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SUMÁRIO

How Brazilian football teams coped with remotely/online strength and conditioning training.....129
Rodolfo André Dellagrana, Juliano Fernandes da Silva, Anderson Santiago Teixeira, Hugo Alexandre de Paula Santana, João Cláudio Braga Pereira Machado, Mateus Rossato

Relationship between physical tests with internal load and time spent in high intensity for male soccer players U-20 of regional level.....140
Dagnou Moura, Alexsandro Santos da Silva, Matheus Luiz Penafiel, Beatriz Gonçalves, Antonio Carlos Tavares Junior, João Paulo Borin, Julio Wilson dos Santos

Cognitive stimulation and dementia: traditional interventions vs. computer-based methodologies 148
Liliana Mendes, Joana Oliveira, Miguel Castelo-Branco

Direção técnica em ginásios e health clubs: um estudo exploratório sobre a perceção dos profissionais de exercício físico.....157
Diogo Teixeira, Ana Sousa, César Chaves, Rodrigo Ruivo, Amândio Dias, Pedro Asseiceira, Filipe Rodrigues, Diogo Monteiro, Luis Cid, Vasco Bastos, Vera Pedragosa, Hugo Pereira

Familiarização, reprodutibilidade e análise de concordância da altura do salto vertical com contramovimento na plataforma de força em homens jovens 168
Danielli Belucci, Edlene Perpétua de Oliveira, Luis Ferreira Monteiro Neto, Igor Augusto Braz, José Claudio Jambassi Filho

Aptidão física funcional e qualidade de vida em pessoas com dificuldade intelectual e desenvolvimental: estudo exploratório 174
Susana Diz, Miguel Jacinto, Diogo Monteiro, Rui Matos, Nuno Garrido, Aldo M. Costa, Raúl Antunes

An overview of the effects of physical exercise programs on individuals with Intellectual and Developmental Disabilities 181
Miguel Jacinto, José Pedro Ferreira, Diogo Monteiro, Raul Antunes, Maria João Campos, Rui Matos

Mario Trindade's training method: the journey to 100 metres wheelchair gold medal at European championships in Berlin (2018) 187
Eduarda Coelho*, Tiago Barbosa, Pedro Forte, Flávia Costa, José Vilaça

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How Brazilian football teams coped with remotely/online strength and conditioning training

Rodolfo André Dellagrana[1]*, Juliano Fernandes da Silva[2], Anderson Santiago Teixeira[2], Hugo Alexandre de Paula Santana[3], João Cláudio Braga Pereira Machado[4], Mateus Rossato[4]

ABSTRACT

The present study aimed to investigate the communication/training strategies and technological tools used by fitness coaches from Brazilian football teams during home-based training according to age categories (professional and youth), competitive level (1st, 2nd and 3rd/4th divisions) and sex (male and female). An online questionnaire was applied to collect data. Eighty-two fitness coaches from sixty-seven male and female football teams (professional and youth teams) answered the questionnaire. Message apps were the main communication route between fitness coaches and players during home-based training. Online spreadsheets were frequently used to control the training. Regarding equipment provided to players for training, 70.7% of male professional players used some equipment. In contrast, most female professional and youth players (both sexes) did not receive any equipment, respectively ($p< 0.01$). Male players who compete in the 1st and 2nd divisions received more equipment for training than those who compete in the 3rd and 4th divisions ($p< 0.01$). The main physical fitness variables trained by all players during home-based training were muscle strength, strength-endurance, and aerobic capacity. Training load and training response were applied through series/repetitions/time and effort perception scales, respectively. In conclusion, the financial differences between professional and youth teams and between males and females and competitive levels can induce different home-based training conditions in Brazilian football teams during lockdown-like situations, especially related to equipment available for training targeted physical qualities. Thus, players should be monitored closely during lockdown-like situations and provided appropriate support to facilitate their training.

KEYWORDS: lockdown; soccer; team sports; pandemic; strength and conditioning.

INTRODUCTION

In early 2020, a novel coronavirus disease (COVID-19) began to spread rapidly worldwide. The World Health Organization (WHO) classified COVID-19 as a global pandemic (WHO, 2020) on March 11, 2020. In Brazil, the first known COVID-19 infection was diagnosed in February 2020 (Secretaria de Vigilância em Saúde, 2020), leading to implementation of public health measures, including social distancing (SD), which required citizens to avoid social meetings, crowded places, habitual greetings (e.g., handshakes), and contact with older individuals (Secretaria de Vigilância em Saúde, 2020; Wilder-Smith & Freedman, 2020; WHO, 2020).

The COVID-19 pandemic has also affected football leagues and other sports entities across the world, leading to lock-down in the majority of countries in an attempt to avoid the uncontrolled spread of the disease among players and fans (Corsini et al., 2020; Mohr et al., 2020). In Brazil, regional leagues and national championships were interrupted from March 2020 until June 2020, and the start of the National League changed from May 2020 to August 2020 (CBF, 2020). Consequently, all competition

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and training activities were suspended in March 2020, and players were instructed to self-isolate. In non-pandemic conditions, football players regularly cease their daily training and competitive activities for a short period of one month after the end of the in-season (i.e., off-season). This off-season period (i.e., regular vacation) is characterised by leisure time with a total absence of scheduled activities (games and training sessions), allowing players to recover from the previous season. On the other hand, during the pandemic situation, when the activities of players were stopped for approximately three months, the stress and concerns related to the uncontrolled COVID-19 pandemic in the country increased (Jukic et al., 2020), which could result in more severe psychological and physical consequences than a traditional off-season period in athletes (Grazioli et al., 2020).

It should be noted that Brazil has a continental dimension, and the COVID-19 pandemic started when the regional state leagues were in the middle of their competition. In these regional leagues, football teams from different levels (1st, 2nd, 3rd and 4th series and no series) compete against each other. In addition to differences in the levels of teams, the financial reality among football teams in Brazil is very varied, which leads to concerns about when training will return. Furthermore, the velocity at which COVID-19 spread differed among Brazilian states (Cavalcante et al., 2020), and the implemented SD models were distinct according to each state. The challenges in returning to the football pitch may be more evident for the poorer football teams since the safe return involves adherence to recommendations and testing all players for COVID-19 (Primorac et al., 2020), resulting in high financial costs.

In this scenario, each football team probably adopted its own training strategy in an attempt to maintain the physical conditioning of its professional and youth players during the SD period. Home-based physical training challenged fitness coaches since football is a multifaceted competitive team sport involving aerobic endurance, high intensity, and explosive muscle actions, as well as several soccer-specific technical actions (e.g., header, shots, and tackles) (Bangsbo et al., 2006; Mohr et al., 2020). Therefore, it is unlikely that a similar workload can be ensured and monitored between home-based training and traditional on field training (Jukic et al., 2020). During a detraining period, it is accepted to be an overall loss of up to 10% of fitness for each week of inactivity (Varandas et al., 2017). Aimed to avoid a significant reduction in footballers' fitness, Eirale et al. (2020) described recommendations for home-based training for football players, in which the training programme must include aerobic training and strength conditioning activities. In general, for aerobic training, the sessions should not exceed 60 min, the intensity of the effort should be limited to 80% of the maximum heart rate, and the players can perform continuous or intermittent running. For strength activities, the sessions also should not exceed 60 min; it is recommended to avoid maximum loads and exercises conducted at complete muscle exhaustion.

Considering the SD provoked by the COVID-19 pandemic, fitness coaches were quickly forced to implement remote training for players confined at home through online technologies (Hammami et al., 2020; Mohr et al., 2020). Football team technical staff members had not previously considered this new training modality (i.e., remote activities). Therefore, we would like to investigate the strategies used by fitness coaches of Brazilian soccer teams during a long period of SD. This investigation is the first with Brazilian soccer teams, and the results can be helpful in the future for fitness coaches to plan the training for injured players during the off-season period.

The aim of the present study was to investigate the communication/training strategies and technological tools used by fitness coaches from Brazilian football teams during the period of SD provoked by COVID-19 according to age categories (professional and youth), competitive level (1st, 2nd and 3rd/4th divisions) and sex (male and female). We hypothesised that conditions for home-based physical training would be better for 1st and 2nd divisions, male and professional teams, in comparison to 3rd/4th divisions, female and youth teams, respectively.

MATERIALS AND METHODS

Participants

We used a descriptive study design to document the strategies for training football players implemented by Brazilian fitness coaches during the SD for COVID-19. The participants were recruited through phone messages, apps, and social media. The data collection was performed through an online form (Google Forms®). Participants completed the form between May and early June 2020. The sample consisted of 82 fitness coaches from 67 football teams that answered the online questionnaire. Therefore, 35 men's teams (1st division= 11; 2nd division= 14; 3rd division and 4th division= 10), 8 women's professional teams (all first division), and 24 youth teams (U-15, U17, and U-20; men's teams= 17 and women's teams= 7) participated in the study. Before completing the questionnaire, all participants were informed

about the research procedures and declared their acceptance of participation in this study. We follow the requirements for ethics approvals, indicating that in the sports science area, there might be exceptional circumstances in which strength and conditioning coaches routinely monitor the athletes as part of their employment (Winter & Maughan, 2009). Therefore, the data analysed here are not obtained as part of a formal research project and have not been submitted to an ethics committee.

Measures

The questionnaire comprised four areas: 1) the club (men's or women's team, professional or grassroots categories, SD time, and number of players attached to the training program); 2) the use of technologies (communication with players, communication frequency, training monitoring, and equipment provided for the players); 3) training characteristics (individual or collective training, physical evaluation, physical and physiological capacities, internal and external loads, and injury occurrence); 4) opinion on the new scenario (i.e., remote training) of fitness coaches (Appendix I). The questionnaire was approved by researchers in the sports science area, specifically those with expertise in football science.

In the training characteristics, we asked about training mode (number of players involved in the training — individual, collective or both), physical evaluation (which evaluation was performed during the home-based training), physical fitness (physical and physiological qualities trained during home-based training), training load (external load used by fitness coaches), training response (internal load controlled by fitness coaches), training with ball (if this type of training was used during home-based training), and perception scales (which scales were used by fitness coaches).

Statistical analyses

All statistical analyses were performed using SPSS (v 20.0; SPSS Inc). Data are presented as absolute and relative frequencies for each categorical variable according to age category (professional and youth teams), sex (male and female players), and competitive level for males (1st, 2nd, 3rd and 4th division). The χ^2 test was used to verify the associations between categorical variables and age categories, competitive level (only for male professional teams) and sex. Cramer's V test was used to calculate the effect size for categorical variables. Comparisons between divisions were not performed for female players since only one female division was collected. The significance level was set at 5%.

RESULTS

Regarding the length of the SD period, 87.7 and 94.1% of male and female football players (professional and youth teams) remained confined for more than 45 days, respectively. In addition, 86.6% of fitness coaches were responsible for monitoring more than 22 football players.

Table 1 shows the technologies and instruments used by fitness coaches and players during the period of home-based training according to age categories (professional and youth teams) and sex (men and women). Message apps were the most commonly used technology to communicate with players, followed by online video chats, social media, and phone calls. Social media was often used by the fitness coaches of women's teams (χ^2= 15.538, p= 0.001). Most fitness coaches contacted their players in all categories and both sexes daily. Fitness coaches frequently use online spreadsheets to control the training. In addition, women's teams more frequently used specific software for training control (χ^2= 7.960, p= 0.047), while men's teams more frequently used offline spreadsheets (χ^2= 9.246, p= 0.026). Regarding the provision of equipment to the players, 70.7% of professional male players used some equipment during home-based training. However, only 8.3% of young male players received some training equipment. For professional female players, 40.0% received some equipment, and no youth female players received any equipment for home-based training.

With regard to elite male professional football teams competing at different levels (1st, 2nd, 3rd, and 4thdivisions), message apps, followed by online meetings, phone calls, and social media, were the most commonly used technological resources to communicate with players. Furthermore, phone calls presented a higher proportion in teams from the Brazilian 2nd division than 1st, 3rd, and 4th division teams (χ^2= 6.782, p= 0.034). In all divisions, fitness coaches preferred to contact their players daily and use online spreadsheets to monitor training sessions. Failure to provide equipment for home-based training (χ^2= 15.403, p< 0.01) was higher for teams in the 3rd and 4th divisions, while the provision of equipment for strength activities (χ^2= 15.401, p< 0.01) was higher for teams from the 1st and 2nd divisions (Table 2).

