanismos de apoio à carreia dual e de apoio ao treino.

A identificação de facilitadores e barreira à DC contribuirá para uma melhor compreensão do fenómeno nos vários Estados-membro e consequentemente será um contributo para o seu desenvolvimento e consolidação de mecanismos de apoio (Quadro 4) junto dos vários intervenientes na DC (governos, sistemas desportivos, sistemas educativos, pais, entre outros).

CONCLUSÕES

Os resultados evidenciam barreiras e facilitadores atuais à DC na Europa que importam estudar, nomeadamente as barreiras provocadas pelo ensino universitário, a adaptação cultural associada à transição cultural, o uso de substâncias, o stress, o *burnout* desportivo e a gestão do horário, e identificam as motivações como facilitadores para conseguir combinar ambas as carreiras com sucesso,

É evidente que a implementação de um mecanismo de apoio à DC no sistema universitário é uma questão emergente que deve fazer parte da agenda europeia, face ao aumento do número de estudantes-atletas na Europa que frequentam o ensino superior e não beneficiam de nenhum tipo de apoio para conciliar ambas as carreiras, o que faz com que muitas vezes escolha uma das carreiras.

Existem lacunas em termos de pesquisa que poderão pôr em causa o sucesso da DC (emigração, os ambientes que envolvem a DC, a saúde mental e bem-estar dos atletas, *burnout* desportivo, mecanismos de apoio à carreia dual e de apoio ao treino) que deverão ser objeto de estudo, através de métodos mistos de pesquisa e amostras representativas de estudantes-atletas.

Considera-se que a utilização de amostras representativas de estudantes-atletas (Rosenvinge et al., 2018), é importante pois a utilização das amostras não representativas condiciona a análise do fenómeno e a generalização dos resultados.

Sugerimos a realização de estudos internacionais para que os vários intervenientes europeus possam partilhar experiências e resultados, dando assim respostas a todas as organizações que lidam com a DC (governos, organizações desportivas, organizações educacionais, famílias), assim como a realização de pesquisas em contextos específicos como, a da adaptação cultural devido à emigração, o *burnout* desportivo ou a gestão do tempo.

Por fim, sugerimos a realização de mais estudos, utilizando métodos mistos e menos conceptuais. É preciso estudar a DC do ponto de vista dos "seus utilizadores" sejam eles estudantes-atletas, treinadores, pais, professores ou outros. Só assim será possível, conhecer, compreender e melhorar as condições de estudantes-atletas que beneficiam deste mecanismo de apoio.

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ARTIGO DE REVISÃO

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Instrumentos de avaliação de crianças no meio aquático: uma revisão sistemática

Assessment instruments for children in the aquatic environment: a systematic review

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RESUMO

Objetivou-se identificar e descrever instrumentos referentes à avaliação do comportamento aquático de crianças, por meio de revisão sistemática, e discuti-los à luz do conceito de competência aquática. Realizou-se a busca nas bases *SPORTDiscus with Full Text, MEDLINE Complete, EMBASE, Web of Science* e *PubMed*. Foram incluídos artigos, teses e dissertações em língua portuguesa, inglesa, espanhola e francesa, sem restrição quanto ao ano e tipo de estudo. A estratégia de busca encontrou 14.099 estudos e 62 foram considerados elegíveis. Identificaram-se 21 instrumentos para crianças sem deficiência e estes incluem, predominantemente, tarefas relacionadas à natação propriamente dita e utilizam a qualidade da execução da tarefa como critério de avaliação. Identificaram-se também 15 instrumentos para crianças com deficiência. Estes incluem, predominantemente, tarefas relacionadas à adaptação ao meio aquático e utilizam o nível de autonomia na execução da tarefa como critério de avaliação. Ressalta-se que para ser competente na água uma criança deve saber executar tarefas de diferentes esportes aquáticos e ser capaz de aplicá-las em ambientes com características distintas. Nesse caso, os instrumentos de avaliação encontrados se mostraram limitados. A partir da problematização realizada percebeu-se a urgência de discutir o conceito de competência aquática para qualificar programas de ensino do nadar.

PALAVRAS-CHAVE: ensino; competência aquática; avaliação.

ABSTRACT

The aim was to identify and describe assessment protocols for children's aquatic behaviour through a systematic review and discuss the results using the aquatic competence concept. The search was carried out on *SPORTDiscus with Full Text, MEDLINE Complete, EMBASE, Web of Science* and *PubMed*. Articles, theses and dissertations in Portuguese, English, Spanish and French were included, without restriction on the year and type of study. The search found 14,099 studies, and 62 were considered eligible. Twenty-one instruments for children without disabilities were identified, and these include tasks related to swimming itself and use the quality of task execution as an evaluation criterion. Fifteen instruments were also identified for children with disabilities. These include tasks related to adaptation to the aquatic environment and use the level of independence in executing the task as an evaluation criterion. To be competent in the aquatic environment, a child must know how to perform tasks of different aquatic sports and be able to apply them in environments with different characteristics. In this regard, the assessment instruments found were limited. Thus, discussing the concept of aquatic competence to qualify swimming teaching programs is urgent.

KEYWORDS: teaching; aquatic competence; evaluation.

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INTRODUÇÃO

Quando o tema "saber nadar" é abordado, os quatro estilos competitivos tornam-se o centro da discussão, entretanto tal visão sobre o nadar restringe o processo de aquisição das habilidades aquáticas a um esporte apenas, impedindo que habilidades aquáticas básicas, bem como habilidades específicas de outros esportes aquáticos, igualmente importantes para o relacionamento seguro com o meio aquático, sejam desenvolvidas (Canossa, Fernandes, Carmo, Andrade, & Soares, 2007). Nesse cenário é que ganha importância o conceito de competência aquática. Competência aquática refere-se a um conjunto de habilidades que proporcionam relacionamento mais seguro e prazeroso com o ambiente aquático, visto que amplia a ideia já estabelecida sobre o conceito de "saber nadar" (Langendorfer, 2011; Quan et al., 2015).

No caso do ensino da natação para crianças, é fundamental a avaliação constante das habilidades aquáticas, isso porque mortes por afogamento não são incomuns. De acordo com a World Health Organization (WHO, 2014) 372.000 pessoas morrem afogadas no mundo a cada ano, mais de 90% dessas mortes ocorrem em países de baixa e média renda (WHO, 2014). Ainda, o afogamento está entre as primeiras cinco causas de morte de pessoas com idade entre 1 e 14 anos em mais da metade de 85 países pesquisados (WHO, 2014). Nesse caso, conscientizar crianças e informar os familiares sobre as reais competências da criança no meio aquático, utilizando-se para isso os resultados de processos avaliativos, é uma questão até mesmo de sobrevivência, visto que, a partir da avaliação, pode-se determinar o nível mínimo de habilidade necessário para participar de atividades aquáticas de maneira segura (Langendorfer, 2011; Chan, Lee, & Hamilton, 2020). Além disso, o processo de avaliação permite estimar os resultados de determinada abordagem, bem como as estratégias de ensino utilizadas (Quan et al., 2015), fornecendo subsídios também para aprimorar a qualidade do ensino da natação (Moreno-Murcia, 2005).

De acordo com Chróinín e Cosgrave (2013), a avaliação da aprendizagem possibilita que os resultados obtidos sejam utilizados para determinar quais componentes da habilidade ainda precisam ser desenvolvidos e quanto tempo de instrução deve ser dedicado a cada componente. Além disso, fornece *feedback* para professor e aluno quanto ao processo de aprendizagem, e, ainda, contribui para construir, analisar e revisar o plano de aula e o planejamento de ensino como um todo, impactando positivamente no processo pedagógico (Chróinín & Cosgrave, 2013).

Nesse sentido, a avaliação deveria ser entendida como aliada ao processo de construção do planejamento, visto que, como salientam Penney, Brooker, Hay e Gillespie (2009), currículo, pedagogia e avaliação são importantes dimensões que se relacionam e determinam a qualidade de um programa motor. Embora a avaliação contribua sobremaneira em diferentes aspectos do planejamento da aprendizagem, Penney et al. (2009) ressaltam que, na prática, os tópicos exigidos na avaliação não se mostram em consonância com os conteúdos trabalhados no cotidiano das aulas. Assim, é importante que o instrumento avaliativo forneça dados que retroalimentem o processo de ensino e favoreça o oferecimento de *feedback* específico, fornecendo subsídios para a reestruturação do planejamento, quando necessário (Chróinín & Cosgrave, 2013).

Acredita-se que a utilização de métodos avaliativos pode contribuir para a obtenção de dados relativos a processos de organização, sistematização, aplicação de conteúdos e procedimentos pedagógicos eficazes (Moreno-Murcia, 2005). Assim, utilizando-se, como base, um referencial teórico que problematiza o ensino reducionista da natação, o objetivo desse artigo foi identificar e descrever instrumentos que se referem à avaliação do comportamento aquático de crianças e a partir disso, analisar os achados à luz do conceito de competência aquática.

MÉTODOLOGIA

Esta revisão sistemática foi realizada com base nas recomendações do protocolo para projetos de pesquisa PRISMA-P (Moher et al., 2015) e registrada na plataforma do *International Prospective Register of Systematic Reviews* (PROSPERO — CRD42020165168).

Critérios de elegibilidade

Foram incluídos estudos que tratam da avaliação do comportamento aquático de crianças na natação. Com isso, o objetivo da revisão foi identificar estudos que utilizaram escalas, testes, fichas de avaliação, listas de checagem e demais protocolos avaliativos desenvolvidos com o propósito de coletar informações a respeito do comportamento aquático de crianças. Foram incluídos artigos, teses e dissertações em língua portuguesa, inglesa, espanhola e francesa, sem restrição quanto ao tipo de estudo e período de publicação do material. Os estudos que citaram, entretanto não apresentaram no corpo do texto a descrição do instrumento, bem como dos critérios de avaliação utilizados, foram mantidos até a última etapa da revisão para posterior busca do instrumento de avaliação em outras fontes. Caso, após efetuada a procura, a versão integral do instrumento não fosse encontrada, o estudo era então, descartado da revisão. Foram excluídos os estudos que não estivessem de acordo com a temática, ou seja, que não

avaliaram crianças, que não utilizaram protocolos avaliativos referentes às habilidades aquáticas, que utilizaram protocolos avaliativos referentes aos quatro estilos competitivos de nado (crawl, costas, peito, borboleta).

Fonte de busca

A busca foi efetuada nas seguintes bases de dados eletrônicas: *SPORTDiscus with Full Text (EBSCO), MEDLINE Complete (EBSCO), EMBASE, Web of Science* e *PubMed*. Além disso, foram realizadas buscas nas listas de referências dos artigos, teses e dissertações incluídos na revisão.

Estratégia de busca

A estratégia de busca partiu das combinações entre sinônimos e termos do *Medical Subject Headings* (*MeSH's)* e dos termos *ENTREE* da plataforma *EMBASE* para as palavras "children", "assessment" and "swimming" publicados até fevereiro de 2019. Foram utilizados os operadores Booleanos "*AND*", "*OR*". O operador Booleano "*NOT*" foi também utilizado como recurso para objetivar a busca, visto que número muito alto de estudos foi encontrado. Exemplo da estratégia de busca em uma das bases de dados encontra-se na Tabela 1.

Seleção dos estudos e extração dos dados

Na primeira fase, os títulos e resumos identificados pela estratégia de busca foram avaliados por um avaliador. Resumos que não apresentaram informações suficientes foram selecionados para avaliação do artigo completo. Na segunda fase, dois revisores, de maneira independente, realizaram a análise dos artigos na íntegra, bem como a seleção dos estudos de acordo com os critérios de elegibilidade. Desacordos entre os revisores foram resolvidos por um terceiro revisor. A extração dos dados foi realizada por dois revisores de forma independente. Todos os revisores eram professores de educação física e natação, além disso possuíam experiência na área da pedagogia da natação.

Tabela 1. Exemplo de estratégia de busca.

População	"Child"[Mesh] OR "Child" OR "Child Development"[Mesh] OR "Child Development" OR "Development, Child" OR "Behavior, Child" OR "Child Behavior"[Mesh] OR "Child Behavior" OR "Child, Preschool"[Mesh] OR "Child, Preschool" OR "Preschool Child" OR "Preschool Child Development" OR "Preschool Child Behavior" OR "Children" OR "Children Development" OR "Development, Children" OR "Behavior, Children" OR "Children Behavior" OR "Children, Preschool" OR "Preschool Children" OR "Preschool Children Development" OR "Preschool Children Behavior" OR "Young Child" OR "Young Child Development" OR "Young Child Behavior" OR "Young Children" OR "Young Children Development" OR "Young Children Behavior" OR "Young Swimmer" OR "Young Swimmers" OR "Toddler" OR "Toddler Development" OR "Toddler Behavior" OR "Preschoolers" OR "Preschoolers Development" OR "Preschoolers Behavior" OR "Youngster" OR "Youngster Development" OR "Youngster Behavior" OR "Youngsters" OR "Youngsters Development" OR "Youngsters Behavior" OR "Infant"[Mesh] OR "Infant" OR "Infant Development" OR "Development, Infant" OR "Infant Behavior"[Mesh] OR "Infant Behavior" OR "Behavior, Infant" OR "Developing Child" OR "Developing Children" OR "Developing Preschool Child" OR "Developing Preschool Children" OR "Developing Young Child" OR "Developing Young Children" OR "Developing Toddler" OR "Developing Preschoolers" OR "Developing Youngster" OR "Developing Youngsters" OR "Developing Infant"
Intervenção	"Swim" OR "Swimming"[Mesh] OR "Swimming" OR "Aquatic" OR "Aquatic Sport" OR "Aquatic Sports" OR "Aquatic Ability" OR "Aquatic Abilities" OR "Aquatic Exercise" OR "Aquatic Exercises" OR "Pool" OR "Pool Exercise" OR "Water Exercise" OR "Water"[Mesh] OR "Water" OR "Water Movements"[Mesh] OR "Water Movements" OR "Water Movement" OR "Water Sports"[Mesh] OR "Water Sports" OR "Water Sport" OR "Crawl" OR "Freestyle" OR "Backstroke" OR "Butterfly" OR "Breaststroke"
Desfecho	"Ability" OR "Abilities" OR "Motor Ability" OR "Motor Abilities" OR "Pattern" OR "Patterns" OR "Motor Pattern" OR "Motor Patterns" OR "Motor Proficiency" OR "Proficiency" OR "Competence" OR "Motor Competence" OR "Movement" OR "Movements" OR "Skill" OR "Motor Skills"[Mesh] OR "Motor Skills" OR "Readiness" OR "Motor Readiness" OR "Testing Battery" OR "Motor Testing Battery" OR "Behavior" OR "Motor Behavior" OR "Performance" OR "Motor Performance" OR "Assessment" OR "Evaluation" OR "Development" OR "Motor Development" OR "Motor Activity"[Mesh] OR "Motor Activity" OR "Motor Activities" OR "Motor Acquisition" OR "Motor Assessment" OR "Motor Evaluation" OR "Motor Acquisition" OR "Test" OR "Motor Test" OR "Scale" OR "Motor Scale" OR "Inventory" OR "Motor Inventory"
NOT	"Enzyme" OR "Biology" OR "Biological" OR "Microbiology" OR "Microbiological" OR "Toxic" OR "Toxicological" OR "Toxicology" OR "Toxicity" OR "Drugs" OR "Microorganism" OR "Microorganisms" OR "Pollution" OR "Virus" OR "Bacteria" OR "Disease" OR "Diseases" OR "Pathologic" OR "Syndrome" OR "Epidemiology" OR "Mice" OR "Mouse" OR "Dolphin" OR "Dolphins" OR "Fish" OR "Fish" OR "Fishes" OR "Whale" OR "Shark" OR "Ocean" OR "River" OR "Mammalian" OR "Adult" OR "Adults" OR "Elderly" OR "Elderlies" OR "Adolescent" OR "Adolescents" OR "Woman" OR "Women" OR "Man" OR "Men" OR "Medical" OR "Nursing" OR "Dental"

Desfechos

Como desfecho da revisão objetivou-se encontrar instrumento de avaliação utilizado para avaliar o comportamento aquático de crianças.

Avaliação do risco de viés

Para a avaliação da qualidade metodológica dos estudos recrutados, escala de Downs e Black (1998) foi utilizada por dois revisores que atuaram de forma independente na análise dos estudos. Essa escala foi escolhida por apresentar níveis satisfatórios de validade para aplicação tanto em estudos randomizados, quanto não-randomizados (Downs & Black, 1998). A Escala original é constituída por 27 questões distribuídas em cinco subescalas: *reporting; external validity; internal validity — bias; internal validity — confounding; power*. Realizou-se adaptações no instrumento de modo que as questões 13 e 27 foram retiradas, permanecendo 25 questões no instrumento. Tal procedimento foi adotado porque a questão 13 apresenta conteúdo incoerente com o tema pesquisado e a questão 27 avalia o poder do estudo em identificar se os resultados podem ser devido ao acaso. Importante ressaltar que procedimento semelhante foi realizado por Feitosa, Correia, Barbosa, e Castro (2019) de modo a ajustar o conteúdo da Escala às características dos estudos que se pretende avaliar. Após as adaptações, 26 pontos tornou-se o máximo valor possível de ser atingido por um estudo, visto que cada questão é pontuada com valor de 1 ou 0, com exceção da questão cinco que pode ser pontuada com 2, 1 ou 0.

Análise dos dados

A análise dos dados foi realizada de forma qualitativa, por meio da identificação e descrição dos instrumentos de avaliação do comportamento aquático de crianças encontrados nos artigos, teses e dissertações selecionados no processo de busca. A descrição dos instrumentos contém informações a respeito do nome do instrumento, autores que utilizaram o instrumento, ano de publicação e amostra desses estudos, tarefas avaliadas, critérios de avaliação e informações referentes à processos de validação e localização desses instrumentos. Os instrumentos foram analisados com base em referencial que aborda o conceito de competência aquática.

Para análise da qualidade metodológica dos estudos, pontuação obtida por cada estudo de acordo com a Escala de Downs e Black (Downs & Black, 1998) foi apresentada. Valores próximos de 26 indicam maior qualidade metodológica dos estudos. Para corroborar com essa análise, foi calculada e apresentada a frequência percentual para cada questão de modo a caracterizar, de maneira geral, a qualidade dos estudos encontrados.

RESULTADOS

A busca inicial identificou 14.097 estudos. Dois estudos adicionais foram identificados por meio de outras fontes, totalizando 14.099 estudos. Em um primeiro momento, foram excluídas 4.742 publicações por serem duplicadas. Das 9.357 publicações mantidas, 5.155 foram excluídas por apresentarem títulos que não se relacionavam com o objetivo da pesquisa, para isso utilizaram-se termos como filtros (*chicken, frog, titanium*, iodo, *bacteria, malaria, cholera*, urticaria). Após essa etapa, restaram ainda 4.202 estudos para análise de título e resumo. Essa etapa excluiu 4.074 publicações, restando 128 estudos para análise de texto completo. Desses, 51 foram excluídos por não apresentarem, de maneira clara, o instrumento utilizado, 14 foram excluídos por não terem sido encontrados na íntegra, um foi excluído por estar redigido em chinês. Com isso, 62 estudos foram considerados elegíveis de acordo com os critérios estabelecidos nessa revisão sistemática. A Figura 1 apresenta, de forma sucinta, o processo de revisão sistemática.

Dos 62 estudos incluídos na revisão, 36 abordaram estratégias de avaliação do comportamento aquático direcionadas para crianças sem deficiência, entre esses estudos foram identificados 21 instrumentos de avaliação. A Erbaugh Rating Scale foi o instrumento mais citado entre os estudos. Além desses, outros 26 estudos abordaram estratégias de avaliação do comportamento aquático direcionadas para crianças com alguma deficiência. Entre esses estudos, identificaram-se 15 instrumentos de avaliação, sendo que o *Water Orientation Test of Alyn* 1 e 2 foi o instrumento mais citado. Realizou-se essa classificação por entender que os instrumentos destinados à avaliação de crianças com deficiência possuem especificidades quanto às habilidades e principalmente, quanto aos critérios de avaliação. Embora as características da amostra dos estudos tenham sido utilizadas como critério de classificação, não se descarta a possibilidade de que algum instrumento que tenha sido classificado em um grupo, seja aplicável ao outro grupo. A Tabelas 2 e a Tabela 3 identificam e descrevem os instrumentos de avaliação do comportamento aquático para crianças sem deficiência e para crianças com deficiência, respectivamente.

Os resultados da análise da qualidade dos estudos são apresentados na Figura 2 para cada estudo identificado na revisão. Entre os 62 estudos identificados, nove não passaram por avaliação por serem estudos de revisão. Entre os 53 estudos que permaneceram, a pontuação obtida variou entre 3 e 20, sendo 10,75 a média de pontos entre os estudos.

A Figura 3 apresenta os resultados da análise com base na frequência percentual dos resultados para cada questão do instrumento.