The majority of fitness coaches (all male and female categories) reported using periodised training strategies during the period of SD, in which the training mode involved individual and collective monitoring. The period of SD precluded the physical evaluation of players since few evaluations were applied during this period. Muscle strength, strength-endurance, and aerobic capacity were the main physical training variables. It should be noted that training of muscle strength presented a higher proportion for

Table 1. Communication and training technologies/instruments used by fitness coaches and players during SD by COVID-19.

	Male players		Female players		p-value	ES
	Professional	Youth	Professional	Youth		
	% (n)	% (n)	% (n)	% (n)		
Communication[A]						
Message app	100.0 (41)	100.0 (24)	100.0 (10)	100.0 (7)	---	---
Online meet	70.7 (29)	66.7 (16)	80.0 (8)	85.7 (6)	0.720	0.13
Phone call	43.9 (18)	16.7 (4)	40.0 (4)	42.9 (3)	0.155	0.25
Social media	22.0 (9)	41.7 (10)	70.0 (7)	85.7 (6)	0.001[§]	0.44
SMS	2.4 (1)	0.0 (0)	10.0 (1)	0.0 (0)	0.365	0.19
Contact frequency						
Daily	68.3 (28)	50.0 (12)	70.0 (7)	57.1 (4)	0.382	0.20
3 times/week	19.5 (8)	12.5 (3)	20.0 (2)	28.6 (2)		
Weekly	12.2 (5)	29.2 (7)	10.0 (1)	14.3 (1)		
Biweekly	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)		
Monthly	0.0 (0)	8.3 (2)	0.0 (0)	0.0 (0)		
Training control[A]						
Online spreadsheet	85.4 (35)	66.7 (16)	90.0 (9)	71.4 (5)	0.240	0.23
Online meet	46.3 (19)	54.4 (13)	50.0 (5)	57.1 (4)	0.912	0.08
Specific software	7.3 (3)	8.3 (2)	20.0 (2)	42.9 (3)	0.047[§]	0.31
Offline spreadsheet	2.4 (1)	20.8 (5)	0.0 (0)	0.0 (0)	0.026[§]	0.34
Equipment provided						
Yes	70.7 (29)	8.3 (2)	40.0 (4)	0.0 (0)	< 0.01[§]	0.61
No	29.3 (12)	91.7 (22)	60.0 (6)	100.0 (7)		

[A]For "communication" and "training control" items, percentages within age categories (professional or youth) for male and female professional teams represent a "yes" answer relative to a "no" answer; [§]$p < 0.05$; ES: effect size (Cramer's V test).

male professional players than youth players (χ^2= 8.233, p= 0.041), as well as training for anaerobic capacity had a higher proportion for male professional players than male youth players and female players (χ^2= 16.340, p= 0.001). Training load was controlled using the number of series/repetitions and exercise time, while effort perception scales or questionnaires mainly verified the training response. Other instruments, such as pain, fatigue, recovery, welfare, sleep, and mood scales, presented low use. The total number of specific training (ball drills) was small during the period of SD for COVID-19 (Table 3).

Considering the men's professional teams, Table 4 shows similar training control by fitness coaches in all Brazilian divisions (1st, 2nd, 3rd, and 4th). Training to improve strength-endurance presented a higher proportion for players who compete in the 1st and 2nd divisions compared to players who compete in the 3rd and 4th divisions (X^2= 6.583, p= 0.037). Similarly, coordination was more commonly trained by the 1st and 2nd division teams than teams from the 3rd and 4th divisions (X^2= 7.999, p= 0.018). The coaches reported five male injured players and three female injured players. The injured body regions were knee (3), pubis (2), hamstrings (1), and lower back (2).

Regarding approval of the new training mode, 95.1% of men's professional teams and 95.8% of the youth teams accepted and performed the training sessions. For the women's professional and youth teams, 50.0% and 57.2% accepted the training during the period of SD for COVID-19, respectively. Regarding the technologies and training performed during the SD period, 59.8% of fitness coaches would use it in the future with no pandemic conditions, while 32.9% would not use it, and 7.3% replied that they might use it.

DISCUSSION

The aim of the present study was to investigate the communication/training strategies and technologies used by

Table 2. Communication and training technologies/instruments used by fitness coaches and male professional players during the SD provoked by COVID-19.

	Male Divisions				
	1st division *n*= 11	2nd division *n*= 14	3rd/4th divisions *n*= 10	p-value	ES
	% (n)	% (n)	% (n)		
Communication[A]					
Message app	100.0 (11)	100.0 (14)	100.0 (10)	---	---
Online meet	72.7 (8)	78.6 (11)	70.0 (7)	0.885	0.08
Phone call	36.4 (4)	71.4 (10)	20.0 (2)	0.034[§]	0.44
Social media	9.1 (1)	35.7 (5)	20.0 (2)	0.281	0.27
SMS	0.0 (0)	7.1 (1)	0.0 (0)	0.462	0.21
Contact frequency					
Daily	72.7 (8)	64.3 (9)	60.0 (6)	0.143	0.31
3 times/week	9.1 (1)	35.7 (5)	10.0 (1)		
Weekly	18.2 (2)	0.0 (0)	30.0 (3)		
Biweekly	0.0 (0)	0.0 (0)	0.0 (0)		
Monthly	0.0 (0)	0.0 (0)	0.0 (0)		
Training control[A]					
Online spreadsheet	90.9 (10)	78.6 (11)	80.0 (8)	0.691	0.15
Online meet	36.4 (4)	64.3 (9)	40.0 (4)	0.311	0.26
Specific software	9.1 (1)	7.1 (1)	10.0 (1)	0.967	0.04
Offline spreadsheet	0.0 (0)	7.1 (1)	0.0 (0)	0.462	0.21
Equipment provided[A]					
None	9.1 (1)	14.3 (2)	80.0 (8)	<0.01[§]	0.66
Aerobic equipment*	27.3 (3)	7.1 (1)	0.0 (0)	0.118	0.35
Strength equipment**	90.9 (10)	85.7 (12)	20.0 (2)	<0.01[§]	0.66
Heart rate monitors	0.0 (0)	0.0 (0)	10.0 (1)	0.276	0.27
GPS	0.0 (0)	7.1 (1)	0.0 (0)	0.462	0.21

[A]For "communication", "training control" and "equipment provided" items, percentages within competitive level (1st, 2nd and 3rd/4th divisions) represent a "yes" answer relative to a "no" answer; *cycle ergometer and treadmill; **PVC plates, dumbbell rod, curl rod, and medicine ball; [§]$p < 0.05$; ES = effect size (Cramer's V test).

Brazilian football fitness coaches (professional and youth teams) during the period of SD provoked by COVID-19. To the best of our knowledge, this is the only study to assess the training conditions of Brazilian football players during the SD period provoked by COVID-19. Our main findings revealed that (i) fitness coaches preferred to communicate daily with their players through message apps and use online spreadsheets to control the training regardless of age, competitive level and sex; (ii) male professional teams from the 1st and 2nd divisions provided more access to equipment to their players than female (regardless of age) and male professional 3rd/4th division and youth teams; (iii) the provision of equipment for strength was higher in the 1st and 2nd division teams than 3rd/4th ones; (iv) muscle strength, strength-endurance and aerobic capacity were among the main physical qualities targeted by fitness coaches; of interest, more emphasis on muscle strength and anaerobic capacity was reported in male professional than in youth football teams, while strength-endurance and coordination qualities were more targeted at 1st and 2nd division than in 3rd/4th division teams. Thus, our hypothesis was partially supported showing that male professional football teams from the 1st and 2nd divisions presented better conditions to home-based physical training than female teams and other competitive levels. It is important to highlight that during the game break, some football players attended the club training centre, but in the present study, we only consider data on home-based training. It is noteworthy that

Table 3. Training characteristics during SD for COVID-19.

	Male players		Female players		p-value	ES
	Professional	Youth	Professional	Youth		
	% (n)	% (n)	% (n)	% (n)		
Periodization						
Yes	80.5 (33)	87.5 (21)	70.0 (7)	85.7 (6)	0.666	0.14
No	19.5 (8)	12.5 (3)	30.0 (3)	14.3 (1)		
Training mode						
Individual	12.2 (5)	0.0 (0)	10.0 (1)	0.0 (0)	0.092	0.26
Collective	19.5 (8)	50.0 (12)	40.0 (4)	14.3 (1)		
Both	68.3 (28)	50.0 (12)	50.0 (5)	85.7 (6)		
Evaluation						
None	90.2 (37)	79.2 (19)	100.0 (10)	85.7 (6)	0.360	0.23
Questionnaires/scales	4.9 (2)	12.5 (3)	0.0 (0)	0.0 (0)		
Anthropometric	2.4 (1)	8.3 (2)	0.0 (0)	0.0 (0)		
Physical performance	2.4 (1)	0.0 (0)	0.0 (0)	14.3 (1)		
Physical fitness[A]						
Muscle Strength	90.2 (37)	70.8 (17)	100.0 (10)	100.0 (7)	0.041[§]	0.32
Aerobic capacity	87.8 (36)	83.3 (20)	90.0 (9)	71.4 (5)	0.674	0.14
Anaerobic capacity	85.4 (35)	45.8 (11)	50.0 (5)	28.6 (2)	0.001[§]	0.45
Strength-endurance	82.9 (34)	75.0 (18)	100.0 (10)	85.7 (6)	0.367	0.20
Muscle power	80.5 (33)	50.0 (12)	70.0 (7)	57.1 (4)	0.074	0.29
Coordination	70.7 (29)	79.2 (19)	60.0 (6)	71.4 (5)	0.715	0.13
Agility	58.5 (24)	45.8 (11)	60.0 (6)	85.7 (6)	0.301	0.21
Speed	48.8 (20)	33.3 (8)	40.0 (4)	28.6 (2)	0.563	0.16
Speed-endurance	43.9 (18)	20.8 (5)	40.0 (4)	28.6 (2)	0.289	0.21
Sprints	34.1 (14)	45.8 (11)	30.0 (3)	28.6 (2)	0.712	0.13
Training load[A]						
Number of series	95.1 (39)	91.7 (22)	100.0 (10)	100.0 (7)	0.685	0.14
Resistance load*	63.4 (26)	29.2 (7)	60.0 (6)	57.1 (4)	0.058	0.30
Distance covered	46.3 (19)	16.7 (4)	30.0 (3)	28.6 (2)	0.105	0.27
Speed	24.4 (10)	25.0 (6)	20.0 (2)	14.3 (1)	0.931	0.07
Time/repetitions	92.7 (38)	87.5 (21)	100.0 (10)	100.0 (7)	0.514	0.17
Training response[A]						
Effort perception	87.8 (36)	79.2 (19)	100.0 (10)	71.4 (5)	0.291	0.21
Heart rate	7.3 (3)	0.0 (0)	100.0 (10)	100.0 (7)	0.374	0.20
Questionnaire/scales**	90.2 (37)	95.8 (23)	100.0 (10)	100.0 (7)	0.528	0.16
Training with ball						
Yes	36.6 (15)	37.5 (9)	40.0 (4)	57.1 (4)	0.708	0.13
No	61.0 (25)	58.3 (14)	60.0 (6)	42.9 (3)		
Perception scales						
None	68.3 (28)	79.2 (19)	60.0 (6)	85.7 (6)	0.722	0.16
Pain/Fatigue/Recovery	14.6 (6)	12.5 (3)	30.0 (3)	0.0 (0)		
Welfare/Sleep/Humor	17.1 (7)	8.3 (2)	10.0 (1)	14.3 (1)		

[A]For "physical fitness", "training load" and "training response" items, percentages within age categories (professional or youth) for male and female professional teams represent a "yes" answer relative to a "no" answer; *e.g. 1RM; ** Specific questionnaires to training response; [§]$p < 0.05$; ES: effect size (Cramer's V test).

Table 4. Training characteristics during SD for COVID-19 among male professional teams.