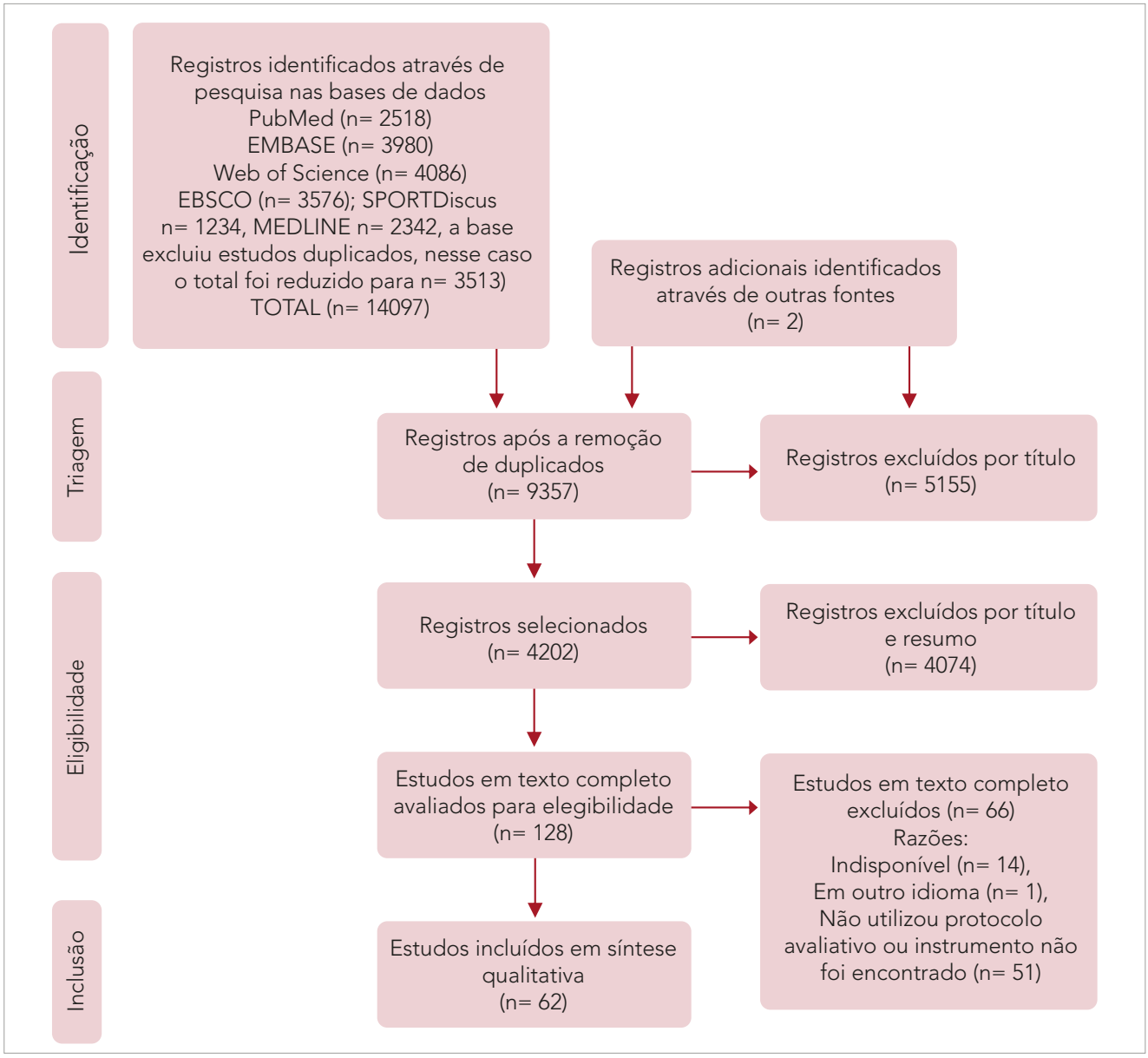

Figura 1. Fluxograma com etapas da revisão sistemática.

DISCUSSÃO

Pelo potencial de pautar grande parte das decisões metodológicas do professor no que se refere ao planejamento de ensino, estratégias de avaliação deveriam ser entendidas como pontos de partida (Di Paola, 2019). Quando se trata do planejamento de ações que visam o ensino da natação, entretanto, na prática, a avaliação tem tido papel pouco relevante (Di Paola, 2019). Tal constatação orientou a realização desse estudo que, por meio de uma revisão sistemática, teve como principal objetivo identificar e descrever instrumentos de avaliação do comportamento aquático infantil, buscando, com isso, contribuir e qualificar o trabalho de professores de natação em seu cotidiano profissional.

Por muitos anos, atribuiu-se aos quatro estilos competitivos de nado papel central no que se refere aos conteúdos desenvolvidos no ensino da natação (Canossa et al., 2007; Fiori, Castro, Teixeira, & Wizer, 2019). Atualmente, aspectos referentes à segurança aquática e à inclusão de outros esportes aquáticos vêm sendo também incorporadas às discussões teóricas sobre o ensino da natação, de modo que, para um indivíduo ser considerado competente na água, precisa ser proficiente em uma gama de habilidades aquáticas básicas e específicas de esportes como natação, nado artístico, polo

Tabela 2. Identificação e descrição dos instrumentos de avaliação do comportamento aquático de crianças sem deficiência.

Instrumentos de avaliação para crianças sem deficiência			
Nome do instrumento / estudos que utilizaram / amostra dos estudos	Tarefas propostas na avaliação	Critérios de avaliação	Informações e comentários adicionais
Anderson e Rodriguez (2014) n= 272 crianças de 3 a 8 anos.	Três níveis. As tarefas são: entrada na água; submersão; controle respiratório (respiração frontal e lateral); deslocamento (nado submerso, crawl, costas, ondulação); palmateios; saltos em pé e de cabeça.	Critérios correspondem ao cumprimento de tarefas exigidas para troca entre níveis 1, 2 e 3.	Evidências de validade não foram encontradas. Instrumento descrito no estudo.
Blanco e Diaz-Urena (2016) n= 337 crianças de 3 a 11 anos.	Três tarefas: respiração; flutuação; deslocamento ventral e dorsal.	Duas opções de resposta: se executa(sim), se não executa(não).	Evidências de validade não foram encontradas. Instrumento descrito no estudo.
Blanksby, Parker, Bradley e Ong (1995) n= 326 crianças de 2 a 8 anos.	Três níveis. As tarefas são: submersão; controle respiratório; flutuação; deslocamento (crawl, costas e peito).	Critérios correspondem ao cumprimento de tarefas exigidas para troca entre níveis 1, 2 e 3.	Evidências de validade não foram encontradas. Instrumento descrito no estudo.
Erbaugh Rating Scale **Versão completa:** **Erbaugh (1978)** – n= 57, 2 a 6 anos; **Erbaugh (1986a)** – n= 126, 2,5 a 5,5 anos; **Erbaugh (1986b)** – n =117, 3 a 6 anos; **Wizer, Meira Júnior e Castro (2016)** – n= 17, 3 anos; **Wizer, Franken e Castro (2016)** – n= 26, 3 anos **Zhu e Erbaugh (1997)** – n= 20 crianças. **Versão adaptada:** **Bradley, Parker e Blanksby (1996)** – n= 33, 6 anos; **Parker, Blanksby e Quek (1999)** – n= 19, 6 e 7 anos; **Scurati, Roione, Michielon e Invernizzi (2006)** – n= 20, 8 e 9 anos.	Seis tarefas: entrada na água; pegar objetos no fundo da piscina; deslocamento ventral e dorsal; movimento de pernas e mergulhos da borda.	Entre 3 e 18 opções de resposta. Correspondem aos padrões de desenvolvimento do nadar. Item de valor mais alto é o de maior complexidade na execução da tarefa.	Apresenta evidências de validade com base: • no conteúdo e na fidedignidade (Erbaugh, 1978). • na fidedignidade (Erbaugh, 1986) • na fidedignidade (Wizer, Franken, & Castro, 2016) • no conteúdo, e na relação com variáveis externas e na fidedignidade (Escala de Erbaugh modificada, Bradley et al., 1996) • na fidedignidade (Parker et al., 1999) Instrumento NÃO é descrito nos estudos
Lista de verificação para a Adaptação ao Meio Aquático Canossa, Fernandes, Carmo, Andrade e Soares (2007) Obs.: estudo sem amostra	São elas: equilíbrio vertical com e sem apoio; controle respiratório; submersão; flutuação, deslize e deslocamentos (ventral e dorsal); rotações; pernada; rolamentos; troca de posições; saltos da borda em pé e de cabeça.	Entre 2 e 9 opções de resposta. Item de valor mais alto é o de maior complexidade na execução da tarefa.	Evidências de validade não foram encontradas. Instrumento descrito no estudo.
Aquatic Readiness Assessment Costa et al. (2012) – n= 94, 4 anos; **Kjendlie e Mendritzki (2012)** – n= 24, entre seis e oito anos; **Langendorfer e Bruya (1995)** Estudo sem amostra; **Parker, Blanksby e Quek (1999)** – n= 19, 6 e 7 anos; **Rocha, Marinho, Garrido, Morgado e Costa (2018)** – n= 17, 4,7anos.	São elas: adaptação e orientação aquática; entrada na água; controle respiratório; flutuação; posição corporal; ação de braços e de de pernas; movimentos combinados.	Entre 3 e 5 opções de resposta. Correspondem a padrões de desenvolvimento do nadar. Item de valor mais alto é o de maior complexidade na execução da tarefa.	Evidências de validade foram citadas no instrumento, porém valores não foram apresentados. Instrumento NÃO é descrito no estudo.
Hoja de Observación para la Evolución de la Psicomotricidad Acuática Geamonond (2017) n= dez crianças de três anos	Cinco dimensões: familiarização com o meio aquático; equilíbrio; deslocamento; manipulações e relações sociais	Cinco opções de resposta: nunca (1); quase nunca (2); às vezes (3); quase sempre (4); sempre (5).	Apresenta evidências de validade com base: • no conteúdo, na estrutura interna e na fidedignidade (Gómez-Mármol, Rodriguez, & Martinez, 2015). Instrumento descrito no estudo acima citado.

Continua…

Tabela 2. Continuação.

Instrumentos de avaliação para crianças sem deficiência			
Nome do instrumento / estudos que utilizaram / amostra dos estudos	Tarefas propostas na avaliação	Critérios de avaliação	Informações e comentários adicionais
YMCA Progressive Swimming instructor's guide (1986) **Gup (1994)** n= 38 crianças iniciantes em programas de natação (1° até 4° ano)	São elas: deslocar-se pela parede; submersão; ação de pernas; flutuação ventral e dorsal; saltos da borda; mergulho de cabeça (posição sentada); remada (ação de braços).	Duas opções de resposta: habilidade é executada (pass= 1), habilidade não é executada (fail= 0).	Evidências de validade não foram encontradas. Instrumento descrito no estudo.
Junge, Blixt e Stallman (2010) n= 70 crianças de nove e dez anos	São elas: pular ou mergulhar em águas profundas (3 m) e nivelar o corpo; nadar 12,5 m em decúbito ventral; girar 180 graus; rolar; descansar por 30 s com um mínimo de movimento; nadar de volta ao ponto de partida em decúbito dorsal.	Três opções de reposta: não é capaz de realizar a tarefa (0); executa a tarefa com visível desconforto (1); executa a tarefa com tranquilidade (2).	Apresenta evidências de validade com base: • na relação com variáveis externas (Junge et al., 2010) Instrumento NÃO é descrito no estudo (faltam critérios de pontuação).
Jurak, Kapus, Strel e Kovac (2001) n= 370 crianças de oito e nove anos	Cinco níveis. As tarefas são: flutuação; deslocamento; saltos da borda; troca de direção, troca de posição.	Critérios correspondem ao cumprimento de tarefas exigidas para troca entre níveis 1, 2, 3, 4 e 5.	Evidências de validade não foram encontradas. Instrumento descrito no estudo.
Kjendlie et al. (2013) n= 66 crianças de 11 anos	São elas: flutuação; rotação e mergulho da borda.	Cinco opções de resposta. Item de valor mais alto é o de maior complexidade na execução da tarefa.	Apresenta evidências de validade com base: • na fidedignidade (Kjendlie et al., 2013). Instrumento descrito no estudo.
Red Cross (2014)* **Lawson e Fazey (1996)** – n= 84 meninas, seis a 11 anos; **Summers e Wallace (2013)** – n= 15 crianças com autismo, quatro a 15 anos; **Weiss, McCullagh, Smith e Berlant (1998)** – n= 24, 6,2 anos.	Seis níveis. As tarefas são: entrada; adaptação ao meio aquático; controle respiratório; submersão; caminhada na água; flutuação ventral, dorsal e vertical; deslize ventral e dorsal; deslocamentos (nado lateral, crawl, costas, peito, golfinho); rotações; troca de posição; mudança de direção; saltos da borda; viradas; saída da piscina; habilidades de segurança.	Critérios correspondem ao cumprimento de tarefas exigidas para troca entre níveis de 1 a 6.	Evidências de validade não foram encontradas. Instrumento descrito no seguinte link: cdn1.thprd.org/pdfs2/document2721.pdf
Michielon, Scurati, Roione e Invernizzi (2006) n= 30 crianças de quatro a 36 meses	Seis características: submersão; inclinação do corpo na água 20°–45°; ação simultânea de braços; ação alternada de braços; ação simultânea de pernas; ação alternada de pernas.	Duas opções de resposta: está ausente (0); está presente (1).	Evidências de validade não foram encontradas. Instrumento descrito no estudo.
Mirvic e Rasidagic (2017) n= 245 meninos de oito a dez anos	São elas: entrada na água; submersão; permanecer agachado na água; controle respiratório; flutuação e deslize (ventral e dorsal); saltar em pé na água.	Duas opções de resposta: é capaz de executar; não é capaz de executar.	Evidências de validade não foram encontradas. Instrumento descrito no estudo.
Moreno-Murcia et al. (2016) – n= 16 crianças, três a cinco anos; **Moreno-Murcia, Hernandez e Parra (2017)** – n= 78 crianças, quatro e cinco anos	São elas: salto de cabeça; submersão; deslocamento dorsal; introdução de argola em local estabelecido; equilíbrio no colchonete; salto do colchonete para a água; deslocamento ventral; colocação de material em local estabelecido.	Quatro opções de resposta: executa incorretamente (A) até executa corretamente (D).	Apresenta evidências de validade com base: • na fidedignidade (Moreno-Murcia et al., 2016; Moreno-Murcia et al., 2017) Instrumento descrito no estudo (Moreno-Murcia et al., 2016).
Olaisen, Flocke e Love (2018) n= 149 crianças de três a 14 anos.	Cinco níveis. As tarefas são: entrada na piscina; controle respiratório; equilíbrio; flutuação e deslize (ventral e dorsal); deslocamentos (crawl, costas, peito e golfinho); deslocamento submerso; rotações; viradas; respiração bilateral; saltos em pé e de cabeça; habilidades de resgate; palmateios; saída da piscina pela escada e pela borda.	Duas opções de resposta: executa satisfatoriamente (1), não executa ou executa insatisfatoriamente (0).	Evidências de validade com base no conteúdo foram citadas, porém valores não foram apresentados. Instrumento descrito no estudo (material suplementar)

Continua…

Tabela 2. Continuação.

Instrumentos de avaliação para crianças sem deficiência			
Nome do instrumento / estudos que utilizaram / amostra dos estudos	Tarefas propostas na avaliação	Critérios de avaliação	Informações e comentários adicionais
Inventory of Evolutionary Aquatic Development **Salar-Andreu, Moreno-Murcia e Ruiz-Pérez (2018)** n= 211 bebês, de seis a 12 meses.	Quatro áreas: sócio-emocional (entrada na água, responder ao nome quando chamado, brincar de "peek-a-boo"), linguagem (associa palavras a objetos ou ações, balbucia, realiza sons), cognitivo (exploração do ambiente e dos objetos, encontra o brinquedo), motricidade aquática (entrada na água, deslocamento, controle respiratório, equilíbrio dorsal e vertical).	Quatro opções de resposta: não executa a atividade (1); maior independência na realização da atividade (4).	Apresenta evidências de validade com base: • no conteúdo, na estrutura interna (Salar-Andreu et al., 2018). Instrumento descrito no estudo.
MOBAK-3 **Scheur, Bund, Becker e Herrmann (2017** n= 399 crianças de sete a dez anos.	São elas: flutuação; deslize e mergulho (tarefas pertencem a um instrumento chamado MOBAK-3).	Três opções de resposta: executa a tarefa com maior grau de complexidade (nível 2); executa a tarefa com nível intermediário de complexidade (nível 1); a criança não executa a tarefa(falhou).	Apresenta evidências de validade com base: • no conteúdo, na relação com variáveis externas, na estrutura interna e na fidedignidade (Scheur, Bund, & Becker, 2014). Instrumento descrito no estudo.
Torlaković (2009) n= 88 crianças, 9,3 anos.	Seis tarefas: mergulho de cabeça; pegar objetos no fundo da piscina; salto em pé em água rasa e funda; flutuação ventral e dorsal.	Duas opções de reposta: a criança é capaz de executar a tarefa; a criança não é capaz de executar tarefa.	Evidências de validade não foram encontradas. Instrumento descrito no estudo.
Moreno-Murcia (2005) n= 645 crianças de três a 11 anos	Quatro níveis. As tarefas são: submersão; controle respiratório; deslocamento pela borda; flutuação, deslize e deslocamento (ventral e dorsal); saltos da borda; rotações.	Quatro opções de resposta: nunca (1); algumas vezes (2); quase sempre (3); sempre (4).	Apresenta evidências de validade com base: • na estrutura interna e na fidedignidade (Moreno-Murcia, 2005). Instrumento descrito no estudo.
Ortizn (2010) n= 715 crianças de trê a sete anos	Sete níveis. As tarefas são: submersão; controle respiratório; caminhada na piscina; deslocamentos ventral e dorsal (crawl, costas, peito e golfinho); respiração lateral; rotações; salto de cabeça; viradas.	Critérios correspondem ao cumprimento de tarefas exigidas para troca entre níveis 1, 2, 3, 4, 5, 6 e 7.	Evidências de validade não foram encontradas. Instrumento descrito no estudo.

Foram agrupados os estudos que mencionaram a utilização de instrumentos da American Red Cross, embora as versões utilizadas sejam relativas a períodos diferentes. Neste caso, optou-se por utilizar versão mais recente e disponível do documento (American Red Cross, 2014) para representar os instrumentos citados nos estudos.

aquático, saltos ornamentais e, ainda, ser proficiente em habilidades que se referem à segurança aquática (Canossa et al., 2007; Stallman, Junge, & Blixt, 2008; Langendorfer, 2011; Quan et al. 2015; Castro, Correia, & Wizer, 2016; Fiori et al., 2019). Embora inseridos nas discussões teóricas da pedagogia da natação, na prática a inclusão desses conteúdos ainda é incipiente (Fiori et al., 2019). Com isso, foi objetivo desse estudo também verificar, por meio dos instrumentos avaliativos, se os programas de ensino da natação incorporaram, de fato, o conceito de competência aquática.

A partir dos resultados encontrados, é possível afirmar que, embora a utilização de instrumentos de avaliação no contexto do ensino da natação infantil seja escassa, número relativamente alto de instrumentos de avaliação foi encontrado no processo de busca. Os instrumentos encontrados, bem como os estudos, serão discutidos a seguir.

Sobre a relação entre instrumentos de avaliação do comportamento aquático e a competência aquática

Embora houvesse a intenção de relacionar os instrumentos com o conceito de competência aquática, poucos abordaram, de fato, o conceito. Langendorfer e Bruya (1995) propuseram um instrumento de avaliação cujo objetivo foi

Tabela 3. Identificação e descrição dos instrumentos de avaliação do comportamento aquático de crianças com deficiência.

Instrumentos de avaliação de crianças com deficiência			
Nome do instrumento / estudos que utilizaram / amostra dos estudos	Tarefas propostas na avaliação	Critérios de avaliação	Informações adicionais
Aquatic Skills Checklist **Alaniz, Rosenberg, Beard e Rosario (2017)** n= sete crianças de trê à sete anos com autismo de nível moderado à severo.	São elas: deslocamento pela parede, submersão; controle respiratório; flutuação dorsal; deslocamento dorsal e ventral; rotações; saída da água.	Quatro opções de reposta: incapaz de completar a tarefa (0); completa a tarefa com auxílio de um profissional (1); completa a tarefa com material flutuador (2); completa a tarefa de forma independente (3).	Apresenta evidências de validade com base: • na fidedignidade (Alaniz et al., 2017). Instrumento descrito no estudo.
Matriz de verificación de las habilidades acuáticas proposta por Winnick (2010) **Bataglion, Zuchetto, Nasser e Schmitt (2018)** n= um menino de sete anos de idade com deficiência visual total e deficiência intelectual severa	São elas: entrada na água; orientação aquática (submersão, controle respiratório); flutuação, deslize e deslocamento (ventral e dorsal); deslocamento lateral; saída da água.	Quatro opções de reposta: não consegue realizar (O); realiza com instruções físicas (F); realiza com instruções verbais (V); realiza de forma independente (X).	Evidências de validade não foram encontradas. Instrumento NÃO é descrito no estudo (faltam itens).
Humphries Asseessment of Aquatic Readiness (HAAR) **Pan (2010)** – n= 16 meninos com autismo, entre seis e nove anos; **Pan (2011)** – n= 15 com autismo e 15 deficiência, entre sete e 12 anos; **Chu e Pan (2012)** – n= 21 com autismo e 21 sem deficiência, entre sete e 12 anos; **Caputo et al. (2018)** – n= 26 crianças com autismo, 8,3 anos.	São elas: adaptação; introdução ao ambiente aquático; rotações e troca de posições; equilíbrio e controle de movimento; movimentos independentes na água (flutuação, deslize e deslocamentos).	Duas opções de resposta: é capaz de executa r(1); não é capaz de executar (0).	Apresenta evidências de validade com base: • no conteúdo e na fidedignidade (Humphries, 2008) e na fidedignidade (Caputo et al., 2018; Chu & Pan, 2012; Pan, 2010, 2011). Instrumento descrito no estudo (Pan, 2010)
Aquatic Orientation Checklist **Killian, Joyce-Petrovich, Menna e Arena (1984)** n= 37 indivíduos de seis a 20 anos com autismo	São elas: introdução ao ambiente aquático (caminhar na piscina, tocar a água, entrar na água e assumir posição sentada ou deitada na água); controle respiratório; submersão da face.	Cinco opções de resposta: não realiza a atividade (objeção); realiza com manipulação do instrutor (manipulação); realiza com instruções verbais e visuais do instrutor (demonstração); realiza com instruções verbais do instrutor (voluntário); executa antes das instruções do instrutor (espontâneo).	Apresenta evidências de validade com base: • na fidedignidade (Killian et al., 1984). Instrumento descrito no estudo.
Water Orientation Checklist – Basic e Advanced **Killian, Arena-Ronde e Bruno (1987)** – n= 71, 3,3 a 17,9 anos com atrasos no desenvolvimento; **Clawson (1999)** – n= 42, 3 a 5 anos com atraso no desenvolvimento.	São elas: entrada na água; controle respiratório; submersão do rosto; flutuação ventral e dorsal; deslocamento e rotações.	Water Orientation Checklist – Basic: cinco opções de respostas: não realiza a atividade; realiza com manipulação, dicas verbais e visuais do instrutor; realiza com instruções verbais e visuais do instrutor; realiza com instruções verbais do instrutor; realiza antes das instruções do instrutor. Water Orientation Checklist – Advanced: quatro opções de resposta: realiza a tarefa satisfatoriamente; realiza a tarefa insatisfatoriamente. E para a objeção, as opções são: apresenta objeção verbalmente; apresenta objeção com comportamentos ativos.	Apresenta evidências de validade com base: • na fidedignidade (Clawson, 1999; Killian et al., 1987). Instrumento descrito no estudo.