	Men's Divisions				
	1st division *n*= 11	2nd division *n*= 14	3rd/4th divisions *n*= 10	p-value	ES
	% (n)	% (n)	% (n)		
Periodisation					
Yes	81.8 (9)	85.7 (12)	60.0 (6)	0.303	0.26
No	16.7 (2)	11.1 (2)	40.0 (4)		
Training mode					
Individual	27.3 (3)	0.0 (0)	20.0 (2)	0.301	0.26
Collective	18.2 (2)	28.6 (4)	10.0 (1)		
Both	54.5 (6)	71.4 (10)	70.0 (7)		
Evaluation					
None	81.8 (9)	92.9 (13)	90.0 (9)	0.468	0.28
Questionnaires/scales	9.1 (1)	7.1 (1)	0.0 (0)		
Anthropometric	9.1 (1)	0.0 (0)	0.0 (0)		
Physical performance	0.0 (0)	0.0 (0)	10.0 (1)		
Physical fitness[A]					
Muscle Strength	100.0 (11)	92.9 (13)	70.0 (7)	0.079	0.38
Aerobic capacity	90.9 (10)	85.7 (12)	90.0 (9)	0.908	0.07
Anaerobic capacity	90.9 (10)	92.9 (13)	70.0 (7)	0.241	0.28
Strength-endurance	81.8 (9)	100.0 (14)	60.0 (6)	0.037[§]	0.43
Muscle power	90.9 (10)	92.9 (13)	70.0 (7)	0.241	0.29
Coordination	72.7 (8)	92.9 (13)	40.0 (4)	0.018[§]	0.48
Agility	72.7 (8)	57.1 (8)	50.0 (5)	0.547	0.19
Speed	63.6 (7)	35.7 (5)	60.0 (6)	0.311	0.26
Speed-endurance	27.3 (3)	64.3 (9)	40.0 (4)	0.167	0.32
Sprints	36.4 (4)	42.9 (6)	20.0 (2)	0.501	0.20
Training load[A]					
Number of series	100.0 (11)	92.9 (13)	90.0 (9)	0.588	0.17
Resistance load*	63.6 (7)	71.4 (10)	60.0 (6)	0.832	0.10
Distance covered	54.5 (6)	42.9 (6)	40.0 (4)	0.770	0.12
Speed	36.4 (4)	28.6 (4)	10.0 (1)	0.367	0.24
Time/repetitions	100.0 (11)	85.7 (12)	90.0 (9)	0.440	0.22
Training response[A]					
Effort perception	72.7 (8)	85.7 (12)	100.0 (10)	0.204	0.30
Heart rate	0.0 (0)	14.3 (2)	10.0 (1)	0.440	0.22
Questionnaire/scales**	90.9 (10)	92.9 (13)	90.0 (9)	0.967	0.04
Training with ball					
Yes	63.6 (7)	42.9 (6)	20.0 (2)	0.131	0.34
No	36.4 (4)	57.1 (8)	80.0 (8)		
Perception scales					
None	72.7 (8)	71.4 (10)	60.0 (6)	0.807	0.15
Pain/Fatigue/Recovery	18.2 (2)	7.1 (1)	20.0 (2)		
Welfare/Sleep/Mood	9.1 (1)	21.4 (3)	20.0 (2)		

[A]For "physical fitness", "training load" and "training response" items, percentages within competitive level (1st, 2nd and 3rd/4th divisions) in male professional teams represent a "yes" answer relative to a "no" answer; *e.g. 1RM; **specific questionnaires to training response; [§]$p< 0.05$; ES: effect size (Cramer's V test).

55 and 62.5% of male and female football teams which competed in the Brazilian 1st division, respectively, participated in the present study. In addition, a high number of youth team fitness coaches answered the online form. Therefore, we believe that our results can be extrapolated to other Brazilian football teams.

The COVID-19 pandemic has had significant consequences for football players, including a lack of organised training and competition, inappropriate training conditions, and inadequate communication between players and coaches (Chen et al., 2020; Jukic et al., 2020). Therefore, during the lockdown for COVID-19, remote communication and training methods (i.e., written and voice messages and face-to-face online meetings) were used by Brazilian teams (Table 1), and approximately 95 and 54% of male and female players accepted this method for communication and training, respectively. These results may be related to the growth of smartphone users, free message apps, and online group meetings, especially during the lockdown of the COVID-19 pandemic (Jakhar et al., 2020). On the other hand, although the relationship between coaches and players is an essential variable in team sports (Côté & Gilbert, 2009), a previous study showed that remote communication can preclude human relationships (Przybylski & Weinstein, 2012). However, considering a specific condition provoked by COVID-19, Li et al. (2020) demonstrated that remote face-to-face communication improved relationships between coaches and young football players.

In the pandemic scenario, home-based physical training is recommended (Hammami et al., 2020); thus, some suggestions for football players have been proposed in the literature to guarantee a safe and successful return to playing matches (Jukic et al., 2020; Mohr et al., 2020; Mon-López et al., 2020). In general, for non-athletes, moderate home-based exercise is sufficient to maintain physical fitness (Izquierdo et al., 2007); however, for athletes, high-level activities are necessary (Koundourakis et al., 2014). The absence of appropriate space, the inability to perform specific football actions, and inadequate equipment are among the main barriers for fitness coaches to develop home-based training (Jukic et al., 2020). In this context, young Brazilian players and female players seem to be most affected since male professional players receive more equipment provided by the club (Table 1). Furthermore, players who compete in the 1st and 2nd divisions received equipment for training, while most players who compete in the 3rd and 4th divisions did not receive any equipment for training. These findings are in agreement with those reported by Washif et al. (2022), who also demonstrated that more professional (55 and 71%) than amateur (45 and 63%) players had the necessary equipment to perform strength and cardiovascular training at home, respectively. This latter study also found that most professional players received training programs prescribed by their coach/trainer (53%), while amateur (59%) and semi-pro (47%) players programmed their own training regimens. Taken together, these results reinforce that financial investment differences between professional and youth teams, male and female teams, 1st/2nd divisions and 3rd/4th divisions may distinctly impact the access to equipment for training and supervised training prescription.

The importance of training periodisation is well known and accepted for athletes (Buchheit & Laursen, 2013; Issurin, 2010). In this context, the majority of fitness coaches (professional and youth, male and female) performed a home-based physical training periodisation in order to reach an ideal physical condition to return to matches. However, as the exact date for the return to football was indefinite (Mohr et al., 2020), the periodisation became a "shot in the dark". Therefore, although fitness coaches contacted players daily to assess load and response to the exercises prescribed, they could not monitor changes in physical capacities and recovery during home-based training since most fitness coaches did not apply physical evaluation or perception scales (Tables 3 and 4).

In some conditions involving non-competitive periods such as off-season (i.e., vacations) or injuries, football players can experience physical detraining, which involves partial or total loss of previously acquired training adaptations (Mujika & Padilla, 2001). However, during the period of SD caused by COVID-19, the detraining experienced by players could be more harmful since home confinement can lead to several negative behaviours, for example, inappropriate nutrition, poor sleep quality, loneliness, physical activity reduction, increase in time spent sitting, and, mainly, the decrease in specific physical fitness (Hammami et al., 2020; Jukic et al., 2020). Therefore, it appears that although home-based training cannot replace training on the football pitch during non-pandemic conditions, it was the only alternative in an attempt to maintain the physical fitness of Brazilian football players.

Taking into account the real possibilities of home-based training, practitioners and fitness coaches were challenged to design a training program that would allow players to return to their regular training activities with minimum acceptable levels of physical fitness since it was expected that confinement for COVID-19 would induce a loss in physical fitness and increased match-related fatigue and injury risks for football players (Mohr et al., 2020). In Brazil,

the present study showed that the training prescription commonly was designed to enhance physical qualities in football, such as muscle strength, strength-endurance, and aerobic fitness. Our data are in line with an earlier study whose results also revealed that most players trained to maintain or develop general fitness and health regardless of competitive level, with professional players having more training targeted to maintain or develop strength and power (e.g., plyometric drills), muscular endurance, muscle balance and weight management than amateurs or semi-professional players (Washif et al., 2022). More attention to these physical capabilities seems logical because a long detraining period can negatively impact the functions of the neuromuscular and cardiorespiratory systems (Jukic et al., 2020). Considering that lockdown could last longer than 4 weeks, our data highlight that the main concerns of fitness coaches were to minimise undesired changes related to detraining, such as a decline in maximal oxygen uptake, blood volume, total haemoglobin content, muscle capillarisation, muscle mass, and reduced strength ability (Neufer et al., 1987; Wang & Pessin, 2013). Regarding these efforts to maintain physical conditioning, a study by Grazioli et al. (2020) showed that male professional football players did not demonstrate differences in hamstring eccentric strength, squat jump height, and cardiorespiratory fitness compared to pre-season values. However, negative changes in the body composition, countermovement jump, and 10m and 20m sprint times occurred after quarantine. This finding suggests that superior decrements in power-speed-related abilities could be mainly attributed to the absence of appropriate training facilities for developing these physical components during confinement at home.

Most players did not perform specific football training (i.e., ball drills) during the lockdown caused by COVID-19. Small-sided games are a common high intensity training method to improve physical and endurance fitness (Buchheit & Laurse, 2013). However, small-sided games were made impossible during forced confinement due to COVID-19 because at least two players and an appropriate space were needed. According to Mohr et al. (2020), the lack of high intensity stimuli is harmful to the high intensity performance of players during football matches, and the unexpected playing pause can result in high bio-physiological load after confinement, since the time to build up ideal physical fitness was limited.

In addition to football training load reduction, athletes could be more susceptible to injury occurrence after the SD period for COVID-19 (Mohr et al., 2020). Although home-based training is less demanding in terms of intensity and volume than regular and traditional football training (Jukic et al., 2020), non-contact injuries were reported in the knee, pubis, hamstrings, and lower back. These sites already present a high incidence of injury in football players (Pfirrmann et al., 2016). Noncontact injuries are known to present multifactorial factors, such as fatigue (training and matches), muscle imbalance, fitness, and movement efficiency (McCall et al., 2014). Considering that players reported the occurrence of injuries, we believe that injury prevalence during confinement for COVID-19 may be underestimated for youth and men's professional players of the 3rd and 4th divisions.

Almost all Brazilian football players accepted the home-based training during the special conditions arising from the COVID-19 pandemic. Although physical training depends on the presence of the fitness coach, some individuals reported that technologies and strategies used during the SD period could be used in the future, especially in possible SD conditions. Finally, the results of the present study could be helpful for fitness coaches and managers by providing information on the different possibilities, acceptance, and equipment necessary for football players to train during special conditions that preclude in-person training. For instance, our data can assist sports organisations in developing their own technological system to better implement strategies for strength and conditioning practices remotely and online during sports disruption periods according to the population's features and competitive level. Future research should explore methods for better integrating home-based physical training into the sports science context during either sports restrictions or off-season periods. This study is not without limitations. Subjective questionnaires were used to obtain responses from fitness coaches retrospectively and, therefore, subject to recall bias. Here, we considered a convenience sampling approach that limits the generalisability of our findings. Furthermore, a qualitative analysis through interviews might address more detailed (or specific) issues of fitness coaches from a different perspective of performance.

CONCLUSION

In the context of sport and training, fitness coaches preferred to communicate daily with their players through message apps and use online spreadsheets to control the training. Furthermore, fitness coaches (and their players) of the men's football teams of the 3rd/4th Brazilian division and professional female and youth teams were more impacted by the COVID-19 lockdown regarding training

conditions than those professionals who worked at 1st and 2nd division football teams. At home, training goals shifted to soccer-related physical qualities depending on age (i.e., muscle strength and anaerobic capacity being more prevalent in professional teams) and competitive level (strength-endurance and coordination qualities more targeted at 1st and 2nd division teams).

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Relationship between physical tests with internal load and time spent in high intensity for male soccer players U-20 of regional level

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ABSTRACT

The relationship between performance in physical tests and the match intensity from the heart rate (HR) response has not been studied in soccer. Thus, this study aimed to verify the correlation between the performance in physical tests and the intensity of the soccer match. Eleven Under-20 soccer players from the first division were evaluated in 2 official matches. The Yo-Yo intermittent aerobic test level 1 (YYIR1), 10-m and 30-m speed, repeated sprints ability (RSA, 6 x 20-20 m), the squat (SJ) and countermovement (CMJ) jump tests were performed. The heart rate (HR) was used to calculate the impulse training (M-TRIMP) by Edwards's methods, and the time spent above 90% of HR_{max} ($HR_{> 90\%}$) was considered a high-intensity parameter. Pearson's correlation was applied, considering the significance level of $p< 0.05$. Significant correlations occurred between YYIR1 and M-TRIMP ($r= 0.72$) and the time in $HR_{> 90\%}$ ($r= 0.51$) and between the best time in RSA (RSA_{best}) and $HR_{> 90\%}$ ($r= -0.50$). YYIR1 was the best test related to the match intensity measured by the HR. RSA_{best} was also a good high-intensity indicator of the match, while jump and speed tests were not.

KEYWORDS: power: speed; TRIMP; vertical jump; yo-yo test; young players.

INTRODUCTION

Soccer is characterised by intermittent efforts and sprints with different durations, accelerations, decelerations, jumps, and constant changes of direction, which are performed with and without a ball (Modric et al., 2023). The match has a predominance of the aerobic energy system, with actions of walking, back running, and standing still (Andersson et al., 2008; Modric et al., 2023). On the other hand, many decisive actions require anaerobic metabolism, such as dribbling, acceleration, deceleration, and sprinting, characterising soccer as a high-intensity intermittent sport (Gonçalves et al., 2021; Mohr et al., 2016).

Considering the high demand of soccer matches on physical capabilities of endurance, speed, strength, and coordination skills (Chmura et al., 2015), the physical fitness evaluation should consider the intermittent aerobic characteristic, the demand for explosive actions and power, speed, and the repeated sprints ability (RSA). Tests such as Yo-Yo recovery level 1 (YYIR1), the jump tests, such as squat jump (SJ) and countermovement jump (CMJ), the speed at 10-m and 30-m, and the test of RSA have been widely used to assess physical fitness in soccer players (Castagna et al., 2019; Doncaster et al., 2016; Gonçalves et al., 2021; Rampinini et al., 2007; Rodríguez-Rosell et al., 2017) since they present specificity with the match actions. The YYIR1 test assesses intermittent aerobic fitness with similar characteristics to the actions of the match, a 20-m shuttle run with a change of direction and recovery between runs, discriminating players of different levels and presenting sensitivity to changes after training (Bangsbo et al., 2008; Castagna et al., 2020). Although the YYIR test has two distinct versions (levels 1 and 2), we chose to use the YYIR1 test because it focuses

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on maximal activation of the aerobic system. In contrast, the Yo-Yo recovery level 2 (YYIR2) assesses the individual's ability to recover from repeated exercise with a high contribution from the anaerobic system (Bangsbo et al., 2008), i.e., the RSA test would already bring us information about the anaerobic demand. The vertical jump tests, SJ and CMJ, are also widely used to control soccer training (Claudino et al., 2017) considering their correlation with explosive strength (Rodríguez-Rosell et al., 2017), speed (Shalfawi et al., 2011), and maximum strength (Wisløff et al., 2004) in soccer players. Because soccer players perform most sprints in the match at distances ranging up to 30 m, tests of 10 m and 30 m are the most used distances in the evaluation of speed in soccer players, with the 10 m being more sensitive to changes in training (Stolen et al., 2005). The performance variables obtained in the RSA are sensitive in discriminating players of different competitive levels and positions (Aziz et al., 2000; Impellizzeri et al., 2008), in addition to correlating with the speed and SJ tests (Lockie et al., 2017).

While physical tests are used to identify the level of physical fitness and verify training changes, the training process has been described based on the training load, described as the input variable that is manipulated to elicit the desired training response (Coutts et al., 2018), depending on whether the measurable aspects occur internally or externally to the athlete, i.e., the external load (training prescribed by the coaches or physical work prescribed in the training plan), and the internal load (psychophysiological responses of the body to the requirements elicited by the external load) (Impellizzeri et al., 2005; Impellizzeri et al., 2019). An external load of the match has shown a positive correlation with the performance of soccer players in physical tests, i.e., the YYIR1 test (Castagna et al., 2019; Doncaster et al., 2016) and the average time of the six sprints in RSA correlates with the distance covered at high intensity and sprints (Rampinini et al., 2007). In addition, the maximal sprinting speed in 10-m from the 40-m test can impact what a player can do in actual playing (Mendez-Villanueva et al., 2011). However, actual match internal load responses have not been correlated with physical fitness tests.

The internal load can be determined by physiological variables such as blood lactate, skeletal muscle damage marker enzymes, heart rate (HR), and psychophysiology variables as the rating of perceived exertion (RPE). Among those internal load variables, HR has been widely used to quantify the internal training load by calculating the training impulse (TRIMP). The TRIMP is an HR-based method that considers the volume (in minutes) and intensity of training sessions determined by the HR, expressed in arbitrary units (AU) (Banister, 1991). There are different approaches to determining TRIMP, including this proposed by Edwards (1993), which is calculated by measuring the product of the accumulated exercise duration (min) of five different intensity zones relative to the percentage of maximum HR (%HR_{max}) by a coefficient (1-5) relative to five intensity zones. This approach has been used in soccer to validate the use of RPE as a parameter of internal training load (Impellizzeri et al., 2004), to compare the dose-response relationship between training load and changes in aerobic performance (Fitzpatrick et al., 2018), and to compare the intermittent performance change (Campos-Vazquez et al., 2017).

In addition to using HR to determine TRIMP, HR has also been used as an indicator of high-intensity physical activity (Castagna et al., 2009; Fox et al., 2018) and can present important information regarding the level of physical fitness. For example, in team sports, significant associations exist between the volume of high-intensity activity completed, defined as time spent above 90% of maximum HR ($HR_{>90\%}$), and changes in aerobic performance (Fox et al., 2018). In soccer, both $HR_{>90\%}$ and TRIMP from the training sessions and matches have been studied in comparison to intermittent performance change (Campos-Vazquez et al., 2017).

Considering the importance of the high level of physical fitness that soccer players must have to support the intensity of the match, the present study aimed to verify the relationship between physical fitness in tests YYIR1, RSA, SJ, CMJ, 10-m, and 30-m tests with the time spent in the high-intensity ($HR_{>90\%}$) and the internal load in the match (M-TRIMP) in Under-20 (U20) soccer players. It was expected that the players with better performance in physical tests would play at a higher intensity and present higher M-TRIMP.

MATERIALS AND METHODS

This study is quasi-experimental research since there was no control group, in addition to randomization of the sample, as the group was already formed before the experiment (Yin, 2001).

Subjects

Eleven players from a U-20 team in the first division of the State Championship participated in the study: three midfielders, three forwards, three full-backs, and two defenders (19.1± 0.9 years, 177.0± 6.0 cm, 70.7± 6.7 kg, 9.7± 0.9% fat). Only players who participated in more than 75% of the match (67.5 minutes) were considered in the analysis (Coelho et al., 2013). The players were evaluated in two matches (M-1 and M-2), with seven players participating in both M-1 and

M-2, while two players participated only in M-1 and other two only in M-2, resulting in 18 observations for statistical analysis. The players trained five days a week, two hours a day (three days: 2 times/day, two days: 1 time/day). Strength training: 3 sessions; technical-tactical training: 4-6 sessions; and physical training for injury prevention, with proprioceptive, balance, and core exercises: 1 session/week. As defined by the coach, the team played in the 4-3-3 formation, marking the opponent's ball out (high pressure), and when in possession of the ball, the team organized itself with short passes from defence to attack, trying to retain possession of the ball, and avoiding long throws to the attack field.

Before data collection, the project was approved by the University's ethics committee (Process: 64920317.1.0000.5398), according to the laws of the country, which was carried out following the ethical principles of the Declaration of Helsinki. Before the study started, the team's technical committee had been contacted to request permission and explain the procedures. After the consent of the team's technical committee, as well as the awareness of the team's board, the players were invited to participate in the study. All players agreed to participate spontaneously after having understood the objectives and read the informed consent term, signed by the players (all players were over 18 years old).

Procedures

The data were collected in the final part of the first qualifying phase of the competition (August-September) after a pre-season of 3 weeks (April-May) plus -three months of a competition in which the team played 14 matches. This period of data collection was chosen because of the little variation in the physical fitness of the players during the competition. The team finished in 5th place in the first qualifying phase. The team won the match M-1 by 7 x 0 and lost the M-2 by 0 x 1. The opponents finished the classification phase in the 11th (M-1) and 1st positions (M-2), respectively.

The matches took place on Saturdays (3:00 to 5:00 p.m.), and the anthropometric and physical performance assessments were made on Mondays (at the same time as the matches), 48 hours after the matches, without the players having made any physical effort during the recovery period. The evaluations were made on a weekday to not interfere with the team's training process since it was the final classification stage. Week 1= anthropometry and pilot match (for better familiarization of players with HR monitors and other adjustments for data collection); weeks 2 and 3= physical evaluation (week 2= SJ, CMJ, and RSA, week 3= 10-m, 30-m, and YYIR1); Week 4 and 5= data collection in matches (M-1 and M-2 in the 19th and 20th round of the competition). The matches were held at the evaluated team's home field, a 105 x 70 m natural grass field. HR was monitored throughout the matches to determine the M-TRIMP using Edwards's method. The players wore soccer shoes during the matches and the YYIR1 and RSA tests.

Body composition

Body composition was determined using the bi-compartmental model by measuring skinfolds. First, body density was calculated by measuring seven skinfolds: triceps, subscapular, middle axillary, pectoral, abdominal, supra-iliac, and thigh (Jackson & Pollock, 1978). The collection was made with a scientific adipometer of the brand Cescorf® (Porto Alegre, Rio Grande do Sul, Brazil), and the percentage of body fat was determined with the Siri equation (Siri, 1961). Body mass and height were measured using a digital scale with an adult ruler Welmy® brand (Santa Bárbara do Oeste, São Paulo, Brazil).

Intermittent aerobic assessment (YYIR1)

The YYIR1 protocol, proposed by Bangsbo (1994), consists of travelling the distance of 20 m of the shuttle run (40 m) with an active recovery of 10s in the space of 5 m (recovery area) between each shuttle run. The test was conducted on a natural grass field with a CD player and a sound box for speed control. The test started with a speed of 10 km·h^{-1}, and the speed was increased progressively, according to the protocol previously recorded on the CD player, until the player's voluntary exhaustion. At the end of the test, the total distance covered (m) was registered. Players who were unable to follow the sound signals for more than two consecutive times were eliminated from the test, and their last completed stage was considered the test result, and the total distance travelled was recorded in meters.

Speed test (10-m and 30-m)

The speed protocol adopted was described by Chamari et al. (2004). The athlete started from the standing position and ran 30 meters in the shortest time possible. The times of 10-m and 30-m were recorded using three photocells (CEFISE®, Campinas, Brazil) placed in the zero, 10-m, and 30-m marks. The times were recorded in hundredths of a second, considering the best time of three attempts, with a two-minute recovery interval between runs.

Repeated run test

The RSA test was performed in six 40-m shuttle runs (20-20 m) with 20 s of recovery between the bouts (Impellizzeri et al., 2008). The time was recorded using the photocell system

(CEFISE®, Campinas, Brazil). For data analysis, we considered the average time of the six sprints (RSA_{mean}), the best time achieved in the six sprints (RSA_{best}), and the index of the decrement ($RSA_{decrement}$), using Equation 1, proposed by Rampinini et al. (2007):

$$([RSA_{mean}] / [RSA_{best}] \times 100) - 100 \quad (1)$$

Jumping test (SJ and CMJ)

The vertical jumps were evaluated using two jumps, SJ and CMJ, as proposed by Bosco et al. (1995). In both jumps, the players started on a contact platform (CEFISE®, Campinas, Brazil) with their hands on their hips and feet hip-width apart. The players were instructed to jump as high as possible in three attempts. The average value of the three attempts of each jump, SJ and CMJ, was considered for the analysis, with an interval of 2-3 min between jumps (Claudino et al., 2017). In SJ, the player starts the jump from the standing position and then flexes his knees up to 90º, holding this position for two seconds before jumping. In CMJ, the player starts the jump standing up, with the knees extended, and after the signal, he must flex the knee to 90º as quickly as possible and jump. Before the evaluation, the players had gone through a jumping learning session with the main researcher of the study.

Heart rate

HR was recorded by second, using the Team System2 monitor and the software from the same manufacturer (Polar, Kempele, Finland). Subsequently, the data were transferred to a computer for analysis using the spreadsheet editor Excel version 2013 (Microsoft Office, Washington, USA). Before the collections, the players had performed two training sessions and a pilot match with the HR monitors to familiarise themselves with the equipment. HR_{max} was considered the highest value reached by the player in the match or the YYIR1 test.

The HR from the match was used to calculate the M-TRIMP, according to the method proposed by Edwards (1993), as described below: HR was divided into five intensity zones according to the HR_{max}: zone 1: 50 to 60%; zone 2: 60 to 70%; zone 3: 70 to 80%; zone 4: 80 to 90%; zone 5: 90 to 100%. The accumulated time in each of the five intensity zones was multiplied by the value of each zone (1-5). The sum in the five intensity zones was the total M-TRIMP, expressed in arbitrary units (UA). In addition to TRIMP, the most intense zone ($HR_{>90\%}$), considered the zone of high-intensity activity (Fox et al., 2018), was also used in the statistical analysis.