Continua...

Tabela 3. Continuação.

Instrumentos de avaliação de crianças com deficiência			
Nome do instrumento / estudos que utilizaram / amostra dos estudos	Tarefas propostas na avaliação	Critérios de avaliação	Informações adicionais
Water Orientation Test Alyn 1 e 2 Tirosh, Katz-Leurer e Getz (2008) – n= 65 crianças com deficiência, entre três e 15 anos; **Dimitrijevic et al. (2012)** – n= 27 com paralisia cerebral, cinco a 14 anos; **Declerck, Feys e Daly (2013)** – n= sete crianças com paralisia cerebral, 10,2 anos; **Dimitrijevic, Mikov, Cvetkovic, e Jorgic (2013)** – n= 7, 8,8 anos; Getz, **Salomonovitch e Hutzler (2015)** – n= 16 crianças com paralisia cerebral, três a seis anos; **Vascakova, Kludacek e Barrett (2015)** – n= dez0 crianças com paralisia cerebral e autismo, 5,5 anos; **Daniyarova (2017)** – n= uma menina com paralisia cerebral, oito anos.	Water Orientation Test Alyn 1: São elas: adaptação; entrada na água; controle respiratório; submersão; flutuação dorsal e lateral, nível de dependência na água; deslocamento (caminhando na água); assumir posição sentada na água; saída da piscina. Water Orientation Test Alyn 2: São elas: adaptação; controle respiratório; submersão; caminhadas e saltos na piscina; flutuação ventral e dorsal; propulsão (crawl, costas e peito) rotações, troca de posições, saída da piscina.	Quatro opções de resposta com base na qualidade da execução e nível de dependência do indivíduo. Valores mais baixos correspondem a um maior nível de dependência e menor qualidade na execução: Water Orientation Test Alyn 1 (1–4 pontos); Water Orientation Test Alyn 2 (0–3 pontos)	Apresenta evidências de validade com base: no conteúdo, com base na relação com variáveis externas e sensibilidade à mudança (Tirosh et al., 2008). Instrumento NÃO é descrito no estudo.
Developmental Aquatic Assessment Doremus (1992) Estudo sem amostra	São elas: entrada na água; adaptação ao meio aquático; movimentação passiva na água; equilíbrio e flutuação ventral e dorsal; controle respiratório; movimentação ativa e deslocamento na água; saída da piscina.	Três opções de resposta: atingiu (+); não atingiu (-); comportamento emergente (+/-).	Evidências de validade não foram encontradas. Instrumento descrito no estudo.
Gelinas e Reid (2000) (Canadian Red Cross Society) n= 40 crianças com deficiência entre cinco e 12 anos	São elas: controle respiratório; flutuação, deslize e deslocamento (ventral e dorsal).	Duas opções de resposta: executa("pass"), não executa("fail").	Apresenta evidências de validade com base: • na fidedignidade (Gelinas & Reid, 2000). Instrumento é descrito no estudo.
Larkin and Hoare method (1991) Donaldson, Blanksby e Heard (2010) n= 22 crianças com sete anos, 11 crianças com Desordem Coordenativa do Desenvolvimento e 11 sem.	São elas: flutuação ventral, deslize, movimento de pernas e nado crawl.	Três opções de resposta: não atingiu (0); atingiu ineficientemente (1); atingiu eficientemente (2).	Evidências de validade não foram encontradas. Instrumento descrito no estudo.
Aquatic Independence Measure Getz, Hutzler e Vermeer (2006) n= 49 crianças com deficiências neuro-motoras de três a sete anos	Três subescalas. As tarefas são: entrada na água; submersão; controle respiratório; deslocar-se na piscina caminhando; flutuação ventral e dorsal; deslocamento (crawl e costas); rotações; troca de posições; saída da água.	Quatro opções de resposta: não inicia a tarefa (0); completa a tarefa de forma independente sem auxílio de material flutuador (4).	Apresenta evidências de validade com base: • na estrutura interna do instrumento, na relação com variáveis externas, na fidedignidade (Getz et al., 2006). Instrumento NÃO é descrito no estudo.
Water Orientation and Swimming Skill Inventory Hutzler, Chacham, Bergman e Reches (1998) – n= 46 crianças com paralisia cerebral, entre cinco e sete anos; **Hutzler, Chacham, Bergman e Szeinberg (1998)** – n= 46 crianças com paralisia cerebral, entre cinco e sete anos.	São elas: entrada na água; deslocamento (caminhada) pela piscina; controle respiratório e submersão; deslize; flutuação dorsal e ventral; deslocamentos (crawl, costas, peito); rotações; troca de posição; saltos na água; saída da água.	Cinco opções de reposta: tarefa não aplicada (0); completa a tarefa parcialmente e com a ajuda do instrutor e de materiais auxiliares (1); completa a tarefa com ajuda do instrutor (2); completa a tarefa sem ajuda do instrutor mas com materiais auxiliares (3); completa parcialmente a tarefa mas completamente ndependente (4); completa totalmente a tarefa de forma independente (5).	Apresenta evidências de validade com base: • na estrutura interna, na fidedignidade (Hutzler, Chacham, Bergman, & Reches, 1998). • na fidedignidade (Hutzler, Chacham, Bergman, & Szeinberg, 1998) Instrumento descrito nos estudos.

Continua...

Tabela 3. Continuação.

Instrumentos de avaliação de crianças com deficiência			
Nome do instrumento / estudos que utilizaram / amostra dos estudos	Tarefas propostas na avaliação	Critérios de avaliação	Informações adicionais
Jull e Mirenda (2016) n= oito crianças com autismo, entre cinco e oito anos	São elas: submersão e controle respiratório; salto vertical até a superfície; pegar objetos no fundo; flutuação e deslize ventral, dorsal e lateral; ação de pernas ventral e dorsal; deslocamentos (crawl, costas, pernada golfinho); saltos da borda em pé e de joelhos.	Três opções de reposta: incorreta; emergindo, estabelecida.	Apresenta evidências de validade com base: na fidedignidade (Jull & Mirenda, 2016). Instrumento descrito no estudo.
Pimenta, Zuchetto, Bastos e Corredeira (2016) n= cinco alunos com autismo, entre nove e 25 anos.	São elas: entrada e saída da piscina; controle respiratório; deslocamento ventral e dorsal.	Quatro opções de resposta: não consegue realizar ou se recusa a realizar a atividade (0); professor conduz o movimento do aluno, instruções verbais e visuais do professor acompanham a execução (1); realiza a atividade após instruções verbais e visuais do professor dirigidas diretamente ao aluno (2); executa a atividade após instruções do professor ao grupo (3).	Evidências de validade não foram encontradas. Instrumento descrito no estudo.
Swimming with Independent Measure **Sršen, Pikl e Vrečar (2011)** – n= 54 crianças sem deficiência e 15 com deficiência; **Sršen et al. (2012)** – n= 54 crianças sem deficiência, 3,5 a 11 anos e 37 com deficiência, sete a 22 anos.	São elas: entrada na água; adaptação ao meio aquático; controle respiratório; equilíbrio; deslocamentos; rotações, troca de posições; saídas.	Sete opções de reposta: indivíduo é incapaz de executar a habilidade, não está seguro para o teste ou item não foi medido (1); indivíduo é capaz de executar a habilidade corretamente e sem auxílio (7).	Apresenta evidências de validade com base: na relação com variáveis externas; na fidedignidade (Sršen et al., 2011, 2012). Instrumento NÃO é descrito no estudo.
Swimmiing Sherrill Model **Yanardag, Erkan, Yilmaz, Arican e Düzkantar (2015)** n= três crianças de seis anos.	São elas: controle respiratório; submersão; buscar objeto no fundo da piscina.	Duas opções de resposta: desempenha a habilidade incorretamente (-), desempenha habilidade corretamente (+).	Evidências de validade não foram encontradas. Instrumento NÃO é descrito no estudo (apenas parte dele é descrito).

avaliar a prontidão aquática de crianças, relacionando-a com o conceito de competência aquática. Estudo de Canossa et al. (2007) criou uma lista de verificação para a adaptação ao meio aquático que aborda a importância de desenvolver habilidades motoras aquáticas básicas para o desenvolvimento da competência nesse meio. Importante ressaltar também que a lista de verificação proposta por Canossa et al. (2007) abrange habilidades que compreendem os diferentes esportes aquáticos (natação, polo aquático, natação artística e saltos ornamentais). Murcia (2005) criou escalas de avaliação da competência motora aquática para crianças com idades entre 4 e 11 anos. Junge et al. (2008) compararam os resultados de dois testes e discutiram-nos com base no conceito de competência aquática.

Outros estudos também se apropriaram do termo "competência aquática". É o caso dos estudos de Donaldson, Blanksby, e Heard (2010); Costa et al. (2012); Kjendlie, Pedersen, (2013); Murcia et al. (2016); Murcia, Hernandez e Parra (2017); Rocha, Marinho, Garrido, Morgado e Costa (2018); Salar-Andreu, Moreno-Murcia e Ruiz-Pérez (2018).