Statistical analysis

The normality of the data was tested using the Shapiro-Wilk test, and the data showed normal distribution. The relationship between the physical tests and the M-TRIMP was tested using Pearson's correlation. The correlation classification was adopted according to the correlation coefficient (r): 0-0.1 very weak; 0.1-0.3 weak; 0.3-0.5 moderate; 0.5-0.7 strong; 0.7-0.9 very strong; 0.9-1.0 almost perfect (Hopkins, 2000). The significance level adopted was $p < 0.05$, and the data were expressed as mean and standard deviation. The data were analysed using the Statistical Package for Social Sciences (SPSS) (IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.).

RESULTS

The results of the physical tests are shown in Table 1. The average participation of players per match was 80.2± 5.2 min since not all players played the 90 min (see subjects description). Table 2 shows the HR results, time in the five intensity zones, and the calculated M-TRIMP (348.46 UA). Players spent over 50% of their time playing on high intensity, ≥ 90%FC_{max}. The three zones of lesser intensity (Z-1 to Z-3) represented less than 15% of the spent in the game.

Only YYIR1 and RSA_{best} showed significant correlations with match intensity parameters (Table 3). YYIR1 presented a very strong correlation with M-TRIMP (r= 0.72) and correlated strongly with the time ≥ 90%FC_{max} (r= 0.51). RSA_{best} presented significant correlation only with ≥ 90%FC_{max} (r= -0.50). The other physical tests showed correlations between weak-moderate (r= -0.129–0.448).

Table 1. Results of the physical tests.

	YYIR1 (m)	10-m (s)	30-m (s)	SJ (cm)	CMJ (cm)	RSA_{mean} (s)	RSA_{best} (s)	$RSA_{decrement}$ (%)
Mean	1,596	1.83	4.28	39.0	40.0	7.24	6.91	4.85
SD	304	8.25	1.34	4.04	3.79	1.49	1.22	2.35

YYIR1: Yo-yo intermittent recuperative level 1; 10-m: Speed of 10 meters; 30-m: Speed of 30 meters; SJ: Squat jump; CMJ: Countermovement jumps; RSA_{mean}: mean time; RSA_{best}: best time; $RSA_{decrement}$: Decrement time. Values expressed in mean and standard deviation (SD).

DISCUSSION

The present study aimed to evaluate whether the performance in physical tests correlates with the M-TRIMP and the time in the $HR_{> 90\%}$. M-TRIMP presented a very strong correlation only with YYIR1 (r= 0.72) and a strong correlation with the time in the zone of highest HR intensity, $HR_{> 90\%}$ (r= 0.51). RSA_{best} presented a significant correlation (r= -0.50) with the $HR_{> 90\%}$. On the other hand, the other parameters of the RSA test, just as the SJ with CMJ, did not present a significant correlation with the M-TRIMP and $HR_{>9\ 0\%}$. Our results indicate that not all physical tests correlate with the intensity that the player performed in the match. This is likely because TRIMP is a general response to the exercise period, while some physical tests are more specific, explaining specific responses and not global ones, such as some RSA test parameters, jumps, and speed tests, as opposed to YYIR1, respectively.

YYIR1 assesses intermittent aerobic physical fitness (Bangsbo et al., 2008; Castagna et al., 2020) and has an important anaerobic demand (Rampinini et al., 2010). YYIR1 also has a positive correlation with the distance travelled at high speed and speed (Castagna et al., 2019; Doncaster et al., 2016), the number of sprints (Castagna et al., 2019), and the total distance covered in the match (Castagna et al., 2019; Doncaster et al., 2016). Our results with M-TRIMP (r= 0.72) and $HR_{> 90\%}$ (r= 0.51) confirm that the YYIR1 test is a good indicator of the intensity of the soccer match, indicating the intermittent aerobic fitness and that M-TRIMP can also be used to calculate the internal load of the match, as done in training sessions. Training intensity at $HR_{> 90\%}$ is also strongly related to aerobic performance in team sports (Fox et al., 2018), demonstrating that $HR_{> 90\%}$ is a good indicator for analysing aerobic performance in team sports.

Another physical test used in the present study was the RSA. Among the test variables, only the RSA_{best} showed a significant negative correlation with the $HR_{> 90\%}$, indicating that the players with the best performance, i.e., lower time in the RSA test, remained longer at high intensity in the match. On the other hand, the RSA_{best} did not present a significant relationship with physical performance in the match (Rampinini et al., 2007). Even so, the authors did not exclude the possibility that the RSA_{best} may be related to the other variables of the match. Our results confirm that idea. RSA_{best} represents the best sprint among the six maximal sprints. However, the recovery between each sprint is 20 s, which is insufficient to complete recovery. Thus, RSA_{best} does not represent the player's maximum speed; there is an aerobic demand during the recovery in the RSA test that can influence RSA_{best} and explain a relationship with the time in $HR_{> 90\%}$. RSA_{best} can also be useful for evaluating the time the player remains at high intensity during the match, time in the $HR_{> 90\%}$ zone. On the other hand, no RSA's variable did not correlate significantly with M-TRIMP. A possible explanation for the lack of significant relationships between the RSA and M-TRIMP is the fact that M-TRIMP is a more general indicator. M-TRIMP considers all the time of the match, including the lower-intensity zones, which represent the moments of the match in which the players are in aerobic activities, such as walking, jogging, or even resting without displacement.

Regarding jump tests, SJ and CMJ did not show a significant correlation with M-TRIMP or $HR_{> 90\%}$. Vertical jumps are used to assess the power of lower limbs (Claudino et al., 2017) and have a significant correlation with explosive strength (Rodríguez-Rosell et al., 2017), speed in soccer (Loturco et al., 2020), speed in basketball (Shalfawi et al., 2011), and the number of balls stolen by basketball players (Gomes et al., 2017). The SJ and CMJ test performance depends on

Table 2. Distribution of internal match load and time at the zone of intensity relative to HR_{max}.

Zone of Intensity	HR_{max} (%)	Time (min)	Time (%)	TRIMP (UA)
Z-1	50–60	0.06± 0.12	0.07± 0.16	0.06± 0.25
Z-2	60–70	2.21± 1.66	2.75± 2.18	4.42± 4.10
Z-3	70–80	9.29± 5.64	11.57± 7.02	27.85± 20.75
Z-4	80–90	27.06± 7.55	33.72± 7.58	108.22± 45.43
Z-5	90–100	41.58± 13.41	51.84± 14.47	207.90± 94.69
Total		80.20± 5.25	100	348.46

UA: arbitrary units; TRIMP: Training impulse calculated; HR_{max}: Maximum heart rate; *High intensity zone, $HR_{> 90\%}$: minutes above 90% of HR_{max}.

Table 3. Correlation between the indicators of the intensity of the match with the physical tests.

r-value	YYIR1 (m)	RSA_{mean} (s)	RSA_{best} (s)	$RSA_{decrement}$ (%)	10-m (s)	30-m (s)	SJ (cm)	CMJ (cm)
M-TRIMP	0.722#	0.192	-0.245	0.448	-0.197	-0.363	0.011	0.142
$HR_{>90\%}$	0.512*	-0.129	-0.507*	0.323	-0.146	-0.282	0.139	0.229

Significant correlation: *p< 0.05; #p< 0.01; M-TRIMP: Training impulse of the match; $HR_{> 90\%}$: minutes above 90% HR_{max}; YYIR1: Yo-yo intermittent with recovery level 1; 10-m: Speed of 10 meters; 30-m: Speed of 30 meters; SJ: Squat jump; CMJ: Countermovement jump.

the simultaneous rapid and vigorous contractile strength of the knee and hip extensor muscle groups (Requena et al., 2011; Tsiokanos et al., 2002). Therefore, the evaluation of very short-duration muscle power, such as jumps, does not affect HR elevation, i.e., jumps do not depend on the cardiorespiratory response, which certainly explains why the performance in jumps did not correlate with the internal load and time at high-intensity in the present study, M-TRIMP and $HR_{> 90\%}$, respectively.

The 10-m and 30-m speed tests did not correlate with M-TRIMP and $HR_{> 90\%}$ either. In the speed tests, the movements are also made with vigorous and rapid contractions of the hip and knee muscles (Bloomquist et al., 2013). Although they have a longer duration than the jumping tests, the cardiorespiratory dependence for the test is not large enough for cause-and-effect relationships to be detected between the test performance and the HR response of the entire match. Jumping tests correlate with speed performance and have been proposed to control the training of speed athletes (Loturco et al., 2018), which may help to explain, in part, why the jumps and sprint runs did not correlate with TRIMP or $HR_{> 90\%}$. The M-TRIMP, as a method of assessing the intensity of the match, as well as time in $HR_{> 90\%}$, did not show enough sensitivity to distinguish players with better performance in neuromuscular tests, such as jumping and speed tests since the TRIMP considers the HR of the entire match. Complementing our results, Fox et al. (2018) concluded in a systematic review that the associations between training load and neuromuscular tests are not clear. In addition, the maximal sprinting speed in 10 m from the 40-m test can impact what a player can do in actual playing (Mendez-Villanueva et al., 2011), the maximum speed achieved in the match is higher than that verified in the 40-m field test (Massard et al., 2018).

The present study confirmed that the YYIR1 test is a good test for assessing the intermittent aerobic performance of soccer players, capable of estimating the internal load of the match. At the same time, the RSA_{best} correlated only with time in $HR_{> 90\%}$, reinforcing the idea that activity time above $HR_{> 90\%}$ is also a good indicator of physical performance. On the other hand, the performance in the power and speed tests with short durations were not good indicators of the overall intensity of the match, the M-TRIMP. As for practical applications, our results indicate that the YYIR1 is of great value for coaches and physical trainers to obtain information about the intermittent aerobic capacity of the players and if the players played the match at high intensity, while the tests with anaerobic characteristics, RSA and jumps SJ and CMJ are not indicative of the overall intensity at which players will develop in the match.

On the other hand, it would be interesting that in future studies, in addition to physical tests, the M-TRIMP also be correlated to the external load of the match through the analysis of displacement during the match to add more information since Aquino et al. (2018) analysing the displacement of players of the same age in the present study, with 30 Hz cameras as opposed to 1-5 Hz GPS from other studies, did not find correlations between high-intensity activity with field tests, YYIR1 correlated positively only with medium-intensity running. A Zig-Zag test only correlated significantly with the maximum speed of the match. In contrast, the 10-m and 30-m speed tests and the RSA test (RAST) did not present significant correlations with any match displacement variables.

The use of only one method of determining the TRIMP, proposed by Edwards (1993), can be pointed out as a limitation of the present study. For example, the individual TRIMP proposed by Manzi et al. (2009) presented a better understanding of the dose-response relationship, considering the comparison between a load of training sessions with physical performance and aerobic and anaerobic variables (Malone et al., 2020). Thus, in future studies with objectives like those of the present study, we propose comparing different TRIMP methods and displacement analysis to add more information about M-TRIMP.

CONCLUSIONS

Among the physical tests studied, YYIR1 correlated positively with M-TRIMP and with playing time in the most high-intense zone ($HR_{> 90\%}$), reaffirming that the YYIR1 test is a good performance indicator for soccer players. In the RSA test, only the RSA_{best} correlated with the spent time $HR_{> 90\%}$ during the U-20 soccer match, indicating that the RSA test adds information about the players' physical fitness about the possibilities of what they can perform in the real match. The present study leaves a practical application for the coaches and physical trainers of soccer teams using the YYIR1 and RSA tests as a parameter for analysing the physical capacity of the players. They can predict that players with higher performance on those tests will be able to play the game at a greater intensity than players who perform less on those tests. However, although all physical tests used in this study are supported by the literature, presenting specificity with the actions of the match and correlations with external load variables of the match, the results in physical tests should be viewed with caution. When one intends to correlate the results of the physical tests with the internal load and high-intensity time of the real match, coaches should

carefully consider the purposes of doing an extensive battery of physical tests, mainly the jump speed tests. Based on our results and considering the studied population, YYIR1 and RSA tests can help to understand the internal load response and the time spent in high intensity in the game. Further studies are needed to understand better the relationship between physical tests and M-TRIMP in soccer players.

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ORIGINAL ARTICLE

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Cognitive stimulation and dementia: traditional interventions vs. computer-based methodologies

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ABSTRACT

We aim to examine the role of cognitive stimulation interventions applied to healthy older adults or older adults with mild-to-moderate dementia. The most important benefits and differences between using these programs without computerized tasks compared to computer-based assistive technologies are also addressed. We conducted a literature review which includes empirical studies in the cognitive stimulation field, applied to healthy older adults or in participants with some type of dementia. All studies include cognitive stimulation intervention using traditional methods or computer-based assistive technology. We included a total of 35 studies in our review. In general, our findings provide support for applying cognitive stimulation programs, using traditional methods or computer-based assistive technology, specifically for older people with dementia. However, we found heterogeneity regarding methods, design of intervention, and procedures in both types of methodology. This review adds value towards a systematisation of heterogeneous data existing in this field. However, it remains difficult to perform unbiased comparisons. Future studies should provide a comparative assessment of the effectiveness of cognitive stimulation programs using computer-based assistive technology involving older adults at various stages of dementia, as well as the efficacy and reliability of this type of intervention, practical effects and the potential to delay or prevent dementia.

KEYWORDS: computer-based assistive technology; cognitive stimulation; dementia; healthy older adults; older adults.

INTRODUCTION

Dementia is one of the leading causes of disability and incapacity among the elderly throughout the world (World Health Organization, 2017). According to the Alzheimer's Disease International (2019), approximately 50 million people worldwide are affected by dementia. This number is expected to increase to more than 152 million by 2050. Moreover, the Alzheimer Portugal Association (2020) estimates that by 2050, the number of Portuguese citizens with dementia will gradually increase from 1.88% (in 2018) to 3.82% of the population.

A significant and rapid evolution of neurodegenerative dementias has been seen as a consequence of the substantial increase in average life expectancy in the last century (Murman, 2015). In fact, this issue has been increasingly considered an international health priority and has a significant impact on global healthcare services and governmental systems (Alzheimer's Disease International, 2019). Additionally, the deterioration of cognitive abilities affects individuals directly and their carers, posing new challenges related to the progression of dementia (Hedden & Gabrieli, 2004), such as impaired functions and changes in neuropsychological measures, functionality, independence, and quality of life.

Dementia must be distinguished from normal ageing (normal cognitive decline). There are several degrees of dementia, including pre-dementia (associated with mild cognitive deficit) (Petersen et al., 2001) and different types of dementia (implying severe cognitive deficits) (Alves et al., 2013), namely Alzheimer's disease (AD). When compared with

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mild cognitive impairment (MCI), dementia significantly affects the person's functioning (US Preventive Services Task Force et al., 2020).

In our view, early intervention must be a priority, and prevention should be assumed as important in the field of study of cognitive decline, namely because dementia is significantly responsible for the decline of several human cognitive functions and is considered the principal neurocognitive disorder (US Preventive Services Task Force et al., 2020).

The present review summarises the significant literature on the role of cognitive stimulation interventions applied to older adults with dementia and without cognitive decline and evaluates its effects and outcomes.

Cognitive stimulation

Cognitive stimulation has been extensively applied as an intervention to people with mild to moderate dementia and has been evidenced as a privileged methodology in this area (Aguirre et al., 2014; Capotosto et al., 2017; Piras et al., 2017). In general, the literature defines cognitive stimulation as a non-pharmacological technique that precludes cognitive decline and comprises computer-based cognitive stimulation systems (e.g. computers and tablets) and other traditional approaches that do not include computerized training, with multiple group activities, including engaging in non-specific activities (Mendes et al., 2022; Woods et al., 2012) such as mentally challenging exercises, museum visits, puzzles, and daily life activities.

Cognitive stimulation intervention is aimed at improving general cognition and social functioning (Bahar-Fuchs et al., 2013; Clare & Woods, 2004; Eckroth-Bucher & Siberski, 2009; Gates & Sachdev, 2014; Kim & Kim, 2014; Kueider et al., 2014; Melguizo Herrera et al., 2017; Miranda-Castillo et al., 2012; Mowszowski et al., 2010; Steinerman, 2010) based on the social environment and multisensory stimulation (e.g., attention, language, problem-solving, memory, information processing speed), for example by increasing attention to improving orientation or engaging in activities to improve memory. This approach combines fun, learning, improving performance and skills, and enhancing social contacts (Piras et al., 2017). Also, the literature highlights that cognitive stimulation may preserve or improve cognitive abilities besides reducing the decline caused by normal ageing.

Various studies reported cognitively stimulating activities or tasks (computerized and non-computerized) to reduce cognitive decline (Newson & Kemps, 2006) and improve the cognitive functioning, health, quality of life, and well-being of healthy older adults (e.g. Castel et al., 2017; Fernández-Prado et al., 2012; Tranter & Koutstaal, 2008) or older adults with dementia (Toh et al., 2016; Woods et al., 2012; Yuill & Hollis, 2011). Research also suggests that cognitive stimulation intervention increases global cognitive functioning within a period of 6 to 12 months among people with cognitive impairment of distinct causes (mild cognitive deficit and other statuses of dementia) (Lin et al., 2013).

Cognitive stimulation without computerized tasks: a traditional intervention

Most studies (see Table 1) that do not include technology showed gains after cognitive stimulation in older adults with mild to moderate dementia (Capotosto et al., 2017; Spector et al., 2003; Woods et al., 2006; Yamanaka et al., 2013; Young et al., 2019), older adults diagnosed with mild to moderate vascular dementia (VaD) (Piras et al., 2017), and individuals with AD (Miranda-Castillo et al., 2012; Vidovich et al., 2011).

The study by Spector et al. (2003) conducted a program consisting of 45-minute sessions twice a week over 7 weeks. The study included a prominent reality orientation approach and focused on cognitive stimulation of 201 older adults with dementia (including multisensory stimulation). Results indicated improvements in the individuals' cognitive functioning and quality of life, namely in emotional symptoms. Along the same line, Woods et al. (2006) demonstrated that cognition-based interventions directly impacted the quality of life in older adults diagnosed with dementia.

Another study by Spector et al. (2010), using the same theoretical concepts and a methodological approach similar to their previous study (Spector et al., 2003), demonstrated improvements in conversation and communication and a positive impact on the well-being of 201 older adults with dementia. Despite their promising results, no significant changes in memory and orientation or praxis were found. Yamanaka et al. (2013) reached similar findings in a study with 56 older adults with dementia (26 in the treatment group and 30 in the control group) designed based on principles of the cognitive stimulation program (Spector et al., 2003) adapted to the Japanese culture. Their results demonstrated significant benefits in improving the cognitive function, quality of life, and mood of participants with dementia. Capotosto et al. (2017) showed similar results, namely, decreased emotional loneliness, in 39 older adults with mild to moderate dementia.

Piras et al. (2017) applied a cognitive stimulation intervention in a specific population of 35 older adults with mild to moderate vascular dementia (VaD) divided into two groups: the intervention group, composed of 21 individuals

Table 1. Type of cognitive intervention (cognitive stimulation) for older adults.

Author(s), Year	Subjects | Research design	Main intervention	Main results
Spector et al., 2003.	201 older adults with dementia (115 intervention group and 86 control group) | RCT	Benefit cognition and QoL (do not include computerized tasks).	⇑ Cognitive functioning. ⇑ QoL.
Woods et al., 2006.	201 older adults with dementia | RCT	QoL, cognition, dementia, mood, dependency, and communication (do not include computerized tasks).	Cognition-based interventions have a direct impact on QoL.
Tranter & Koutstaal, 2008.	44 healthy older adults (intervention and control group) | RCT	Fluid intelligence performance (do not include computerized tasks).	⇑ Problem solving and flexible thinking.
Niu et al., 2010.	32 older adults with AD (intervention and control group) | RCT	Executive functions and working memory (do not include computerized tasks).	⇓ Apathy and depression symptomatology.
Spector et al., 2010.	201 older adults with dementia (115 treatment and 86 control groups) | RCT	Memory, praxis and language (do not include computerized tasks).	⇑ Conversation and communication. No significant changes in memory and orientation or praxis.
Vidovich et al., 2011.	128 patients with AD | RCT; follow-up of participants for 6 months post-intervention.	Reducing score on the Alzheimer Disease Assessment Scale-Cognitive Subscale; QoL, mood, memory, language, executive functions, independent living abilities, and psychiatric symptoms (do not include computerized tasks).	⇑ QoL. ⇓ Cognitive decline.
Fernández-Prado et al., 2012.	104 older adults (53 intervention group and 51 control group) | RCT	QoL and cognitive changes (do not include computerized tasks).	⇑ Cognitive performance and QoL.
Miranda-Castillo et al., 2012.	22 older adults with AD (intervention and control group) | RCT; follow-up of participants for 7 weeks post-intervention.	Cognition, QoL, functional ability (do not include computerized tasks).	⇑ Cognitive function and QoL in the intervention group. No differences in functional ability in both groups.
Moro et al., 2012.	30 older adults with MCI (2 groups) | Pre and post-test design.	Attention, memory, and executive functions (do not include computerized tasks).	⇑ Memory abilities on short-term and working memory in group A and long-term memory in group B.
Thiel et al., 2012.	159 older adults (114 intervention group and 45 control group) | RCT; follow-up of participants for 6 months post-intervention.	Combined physical and cognitive intervention in older adults (do not include computerized tasks).	Cognitive stimulation and physical activity may prevent age-related cognitive decline.
Yamanaka et al., 2013.	56 older adults with dementia (26 treatment group and 30 control group) | RCT	QoL, cognition and mood (do not include computerized tasks).	⇑ Cognition, QoL, and mood.
Alves et al., 2014.	20 older adults with cognitive impairment | RCT	Changes in neuropsychological, functionality, QoL, and caregiver outcomes (do not include computerized tasks).	Excellent adherence and completion rates, reasonable costs, high values of experiential relevance to participants.
Dannhauser et al., 2014.	67 older adults with MCI | RCT	No computerized tasks - ThinkingFit program (physical activity, group-based and individual cognitive stimulation - attention, processing speed, working memory, problem-solving, and reasoning).	⇑ Physical health and fitness. ⇑ Working memory.
De Oliveira et al., 2014.	42 healthy older adults (25 institutionalized and 17 noninstitutionalized) | Pre and post-test design.	Memory and language (do not include computerized tasks).	⇑ Language and cognitive performance institutionalized group.
Suzuki et al., 2014.	58 older adults (intervention and control group) | RCT	Memory, executive functions and attention (do not include computerized tasks).	⇑ Executive function, memory, and attention.
Zimmermann et al., 2014.	14 healthy older adults | Pre and post-test design.	Differences between direct and indirect stimulation of WM (do not include computerized tasks).	Both approaches showed benefits (executive functions and linguistic abilities).
Moro et al., 2015.	30 older adults with MCI (2 groups) | Pre and post-test design	General functions, executive functions, memory, and language (do not include computerized tasks).	⇑ Performance, memory, and general functions in both groups.

Continue...

Table 1. Continuation.