O instrumento proposto por Erbaugh (1981), embora não tenha abordado o termo "competência aquática" diretamente, tornou-se base para a construção do instrumento desenvolvido por Langendorfer e Bruya (1995), autores que, reconhecidamente, iniciaram as discussões sobre o termo. A *Erbaugh Rating Scale* (Erbaugh, 1981) é uma escala voltada para a avaliação de crianças entre dois e seis anos. Sua importância reside não apenas nas tarefas que engloba, mas principalmente na descrição detalhada que cada um dos itens do instrumento propõe em relação à tarefa que representa, descrevendo características da posição corporal, do movimento de braços, do movimento de pernas. Segundo Erbaugh

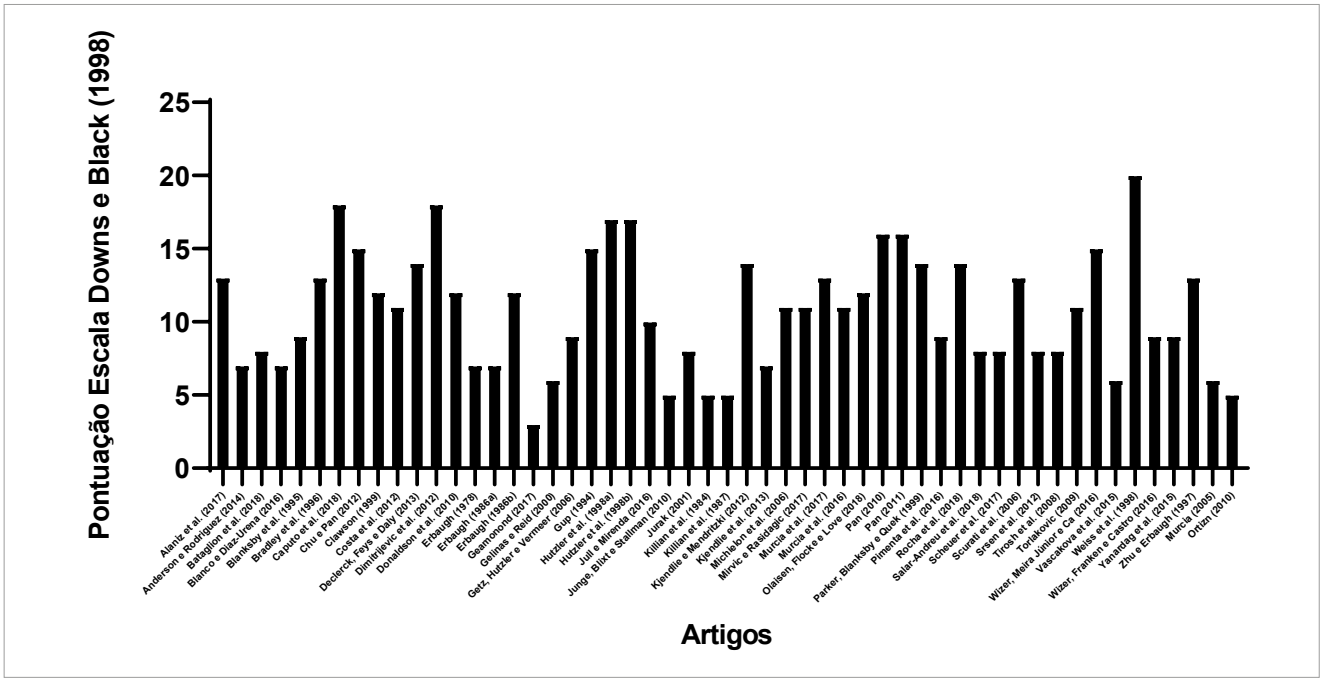

Figura 2. Análise dos artigos de acordo com checklist de Downs e Black (1998).

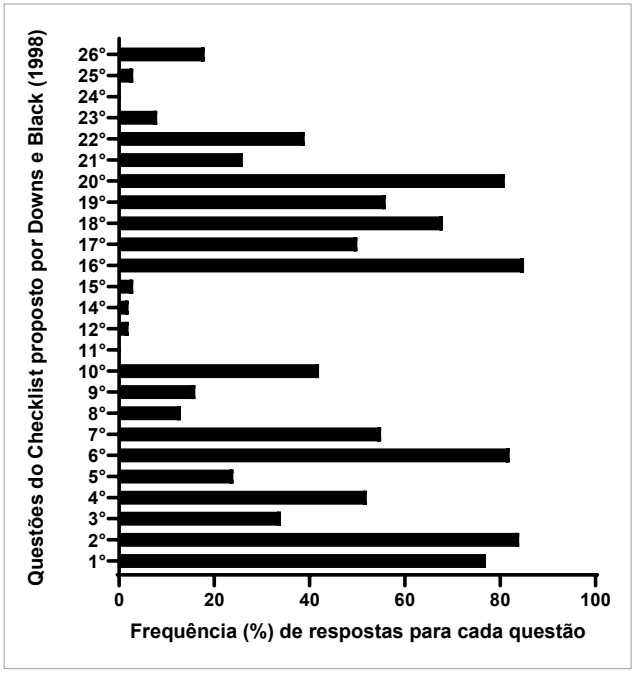

Figura 3. Frequência percentual de respostas para cada questão do checklist de Downs e Black (1998).

(1978), esses itens que compõem as tarefas do instrumento representam etapas do processo de desenvolvimento das habilidades aquáticas, ou seja, sequência ordenada e regular para a aquisição de habilidades aquáticas foi observada e descrita pela autora.

Além da análise qualitativa dos movimentos executados, a Escala de Erbaugh complementa as informações com estimativas da distância percorrida pela criança com seus movimentos (Erbaugh, 1981). Informações que, segundo Chan et al. (2020), promove uma avaliação mais detalhada da competência aquática. Além dos aspectos mencionados, a Escala é ainda facilmente aplicável, permitindo a sua utilização em ambientes com diferentes características. E, nesse contexto de discussão, é importante abordar também o estudo de Kjendlie et al. (2013). Os autores aplicaram um instrumento que aborda as tarefas de flutuação, rotações e mergulhos da borda com crianças de 11 anos em dois ambientes distintos: águas calmas e ambiente com simulação de águas abertas. Os resultados apontam para a perda de proficiência aquática no ambiente que simulou águas abertas. Quanto a isso, Langendorfer (2011) e Di Paola (2019) ressaltam o caráter dinâmico da competência aquática, ou seja, nem sempre uma habilidade realizada em um ambiente controlado (ambiente em que grande parte dos instrumentos são aplicados) pode ser reproduzida em ambiente com características abertas. De acordo com o conceito de competência aquática, é necessário verificar se a proficiência em uma habilidade aquática pode ser reproduzida sob condições diversas (Stallman et al., 2008).

Entre os instrumentos encontrados, observou-se também a predominância de tarefas pautadas nos estilos competitivos de nado. Ainda assim foi possível observar tentativa de aproximação com o conceito de competência aquática. Estudo de

Olaisen, Flocke e Love (2018) é um exemplo disso. Embora o instrumento seja pautado no ensino das habilidades que constituem a natação, engloba, por exemplo, o palmateio e a flutuação vertical, ambas tarefas desenvolvidas e necessárias nas modalidades polo aquático e natação artística.

Sobre a organização dos instrumentos

Instituições de ensino da natação como a *American Red Cross, Canadian Red Cross* e YMCA foram citadas com frequência e parecem exercer forte influência na orientação de programas aquáticos, bem como na construção de instrumentos de avaliação em diversos estudos identificados na revisão (Alaniz, Rosenberg, Beard, & Rosario, 2017; Erbaugh, 1978; Killian, Joyce-Petrovich, Menna, & Arena, 1984; Langendorfer e Bruya, 1995). Gup (1994) salienta que esses programas desenvolveram seus próprios métodos de ensino, bem como instrumentos de avaliação já nos anos 1970/1980 e, por isso, acabaram influenciando outros programas aquáticos.

Importante também destacar que no âmbito dos instrumentos direcionados à avaliação do comportamento aquático de crianças com deficiência, a metodologia Halliwick exerce importante papel no ensino das habilidades aquáticas para indivíduos com deficiência, norteando a construção de diversos instrumentos de avaliação do comportamento aquático. Como são os casos do *Aquatic Independence Measure* (Getz, Hutzler, & Vermeer, 2006), do *Humphries Assessment of Aquatic Readiness* (Caputo et al., 2018; Chu & Pan, 2012; Pan, 2010, 2011), do *Swimming with Independent Measure* (Sršen, Pikl, & Vrečar, 2011; Sršen et al., 2012) e do *Water Orientation Test of Alyn* 1 e 2 (Daniyarova, 2017; Declerck, Feys, & Daly, 2013; Dimitrijevic et al., 2012; Dimitrijevic, Mikov, Cvetkovic, & Jorgic, 2013; Getz, Salomonovitch, & Hutzler, 2015; Tirosh, Katz-Leurer, & Getz, 2008; Vascakova, Kludacek, & Barrett, 2015). De acordo com Tirosh et al. (2008), a principal função da metodologia Halliwick é desenvolver a autonomia aquática entre seus alunos. A metodologia é baseada em dez pontos que orientam o aprendiz para um domínio funcional do meio aquático e é indicada para indivíduos que apresentam dificuldade de aprendizagem em aulas convencionais de natação (Tirosh et al., 2008; Vascakova et al., 2015).

Entre alguns dos instrumentos que têm por função a avaliação de crianças com deficiência, foi possível identificar também o estabelecimento de relações entre eles, de modo que um instrumento serviu como base para a construção de outros. É o caso, por exemplo, do *Aquatic Orientation Checklist*, proposto por Killian et al. (1984), que orientou a construção de outros três instrumentos. Essa situação ocorreu após período de aplicação e apreciação do instrumento, quando foi possível identificar a qualidade dos critérios de avaliação empregados, bem como os aspectos negativos referentes a sua utilização, nesse caso questões foram adaptadas, inseridas e/ou retiradas. Os instrumentos e os respectivos estudos envolvidos nessa situação estão exemplificados na Figura 4.

Sobre a idade dos participantes dos estudos

As idades variaram de quatro meses (Michielon, Scurati, Roione, & Invernizzi, 2006) a 14 anos (Olaisen, Flocke, & Love, 2018) entre os estudos que avaliaram crianças sem deficiência e de 3 (Clawson, 1999; Getz et al., 2006; Getz, Salomonovitch, & Hutzler, 2015; Killian, Arena-Ronde, & Bruno, 1987; Sršen et al., 2012; Tirosh et al., 2008) a 25 anos (Pimenta, Zuchetto, Bastos, & Corredeira, 2016) entre os estudos que avaliaram indivíduos com deficiência. É importante ressaltar que, embora um dos critérios de inclusão dos estudos na revisão se referia a estudos que envolvessem avaliação de crianças, todos os estudos que utilizaram em sua amostra indivíduos adolescentes e/ou adultos, aplicaram o

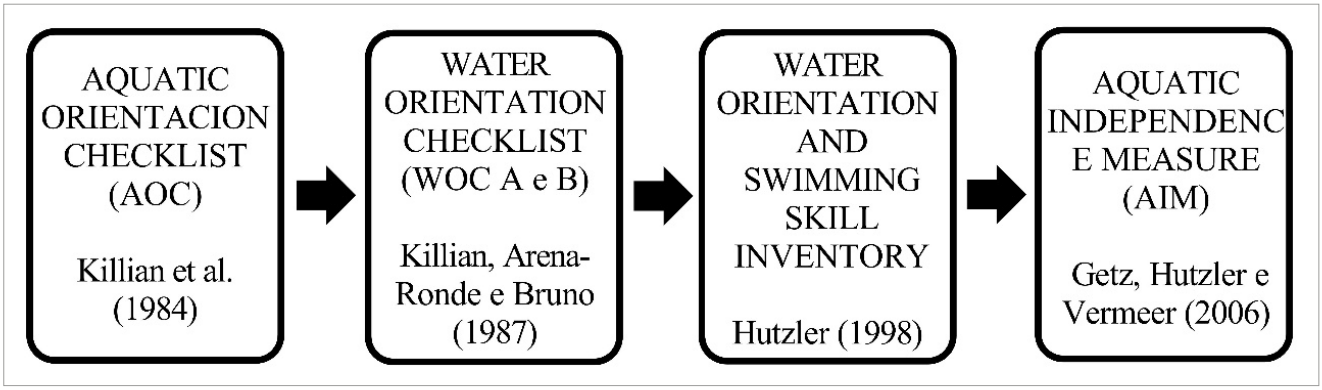

Figura 4. Representação esquemática dos instrumentos.

mesmo instrumento em grupo de crianças também, justificando assim a sua inclusão.