Author(s), Year	Subjects | Research design	Main intervention	Main results
Malvy, 2016.	11 older adults with MCI| Descriptive study.	Attention, memory, language, praxis, visuo-spatial skills, and executive function training. Computerized cognitive stimulation KODRO software.	⇑ Attention, memory, language, and praxis.
Yasini & Marchand, 2016.	15 older adults | Pre and post-test design.	WM, attention, concentration, visual-spatial memory. Tablet application Stim'Art.	No significant difference in improving the well-being between male and female users.
van Zon et al., 2016.	53 older adults (37 experimental and 16 control group) | Pre and post-test design.	Reasoning, attention and memory (do not include computerized tasks).	⇑ Cognitive abilities in long-term care. ⇑ Memory and verbal fluency.
Castel et al., 2017.	176 older adults (123 intervention group and 53 control group) | Pre and post-test design.	No computerized tasks (orientation, memory, language, gnosis, praxis, reminiscences, numerical calculation, attention, and concentration).	⇑ Psychological well-being in cognitive stimulation group.
Capotosto et al., 2017.	39 older adults with mild to moderate dementia | RCT	Cognitive functioning, QoL, mood, functional activities in daily living, and behavior (do not include computerized tasks).	⇑ Cognitive functioning. ⇑ QoL and mood.
Dethlefs et al., 2017.	23 older adults (13 healthy and 10 with dementia) | Pilot nonrandomized.	Memory and communication. Computer-based assistive - Wizard-of-Oz.	⇑ Spoken natural language.
Djabelkhir et al., 2017.	19 older adults with MCI (9 CCS and 10 CCE) | RCT	Computerized cognitive stimulation (KODRO). Global cognitive function, executive functions, working memory, episodic memory, and psychosocial functioning.	⇑ Processing speed, episodic memory, and self-esteem in CCE group. ⇑ Self-esteem in CCS group.
Grimaud et al., 2017.	67 older adults | Pre and post-test design.	Processing speed, working memory, executive functions, memory span, and self-esteem (do not include computerized tasks).	⇑ Memory span, updating and memory self-perception; processing speed. ⇑ Self-esteem.
Melguizo Herrera et al., 2017.	37 older adults (23 experimental group and 14 control group) | Pre and post-test design.	Memory, orientation, information about daily events, and arithmetic (do not include computerized tasks).	⇑ Cognitive functioning.
Ordonez et al., 2017.	124 older adults (102 experimental group and 22 control group) | Pre and post-test design.	Global cognition, depressive and anxiety symptoms, memory complaints, and learning satisfaction. Electronic games equipment Actively Station.	⇑ Language and memory. ⇓ Anxiety symptoms and memory complaints.
Piras et al., 2017.	35 older adults with mild to moderate VaD | RCT	Working memory, language, QoL, mood, behavior and everyday life functioning (do not include computerized tasks).	⇑ General cognitive functioning.
Stewart et al., 2017.	40 older adults with dementia | Pre and post-test design.	Cognition, QoL and depression (do not include computerized tasks).	⇑ Cognitive status. ⇓ Depression. No differences in QoL.
Djabelkhir-Jemmi et al., 2018.	51 older adults with MCI | Pre and post-test design; - follow-up of participants for 3 months post-intervention	Executive functions, attention, and processing speed. Computerized cognitive stimulation KODRO software.	⇑ Executive functioning, processing speed, and memory – patients with MCI-WMH.
Martínez-Alcalá et al., 2018.	22 older adults | Pilot nonrandomized.	Attention, memory, comprehension, perception, and visualspatial processes. Mobile app iBenni.	⇑ Attention, comprehension, and short-term memory.
Karssemeijer et al., 2019.	115 older adults with dementia | RCT; follow-up of participants for 6 months post-intervention.	Executive function, episodic memory, working memory, and psychomotor speed. Interactive virtual bike tours: Bike Labyrinth.	No effects were found on executive function, episodic and working memory.
Valdés et al., 2019.	49 older adults with MCI (24 treatment group and 25 control group) | RCT	Processing speed. Road Sign Test computer training.	⇑ Speed of processing training.
Young et al., 2019.	101 older adults with dementia (51 treatment group and 50 control group) | RCT	Cognitive functioning (do not include computerized tasks).	⇑ Cognitive functioning in the treatment group.
Young, 2020.	80 older adults with mild-stage dementia (41 treatment group and 39 control group) | RCT	Cognitive ability and QoL (do not include computerized tasks).	⇑ General cognitive functioning.

RCT: Randomized controlled trial; AD: Alzheimer's disease; QoL: Quality of life; MCI: Mild cognitive impairment; WM: Working memory; CCS: Computerized cognitive stimulation; CCE: Computerized cognitive engagement; VaD: Vascular dementia; WMH: White matter hyperintensities.

who attended the 14 sessions of the cognitive stimulation program, and the other group, which took part in alternative educational activities. They analysed the cognitive functioning, quality of life, mood, behaviour, and functional activities of daily living and detected improvements in general cognitive functioning and a trend toward increased short-term/working memory in the intervention group.

Contrary to most studies, some did not evidence positive effects on the quality of life of older adults with dementia who integrated a cognitive stimulation program without technology. Namely, Young et al. (2019) and Young (2020) applied an expanded traditional cognitive stimulation model (without computerized tasks) with tai chi techniques to older adults with mild-stage dementia and found a trend toward improving general cognitive functioning but no overall increase in quality of life. Stewart et al. (2017), who applied a cognitive stimulation intervention to 40 older adults with dementia, also did not detect differences in quality of life, even though encouraging results were highlighted in cognitive functioning and reduced depression levels.

Regarding AD, in particular, three studies used traditional interventions. Niu et al. (2010) integrated 32 older adults with mild to moderate AD in a cognitive stimulation therapy group that included individual tasks using executive functioning and working memory, such as "The reality orientation task," "The fluency task," "The overlapping figure task," and "The photo-story learning task." The training consisted of 45-minute sessions twice a week for 10 weeks, and positive effects were found, with decreased apathy and depression symptomatology. Miranda-Castillo et al. (2012), who integrated 22 participants diagnosed with AD in a program of 14 sessions of cognitive stimulation therapy, found improvements in cognitive function and quality of life in the intervention group but no differences in functional ability in either group.

Vidovich et al. (2011) applied a 12-week cognitive activity program with a follow-up of 6 months post-intervention to 128 older adults with AD divided into two groups. In group 1, individuals with mild AD and their companions participated together in a 7-week intervention of one 90-minute session per week focused on cognitive abilities usually affected in AD (attention, processing speed, memory, language, and executive functions). The program had a supervision and practice component with strategy techniques and examples of home activities, with phone-call support. In turn, group 2 only included carers, who received information and materials in the same terms as Group 1 and were instructed to transmit all the knowledge to facilitate patients in their natural environment and everyday situations. The main results revealed an improvement in quality of life and decreased cognitive decline in older adults with mild AD. That study also suggests that the cognitive stimulation approach for individuals with AD is probably more reliable when caregivers are also included in therapy.

Cognitive stimulation intervention without computerized tasks has also been shown to be beneficial for people with MCI. In a two-stage study, Moro et al. (2012) applied cognitive stimulation to 30 older adults with MCI divided into two groups. Both groups were assessed at an early stage of the program, but only 15 individuals of group A took part in an immediate cognitive stimulation intervention for six months. Group B only attended the program in the second stage and received specific training for six months. Positive effects of cognitive stimulation were detected in memory, particularly in short-term and working memory for group A and long-term memory for group B. These results are encouraging and emphasise the significant role of specific training in reducing cognitive impairments in people with cognitive decline. Similar findings were found later by Moro et al. (2015) in a sample of 30 older adults with MCI participating in a program based on cognitive stimulation, whose main intervention focused on general cognitive functions, executive functions, memory, and language. In addition to improvements in memory, the authors found an increment in performance and general functions.

Dannhauser et al. (2014) conducted a study combining physical activity with cognitive stimulation to test a complex multimodal activity intervention (ThinkingFit program) in reducing the risk of dementia in 67 older adults with MCI. The intervention had three components: physical activity and group and individual cognitive stimulation training (in domains of attention, processing speed, working memory, problem-solving, and reasoning). The results showed positive outcomes for physical health and fitness and improved working memory. Previously, Thiel et al. (2012) had already concluded that physical activity, together with cognitive stimulation intervention, could prevent age-related cognitive decline in a large sample of seniors.

A study by Alves et al. (2014) with a sample of 20 older adults with cognitive impairment (cognitive decline ranging from MCI to mild-to-moderate dementia) used two distinct approaches – a standard cognitive stimulation program (17 sessions, six weeks) and a brief cognitive stimulation program (11 sessions, four weeks) — to assess changes in different domains: neuropsychological, functionality, quality of life, and caregiver outcomes. Findings pointed out outstanding adherence and completion rates, acceptable costs, and high values of experiential relevance to users. Despite these

conclusions, the remaining results were not considered clinically significant.

Many studies have confirmed the benefits of cognitive stimulation intervention in healthy older adults. In the study by Castel et al. (2017), 176 older adults were divided into two groups: 123 participated in a cognitive stimulation program, while 53 formed a control group, using a pre-and post-test design. Participants engaged in various tasks related to orientation, memory, language, gnosis, praxis, reminiscences, numerical calculation, attention, and concentration, without the use of computerised methods. Results showed an improvement in psychological well-being in the cognitive stimulation group. Tranter and Koutstaal (2008) observed gains in cognitive functions, such as problem-solving and flexible thinking, in n study that encouraged engagement in mentally stimulating activities. Zimmermann et al. (2014) applied two different approaches for direct and indirect stimulation of working memory: the first group attended a structured working memory training program with 2-hour sessions for 6 weeks, while the second integrated a poetry-based stimulation program of twelve 2-hour sessions for 6 weeks. Both interventions showed benefits in executive functions (direct stimulation) and linguistic abilities (indirect stimulation). De Oliveira et al. (2014) also demonstrated positive effects on executive functions and linguistic abilities in a population of healthy older adults, applying a multisensory and cognitive stimulation method.

Other studies with healthy older adults have found similar benefits when applying traditional cognitive stimulation interventions, including positive results in executive function, memory, and attention (Suzuki et al., 2014), general cognitive functionality (Fernández-Prado et al., 2012; Melguizo Herrera et al., 2017; van Zon et al., 2016); memory and verbal fluency (van Zon et al., 2016); and memory span, updating and memory self-perception and processing speed (Grimaud et al., 2017).

Cognitive stimulation using computer-based assistive technology

Studies on cognitive stimulation based on computerized tasks and supported by technological methodologies have shown strong evidence suggesting that cognitive stimulation intervention in a particular domain improves performance in that specific domain for individuals with mild to moderate cognitive impairment.

Djabelkhir et al. (2017) applied computerized cognitive exercises and social interaction activities in a sample of 19 patients with MCI divided into two groups of intervention: computerized cognitive stimulation (first group, 9 participants) and computerized cognitive engagement (second group, 10 participants). The first group was involved in computerized cognitive exercises (KODRO software) and social interactions, and results confirmed improvement of inhibitory control, mental flexibility, and self-esteem, as well as a higher performance in free recall. The second group conducted tasks previously defined (e.g., exploring applications about a specific theme) in an informal context. Although the main results showed positive effects in processing speed, episodic memory, and self-esteem, no significant differences were detected in quality of life, memory complaints, anxiety, and depression between computerized cognitive stimulation and computerized cognitive engagement. These results are corroborated by another study that confirms this software enables the improvement of executive functioning, processing speed, and memory (Djabelkhir-Jemmi et al., 2018). The study by Malvy (2016) also documented the positive effects of the KODRO cognitive stimulation program applied to 11 individuals diagnosed with MCI, particularly in four domains of six cognitive functions tested: memory, attention, language, and praxis. Participants used a touch tablet in a weekly session for 12 months.

A recent study by Valdés et al. (2019) focused on cognitive processing speed training in 49 older adults with MCI, with three different tasks: i) the Road Sign Test, which tests the reaction time of participants in response to a set of stimuli presented by a computer; ii) The Timed IADL Test, which uses stimuli of instrumental activities of daily living (e.g., reading the directions on a medicine bottle label) presented by a computer; and iii) the UFOV Test, which is a computerized test of cognitive processing speed for visual attention tasks. Conclusions indicated that computer training improved the processing speed in people with MCI.

Dethlefs et al. (2017) conducted a study on 23 participants involved in cognitively stimulating activities (memory and communication tasks) based on processing information, such as sorting, name recall, quiz, and proverbs, for 20 minutes, using the electronic game Wizard-of-Woz (WoZ interface). They showed that this game could improve the spoken natural language of adults with dementia and healthy older people. In turn, Martínez-Alcalá et al. (2018) used the mobile app iBenni to train attention, memory, comprehension, perception, and visual-spatial processes in a more general sample of 22 older adults and detected gains in attention, comprehension, and short-term memory. Ordonez et al. (2017) used a cognitive stimulation tool, the electronic games equipment Actively Station, in 124 older adults and confirmed the improvement of language and memory functions and the reduction of anxiety symptoms and memory complaints.

However, not all studies showed positive effects of cognitive stimulation using computer-based assistive technology, especially in studies including older adults with dementia or MCI. Namely, Karssemeijer et al. (2019), who used the interactive virtual bike tours Bike Labyrinth in 115 older adults with dementia to train executive function, episodic memory, working memory, and psychomotor speed, confirmed improvements in psychomotor speed but no effects on executive function and episodic and working memory. Yasini and Marchand (2016) found no significant differences in the trained cognitive functions when increasing the difficulty levels and the time older adults spend using the tablet application Stim'Art. However, although the results showed no gains in the well-being of users, the participants' self-evaluations reflected an improvement in the well-being score.

CONCLUSION

The current study presents a review of the recent state of cognitive stimulation intervention in older adults with mild to moderate dementia. In general, the studies evidence the psychological and cognitive benefits of applying cognitive stimulation, both traditionally and using computer-based assistive technology. Regarding quality of life, the results reported in some of the studies considered indicate a positive trend of this intervention's traditional use compared to using technology, especially in people with dementia and AD (Miranda-Castillo et al., 2012; Spector et al., 2003; Spector et al., 2010; Vidovich et al., 2011; Woods et al., 2006; Yamanaka et al., 2013) and in improvement of general cognitive functioning (Capotosto et al., 2017; Young et al., 2019; Young, 2020). Positive results have also been verified in several cognitive functions, especially in healthy older adults reported in some of the studies that do not include technology, namely general cognitive functioning (Fernández-Prado et al., 2012; Melguizo Herrera et al., 2017; van Zon et al., 2016), executive function, memory, attention (Suzuki et al., 2014), verbal fluency (van Zon et al., 2016), and processing speed (Grimaud et al., 2017). On the other hand, some authors confirm improvements in attention, memory, language, praxis (Malvy, 2016), processing speed (Djabelkhir et al., 2017; Valdés et al., 2019) and executive functioning (Djabelkhir-Jemmi et al., 2018) in older adults with MCI after computerized cognitive stimulation.