Entre os instrumentos de avaliação para crianças sem deficiência, dois deles eram direcionados para a avaliação do comportamento aquático de bebês. São eles: Michielon et al. (2006) e *Inventory of Evolutionary Aquatic Development* (IEAD), desenvolvido por Salar-Andreu et al. (2018). Entre os instrumentos de avaliação para crianças com deficiência, não foram identificados instrumentos específicos para a faixa etária dos bebês. Outro aspecto importante é que enquanto a aplicação de instrumentos para crianças sem deficiência é específica para determinadas faixas etárias, os instrumentos de avaliação de crianças com deficiência se mostram mais flexíveis quanto a esses recortes de idade, ou seja, instrumentos que avaliam crianças, avaliam também adultos. Esse aspecto pode estar associado às características específicas da amostra compreendida nesses estudos.

Sobre as tarefas propostas na avaliação

Um primeiro aspecto a ser discutido refere-se aos termos e definições utilizados pelos estudos que abordam instrumentos de avaliação no meio aquático. Nesse sentido, os termos tarefa, item e habilidade são utilizados como sinônimos para denominar a ação que é solicitada ao aprendiz durante a avaliação. Essa situação pode ser exemplificada pelos instrumentos *Water Orientation Checklist* (WOC), de Killian et al. (1987), *Water Orientation and Swimming Skill Inventory*, de Hutzler, Chacham, Bergman e Reches (1998); Hutzler, Chacham, Bergman e Szeinberg (1998) e *Hoover Curriculum Checklist*, proposto por Olaisen et al. (2018). Os três instrumentos avaliaram a ação de "soltar bolhas", entretanto termos diferentes foram utilizados para denominar a ação. Enquanto o instrumento WOC nomeou a ação de "soltar bolhas" como tarefa, os outros dois instrumentos, *Water Orientation and Swimming Skill Inventory* e *Hoover Curriculum Checklist*, nomearam a ação de "soltar bolhas" como uma habilidade.

Estudos têm mostrado que a área do comportamento motor apresenta termos com definições imprecisas, além disso estão sendo utilizados de forma inconsistente entre os pesquisadores (Newell, 2020; Scheuer, Herrmann, & Bund, 2019). Scheuer et al. (2019) salientam que a escolha dos itens de um teste, assim como dos construtos empregados são, em muitos casos, escolhas baseadas na experiência e no senso comum. Tal problema é grave, visto que impossibilita ou, no mínimo, dificulta a comparação entre resultados obtidos a partir de diferentes instrumentos, já que, em muitos casos, tarefas diversas são propostas ao aprendiz com o propósito de mensurar a mesma habilidade. Quanto a isso, Scheuer et al. (2019) reforçam também a importância de justificar as escolhas relacionadas aos instrumentos de avaliação com base em evidências científicas.

A partir do estudo de Scheuer et al. (2019), foi possível depreender que o termo "tarefa" se refere à ação solicitada ao aprendiz, para que, a partir da execução, seja possível inferir sobre sua habilidade. Existem situações em que é necessário propor mais que uma tarefa para que seja possível avaliar determinada habilidade. Um exemplo disso é a habilidade de flutuar, em que diferentes tarefas podem ser propostas ao aprendiz para que seja possível inferir sobre essa habilidade. Entretanto, é importante que esses construtos sejam esclarecidos previamente à aplicação dos instrumentos e, principalmente, que a área da pedagogia da natação apresente uniformidade no uso teórico e prático dos termos, de forma a não gerar imprecisões conceituais (Scheuer et al., 2019; Newell, 2020).

Ainda sobre as tarefas que compõem os instrumentos, e especificamente sobre os instrumentos direcionados para crianças com deficiência, considera-se que são constituídos predominantemente de tarefas relacionadas à adaptação e à funcionalidade no meio aquático, de modo que as habilidades adquiridas garantam um relacionamento seguro com esse meio, independentemente do aprendizado dos estilos competitivos de nado (Tirosh et al., 2008). Segundo Tirosh et al. (2008), a autonomia no meio aquático é o objetivo da metodologia Halliwick, que embasa a construção de um grande número de instrumentos voltados à avaliação do comportamento aquático de pessoas com deficiência. Tarefas de submersão, controle respiratório, flutuação, bem como, tarefas de entrada e saída, rotações e troca de decúbitos constituem esses instrumentos, embora alguns deles abordem também os nados competitivos.

Entre as tarefas propostas pelos instrumentos desenvolvidos para avaliar crianças com e sem deficiência, é possível afirmar que algumas se repetem com frequência e constituem quase todos os instrumentos encontrados. É o caso da submersão, controle respiratório, flutuação ventral e dorsal, deslize ventral e dorsal, deslocamento ventral e dorsal (crawl, costas) e saltos (em pé) (Blanco & Diaz-Urena, 2016; Gelina & Reid, 2000; Mirvic & Rasidagic, 2017). Se repetem, mas com frequência inferior, as tarefas que envolvem deslocamento ventral (peito e golfinho), rotação (troca de decúbitos), viradas, troca de posição (passar da posição deitada para a posição em pé), deslocar-se caminhando na piscina, saltos (de cabeça), saída da piscina (Alaniz et al., 2017; Erbaugh, 1978; Moreno-Murcia, 2005). Além dessas, algumas tarefas foram citadas em apenas um, dois ou três instrumentos, é o

caso das tarefas relacionadas à segurança aquática, equilíbrio vertical, mudança de direção do deslocamento, palmateios, deslocamento lateral (Bataglion, Zuchetto, Nasser, & Schmitt, 2018; Canossa et al., 2007; Lawson & Fazey, 1996; Olaisen et al., 2018; Summers & Wallace, 2013; Weiss, McCullagh, Smith, & Berlant, 1998).

Instrumento com características diferentes é o *Aquatic Readiness Assessment* (ARA), proposto por Langendorfer e Bruya (1995). Esse instrumento apresenta tarefas como entrada na água e flutuação assim como os demais instrumentos, no entanto propõe que a tarefa de deslocamento seja avaliada de forma desmembrada, nesse caso os componentes da ação são submetidos aos critérios de avaliação de forma isolada. Além do ARA, os instrumentos propostos por Michielon et al. (2006) e por Blanco e Diaz-Urena (2016) também dividem o ato de nadar em componentes da ação. Esse modelo de avaliação foi proposto por Roberton (1977), a partir de observações realizadas pela autora em que foi evidenciado o desenvolvimento independente dos componentes da ação.

Embora existam instrumentos com características específicas, de maneira geral, os instrumentos se mostraram similares quanto às tarefas propostas e, se forem representações fidedignas dos conteúdos desenvolvidos nas aulas de natação, é possível sugerir então que o ensino pautado nos estilos competitivos de nado e, com foco na natação competitiva, é ainda uma realidade nos programas de ensino da natação para crianças (Fiori et al., 2019). Entretanto algumas mudanças são perceptíveis, visto que alguns instrumentos demonstraram preocupação em introduzir tarefas que representam um conceito mais amplo do nadar, como é o caso dos instrumentos que abordaram o palmateio, a flutuação vertical e/ou tarefas relacionadas à segurança aquática (Anderson & Rodriguez, 2014; Lawson & Fazey, 1996; Olaisen et al., 2018; Salar-Andreu et al., 2018; Summers & Wallace, 2013; Weiss et al., 1998).

Destaca-se, nesse contexto, o estudo de Junge et al. (2010). Os autores compararam os resultados obtidos em um teste de desempenho de 25 m em piscina, com crianças de nove e dez anos, com os resultados obtidos pelas mesmas crianças em um teste constituído de um conjunto de habilidades aquáticas. Os resultados apontaram que, embora todas as crianças tenham conseguido nadar os 25 m, elas não foram capazes de executar todas as habilidades aquáticas propostas no teste. Tarefas como troca de direção e saltos da borda constituíram o instrumento de avaliação e o resultado obtido corrobora com a ideia defendida nesse estudo sobre a prevalência, ainda, da abordagem reducionista no ensino da natação e o quanto essa abordagem nos direciona para uma competência aquática limitada do ponto de vista da segurança aquática. Outro aspecto a ser considerado é que apenas um instrumento (Kjendlie et al., 2013) aplicou tarefas relativas ao nadar em situações de ambiente diversas: águas calmas e águas turbulentas. Houve perda de 16% a 24% na pontuação obtida pelas crianças durante a avaliação em águas turbulentas quando comparada com os valores obtidos em águas calmas.

De acordo com Chan et al. (2020), instrumentos de avaliação do comportamento aquático costumam informar apenas sobre a distância percorrida ou sobre a capacidade ou incapacidade da criança em executar determinada tarefa aquática em um contexto limitado do ponto de vista da competência aquática. Tais informações são imprecisas e não fornecem informações suficientes para subsidiar o planejamento de ensino. De acordo com Hind e Palmer (2007), é atribuição do professor escolher o instrumento avaliativo com características mais apropriadas ao contexto de ensino e, principalmente, consistentes com os objetivos do programa.

A partir disso, é possível afirmar, no que se refere à avaliação da competência aquática que, não apenas a escolha das tarefas do instrumento é importante, mas a escolha do ambiente, e também, das situações em que essas tarefas serão aplicadas, contribuem potencialmente para a determinação do nível de competência aquática da criança. Assim, avaliar a aprendizagem da criança em situações variadas, como nadar com roupas pesadas (camisetas, casacos), nadar sob fadiga, deslocar-se em águas turbulentas, proporcionam situações complexas, em que as habilidades adquiridas pela criança durante as aulas são, de fato, colocadas à prova (Stallman et al., 2008).

Sobre os critérios de avaliação

É possível sugerir que os critérios de avaliação são responsáveis por diferenciar sobremaneira os instrumentos voltados à avaliação de crianças com deficiência dos instrumentos voltados à avaliação de crianças sem deficiência. Isso ocorre porque, enquanto os critérios utilizados para avaliar crianças sem deficiência relacionam-se à qualidade da execução do movimento, os critérios utilizados para avaliar crianças com deficiência se direcionam, preponderantemente, para o nível de autonomia demonstrado durante a execução da tarefa.

Dentre os 15 instrumentos para crianças com deficiência, sete deles utilizaram como critério o nível de autonomia para a execução das tarefas. São eles: *Aquatic Skills Checklist*, *Matriz de Verificación de las Habilidades Acuáticas* proposta por Winnick, *Aquatic Orientation Checklist*, *Aquatic Independence Measure*, *Water Orientation and Swimming Skill Inventory*, instrumento utilizado por Pimenta et al. (2016), e *Swimming with Independent Measure*. Três instrumentos utilizaram a qualidade da execução como critério de avaliação. São eles:

Developmental Aquatic Assessment, *Larkin and Hoare method* e instrumento utilizado no estudo de Jull e Mirenda (2016). Três instrumentos apresentaram apenas duas opções de resposta, ou seja, executa ou não executa a tarefa solicitada, é o caso do *Humphries Asseessment of Aquatic Readiness*, instrumento utilizado no estudo de Gelinas e Reid (2000) e *Swimming Sherrill Model*. Dois apresentaram critérios com base tanto no nível de autonomia, quanto na qualidade da execução do movimento, é o caso do WOC A e B e do WOTA 1 e 2.

Embora a utilização do critério nível de autonomia não considere diretamente a qualidade da execução da tarefa na avaliação, pode ser interessante quando se trata do conceito de competência aquática. O nível de autonomia da criança representa, de forma indireta, muitos aspectos relacionados à competência aquática, como a segurança percebida pela criança no ambiente aquático, a qualidade da execução do movimento e o quanto ela é capaz de executar a tarefa de forma autônoma. Já, dentre os 21 instrumentos para crianças sem deficiência, seis deles apresentaram apenas duas opções de resposta. É o caso dos instrumentos utilizados nos estudos de Blanco e Diaz-Urena (2016), Gup (1994), Michielon et al. (2006), Mirvic e Rasidagic (2017), Olaisen et al. (2018) e Torlaković (2009).

Outros dois instrumentos apresentaram uma escala do tipo Likert referente à frequência de aparecimento da habilidade, com quatro ou cinco possibilidades de resposta (Geamonond, 2017; Moreno-Murcia, 2005). Entretanto, este tipo de critério pode gerar dúvidas em algumas situações, um exemplo disso é o estudo de Geamonond (2017), que utilizou o instrumento "*Hoja de Observación para la Evolución de la Psicomotricidad Acuática*" de Gómez-Mármol, Rodríguez e Martínez (2015). O autor utilizou os critérios: nunca, quase nunca, às vezes, quase sempre, sempre. No entanto a resposta "nunca" tem um caráter positivo quando se refere ao item: "tem medo de pular na água" e caráter negativo quando se refere ao item: introduz a cabeça na água. Nesse caso, a análise das respostas deve ser feita de forma cautelosa pelos profissionais que utilizarem esse instrumento.

Além desses, outros seis instrumentos utilizaram até nove opções de resposta para indicar a qualidade da execução da tarefa, ou ainda, o nível de complexidade da execução. São eles: Lista de verificação para a Adaptação ao Meio Aquático; instrumento utilizado em Junge, et al. (2010); instrumento utilizado em Kjendlie et al. (2013), instrumento utilizado nos estudos de Moreno-Murcia et al. (2016) e Moreno-Murcia, Hernandez e Parra (2017), IDEA e MOBAK-3.

Interessante citar também os critérios utilizados nos instrumentos de Erbaugh (1978) e Langendorfer e Bruya (1995), chamados, respectivamente de Erbaugh Rating Scale e ARA. Ambos utilizaram padrões de desenvolvimento do nadar como critérios a serem utilizados na avaliação. A diferença entre ambos é que, assim como propõe Roberton (1977), o ARA propõe critérios de avaliação que são aplicados nos componentes da ação de forma isolada, enquanto na *Erbaugh Rating Scale* os critérios são aplicados na ação total do aprendiz.

Outra forma de avaliar que se mostrou presente em cinco instrumentos de avaliação para crianças sem deficiência (também comumente utilizada em escolas de natação) é a avaliação realizada por níveis, ou seja, é necessário que a criança adquira proficiência nos critérios estipulados para determinado nível para que ela possa avançar para o nível imediatamente seguinte ao que ela se encontra. É o caso dos instrumentos utilizados nos estudos de Anderson e Rodriguez (2014), Blanksby, Parker, Bradley e Ong (1995), Jurak, Kapus, Strel e Kovač (2001) e Ortizn (2010) e também do instrumento proposto pela American Red Cross e que foi utilizado nos estudos de Lawson e Fazey (1996), Weiss et al. (1998) e Summers e Wallace (2013). Diversas escolas utilizam essa forma de avaliar e costumam utilizar toucas com cores diferentes e nomenclaturas específicas como forma de identificar os níveis.

A crítica que se faz quanto a essa forma de avaliar é que ela permite ter acesso ao nível de competência aquática da criança apenas no momento da passagem entre níveis, com a função de classificar o aluno e quantificar o processo avaliativo, caracterizando uma avaliação somativa (Di Paola, 2019). Além disso, esse tipo de avaliação possibilita o acesso somente ao que a criança é capaz de executar, ela não fornece, por exemplo, informações sobre a qualidade da execução do movimento. Quando se trata de competência aquática, informações sobre a qualidade de execução possuem relevância no contexto pedagógico (Chan et al., 2020). Avaliações formativas, nesse caso, deveriam ser incorporadas ao planejamento, com o propósito de possibilitar o acesso ao nível de competência aquática da criança ainda em tempo de fazer reformulações no planejamento (Di Paola, 2019). Chróinín e Cosgrave (2013) reforçam o papel da avaliação formativa no processo de aprendizagem. Esse tipo de avaliação possibilita analisar o progresso do aluno, determinar necessidades de aprendizagem, avaliar o planejamento de ensino. No entanto, Stallman et al. (2008) destacam que a avaliação formativa é pouco utilizada no contexto do ensino da natação.

Sobre as evidências de validade dos instrumentos

De modo geral, é possível afirmar que procedimentos de validação ainda não são comuns quando se trata de instrumentos

de avaliação no âmbito do ensino da natação. Quanto a isso, os instrumentos voltados à avaliação de crianças com deficiência, como é o caso do HAAR, AIM, SWIM, WOTA 1 e 2, apresentam evidências de validade mais contundentes quando em comparação com estudos de validação voltados à avaliação de crianças sem deficiência.

Sobre a avaliação do risco de viés

Por meio da Escala de Downs e Black (1998) observou-se que os estudos contemplados nessa revisão apresentam, de maneira geral, pontuação baixa, destacando uma característica importante dessa área de estudo, que é a carência de abordagens empíricas com maior rigidez metodológica. Entre os estudos encontrados, a pontuação média obtida foi de 41% da pontuação máxima possível.

Como é possível observar na Figura 4, poucos estudos pontuaram nas questões 11 e 12, que se referem à validade externa do instrumento. Tais questões abordam a representatividade dos resultados em relação à população de origem da amostra. O mesmo ocorreu com as questões 14, 15 e 24. Elas se referem ao cegamento da amostra e dos avaliadores em relação à intervenção e à distribuição dos participantes nos grupos. Tal prática é difícil de ocorrer em estudos na área da pedagogia da natação, visto que não é possível cegar a amostra quanto à intervenção recebida. E, embora seja possível impedir que os avaliadores tenham conhecimento sobre a intervenção, essa não é uma prática comum nessa área de estudo. Sabe-se, no entanto, que tal procedimento reduziria o risco de viés e proporcionaria maior confiabilidade aos resultados (Downs & Black, 1998).

De forma geral, os instrumentos de avaliação apresentados nessa revisão encaminham o leitor para uma reflexão sobre os processos pedagógicos que permeiam o ensino da natação. Embora o objetivo do estudo tenha sido identificar e descrever instrumentos de avaliação do comportamento aquático de crianças e relacionar os instrumentos com o conceito de competência aquática, a variedade de tarefas e critérios utilizados pelos instrumentos indica que mudanças foram vivenciadas pela área ao longo dos anos. Entende-se que a evolução do conceito de competência aquática é um exemplo dessas transformações e repercute sobremaneira nos instrumentos desenvolvidos, visto que instrumentos com diferentes enfoques foram encontrados. Em alguns casos, a aproximação do conceito de competência aquática que se tem hoje com os instrumentos encontrados foi dificultada por essas transformações, podendo até mesmo, ser considerada uma limitação no presente estudo. Importante destacar que a inclusão de estudos, independentemente do período de publicação, também pode ser apontada como uma limitação do estudo, visto que a opção por essa estratégia, embora tenha ampliado o processo de busca, impossibilitou que alguns estudos na íntegra fossem encontrados.

CONCLUSÕES

Existe um número considerável de instrumentos de avaliação disponíveis na literatura, entretanto pouco utilizados no âmbito prático do ensino do nadar. Estes são voltados tanto para a avaliação de crianças com deficiência, quanto à avaliação de crianças sem deficiência, entretanto grande parte deles não apresenta evidências de validade, o que reduz a qualidade das medidas obtidas por meio desses instrumentos.

Sob a perspectiva dinâmica do conceito de competência aquática, é importante considerar que para ser competente na água, uma criança deve ser capaz de executar tarefas referentes a habilidades aquáticas básicas e específicas de diferentes esportes aquáticos além da natação, e ainda, ser capaz de aplicá-las em ambientes distintos e em condições diversas (Langendorfer, 2011). Ocorre que, como salienta Di Paola (2019), instrumentos avaliativos não costumam verificar a reprodutibilidade de execução dessas tarefas em ambientes e condições distintas, ocasionando uma situação perigosa, mas comum no contexto da natação, que é a conquista de competência aquática limitada do ponto de vista da quantidade de habilidades aquáticas adquiridas e da qualidade dessas aquisições. Nesse caso, a identificação, descrição e discussão a respeito dos instrumentos de avaliação encontrados no presente estudo despertou reflexões importantes sobre questões relativas ao que avaliar, em que ambiente avaliar e quais critérios de análise utilizar quando se trata do ensino do nadar.

Por fim, entende-se que os instrumentos encontrados na revisão, de maneira geral, abrangem poucas habilidades pertencentes a outros esportes aquáticos, além da natação, além disso, desconsideram as variações do ambiente, da tarefa e do indivíduo no processo de avaliação da competência aquática. Com isso, percebe-se a urgência de que discussões sobre o conceito de competência aquática rompam a barreira do teórico e alcancem o âmbito prático do ensino da natação. Problematizar os instrumentos de avaliação da natação infantil parece ser um ponto de partida importante para qualificar os programas de ensino do nadar.

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