Despite the significant increase in research on ageing and dementia, it appears that the cognitive stimulation intervention is still at an early stage. Although most studies confirm the effectiveness of a traditional intervention (compared to studies of computer-based assistive technology), further studies are needed to compare the true benefits of this intervention at the various stages of dementia. The analysed studies also confirm the benefits of multimodal interventions (physical activity and cognitive stimulation). Thus, we propose further studies in this area to facilitate the effective verification of this intervention methodology. Future investigations should also study whether or not the cognitive stimulation intervention can delay or prevent dementia. This assessment is relevant because it can facilitate the adoption and implementation of this type of intervention by diverse healthcare entities, reducing the consequences of this disease for society.

We found heterogeneity in the design of intervention studies, namely, study design, sample size and characteristics (the samples of studies that use computer-based assistive technology are considerably smaller compared to studies without computerized tasks or a traditional intervention), control condition, the number of sessions, the program duration, costs and benefits to the user, the ideal level of intensity/difficulty, the standardisation of neuropsychological assessment protocols, and treatment procedures. In this regard, it might be important to consider the standardisation of research methods based on evaluation by specialists in the cognition field and related areas. In terms of brain structures and the effects of cognitive stimulation, it is important to include neuroimaging measures and other neuropsychological assessment measures (depression, fatigue, quality of life, motivation, interpersonal relationships, and others) in the different research stages of dementia and protocols, in order to assess the global and specific effects of this intervention on the user's life, but also its immediate and long-term effects and the possible preventive role.

In conclusion, we argue that there is a need for standardised procedures in the cognitive stimulation intervention field in order to maximise the practical evidence of this type of intervention and its different roles at the various stages and types of dementia. These advances might benefit older adults, specifically their cognitive, psychological and social functioning, directly impacting their quality of life, including healthy older adults or impaired individuals (e.g., MCI, demented patients).

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Direção técnica em ginásios e health clubs: um estudo exploratório sobre a perceção dos profissionais de exercício físico

Technical direction in gyms and health clubs: an exploratory study on the perception of physical exercise professionals

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RESUMO

A figura do diretor técnico foi introduzida na lei em 2012, mas pouca investigação foi produzida para compreender como tem desenvolvido a sua ação. Este estudo pretendeu analisar as perceções dos técnicos de exercício físico (TEF) sobre i) a importância das funções dos diretores técnicos (tal como definidas na lei), e ii) a forma como os diretores técnicos cumprem e desenvolvem as suas funções, contrastando os resultados por segmento de mercado. Realizou-se uma análise descritiva e de frequências a uma amostra de 194 profissionais de exercício com uma média de idades de 34.46 anos (*DP*= 8.78), e com uma média de anos de experiência de 9.04 anos (*DP*= 6.84), que participaram voluntariamente neste estudo. O presente trabalho evidenciou que os TEF valorizam as funções atribuídas ao diretor técnico expressas na lei. Verificou-se que a regularidade do apoio do diretor técnico é bastante heterogénea, sendo que em quase 50% dos respondentes a classificação atribuída foi de inexistente ou pouco regular. Verificou-se ainda que cerca de 45% dos TEF consideraram a prestação dos diretores técnicos como sendo muito fraca ou fraca. Da análise por segmento de mercado, o *low cost* apresentou, genericamente, os piores resultados percentuais, e o *premium* os melhores.
PALAVRAS-CHAVE: ginásios; diretor técnico; técnicos de exercício físico; qualidade do serviço.

ABSTRACT

The position of the technical director was introduced into Portuguese law in 2012, but little research has been produced to understand how it has developed its action since. This study analysed the perceptions of the physical exercise technicians (TEF) regarding i) the importance of the functions of technical directors (as defined in the law) and ii) the way technical directors fulfil and develop their roles, contrasting the results by market segment. A descriptive and frequency analysis was made of a sample of 194 exercise professionals, with a mean age of 34.46 years (*SD*= 8.78) and a mean years of experience of 9.04 years (*SD*= 6.84), who voluntarily participated in this study. The present work showed that the TEF value the role attributed to the technical director expressed in the law. The regularity of the technical director's support was found to be quite heterogeneous, with almost 50% of the respondents classifying it as non-existent or not very regular. It was also found that around 45% of the TEF considered the performance of the technical directors to be very weak or weak. From the analysis by market segment, the low cost generally presented the worst percentage results, while the *premium* segment presented the best results.
KEYWORDS: gymnasium; technical director; physical exercise professionals; service quality.

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INTRODUÇÃO

Os ginásios e *health clubs*, mais contemporaneamente denominados de centros de fitness, são um dos locais preferidos pelos portugueses para a prática de exercício físico (European Commission, 2022; IHRSA, 2022). A nível nacional estão envolvidos milhares de utilizadores nas diversas práticas disponibilizadas (Pedragosa et al., 2022) e, por serem um contexto com prática supervisionada, apresentam um enorme potencial na promoção da saúde pública. No entanto, várias críticas/preocupações têm sido apresentadas à forma como alguns destes espaços funcionam e se organizam (Ramos et al., 2021; Teixeira et al., 2020; Teixeira et al., 2021). Num desses tópicos de preocupação visando o progresso da área, destaca-se a necessidade de elevar a qualidade do serviço prestado, onde a função e atuação do diretor técnico poderá ser determinante.

O diretor técnico em ginásios e health clubs: enquadramento legal e reflexões operacionais

Esta figura é introduzida na Lei n.º 39/2012, tornando-se o responsável pela direção das atividades que decorrem nas instalações, tanto do ponto de vista técnico, como da segurança e higiene das práticas (Mestre, 2017). Deve ainda promover a coordenação e supervisão dos Técnicos de Exercício Físico (TEF), visando *"assegurar o desenvolvimento da atividade desportiva num ambiente de qualidade, segurança e defesa da saúde dos participantes e respeito pelos valores da ética no desporto"* (Portugal, 2009). De acordo com a Lei n.º 9/2009, ao diretor técnico é exigido o grau de licenciatura em desporto ou educação física (ou reconhecimento de qualificações profissionais para o efeito) para que possa exercer esta função. Objetivamente, a Lei n.º 39/2012 (Artigo 6.º) apresenta as seguintes funções como sendo da responsabilidade do diretor técnico: *a) coordenar e supervisionar a prescrição, avaliação, condução e orientação de todos os programas e atividades, da área da manutenção da condição física (fitness), no âmbito do funcionamento das instalações desportivas, aos seus utentes*; *b) coordenar e supervisionar a avaliação da qualidade dos serviços prestados, bem como propor ou implementar medidas visando a melhoria dessa qualidade*; *c) elaborar um manual de operações das atividades desportivas que decorrem nas instalações desportivas que prestam serviços desportivos na área da manutenção da condição física (fitness)*; *d) coordenar a produção das atividades desportivas*; *e) superintender tecnicamente, no âmbito do funcionamento das instalações desportivas, as atividades desportivas nelas desenvolvidas*; e *f) colaborar na luta contra a dopagem no desporto*.

Tal como argumentado por Teixeira et al. (2020), o diretor técnico poderá ser um agente crucial na promoção da qualidade do serviço e dignificação da área profissional. Idealmente, atuaria articuladamente com os TEF visando a prestação de um serviço de qualidade, baseado na evidência, e ajustado às características dos clientes e do espaço de trabalho. No entanto, não é claro como, nem com que qualidade, esta função tem vindo a ser desempenhada desde a última revisão do enquadramento legal.

Apesar de indicação legal sobre a necessidade da identificação de um diretor técnico por espaço, assim como de um horário de permanência, não é claro se essa permanência é alocada exclusivamente às funções de diretor técnico ou feita em simultâneo com outras tarefas técnicas (e.g., treino personalizado e aulas de grupo), nem o tempo específico de dedicação a essas tarefas. Na realidade, considerando que os ginásios têm várias tipologias, dimensões e características (Pedragosa et al., 2022), não seria desejável que existissem imposições legais sobre essa matéria, pois existiria o risco de não serem viáveis ou aplicáveis em todos os contextos. Adicionalmente, também não existem orientações emitidas por nenhuma entidade sobre como desempenhar tal função. Por um lado, porque não existem entidades que regulem contextualmente a prática destes profissionais, estando a atribuição de cédula profissional dependente da obtenção de aprovação num conjunto de formações homologadas para o efeito, onde os programas curriculares poderão ter, ou não, conteúdos sobre esta função técnica. Por outro, porque desempenhando o diretor técnico uma função (muitas vezes cumulativa com a de TEF), e não uma profissão ou categoria profissional especializada, seria expectável que fossem as entidades de formação de profissionais da área que se atualizassem na promoção de conteúdos alinhados neste sentido.

Não havendo dados de estudos nacionais sobre a existência e/ou forma como os conteúdos programáticos associados ao processo de direção técnica em cursos de especialização e formação superior são realizados, nem entidade própria que se debruce sobre esta situação, fica-se perante um vazio formativo de necessidade operacional, expressa na lei, dependente da boa vontade e urgência subjetiva definida por cada entidade formativa. Lamentavelmente, uma pesquisa genérica e exploratória feita no decorrer do desenvolvimento deste trabalho sobre as unidades curriculares e os seus conteúdos nos sites das universidades e institutos politécnicos nacionais que promovem cursos relacionados com o desporto, educação física, ou exercício e saúde, mostra (na maioria) que a direção técnica não está expressa nos conteúdos programáticos. Tendencialmente, ao existirem, são conteúdos associados à gestão de clubes (nem sempre de ginásios ou *health clubs*), que não mencionam ou se dirigem a esta função em particular. Mesmo nos referenciais de formação dos

cursos de especialização tecnológica conferentes de cédula profissional, onde existem módulos de gestão de ginásios e *health clubs*, tal enquadramento não se encontra claramente expresso. Sabendo que este processo formativo não permite, de acordo com a lei, que um TEF exerça a função de diretor técnico, seria no entanto expectável que essa figura fosse genericamente enquadrada de forma clarificar o funcionamento orgânico dos ginásios, e a quem o TEF poderá e deverá esperar apoio e supervisão das suas práticas.

A (in)exploração do impacto contextual e operacional das orientações legais

A exploração do impacto destas orientações legais e respetivas funções teve, em dez anos de aplicação, reduzida atenção por parte da investigação nacional. Uma das primeiras referências encontradas na literatura sobre o tema surge em 2014, que remete apenas para a apresentação desta figura face ao novo enquadramento legal, e um possível aporte que algumas orientações emitidas pelo ACSM para a função poderão ter, apesar de independentes do enquadramento legal português (Brito et al., 2014). No ano seguinte surgem dois trabalhos, uma dissertação de mestrado (Neves, 2015), onde se procurou explorar, através do questionamento aos diretores técnicos, quais as competências e formação que eram percecionadas como essenciais a esta função e as tarefas que comummente realizavam; e um artigo técnico (Ramos et al., 2015), que apesar de estar focado na perceção dos diretores técnicos sobre as competências e formação dos TEF, permitiu uma primeira exploração da opinião que esta figura com funções de gestão técnica possuía. Posteriormente, surge em 2020 um artigo de opinião sobre vários tópicos relacionados com a qualidade do serviço prestado nos ginásios, onde se destaca que a ação do diretor técnico aparentava estar aquém do desejado, do definido na lei, e idealmente necessário para a elevação da qualidade das práticas e dignificação da área profissional (Teixeira et al., 2020). Como possíveis problemas, foi identificada a falta de delimitação conceptual à função, supervisão ao cumprimento das tarefas por inexistência de órgão ou entidade para esse efeito, formação específica, e possíveis diferenças na qualidade do serviço prestado de acordo com o segmento de mercado pelo preço[1] (Pedragosa et al., 2022). No ano seguinte surge por Ramos et al. (2021) uma tentativa de caracterizar os profissionais de fitness em Portugal (*N*= 445), onde 42.2% dos inquiridos possuía título de diretor técnico. Infelizmente, não houve diferenciação entre TEF e diretor técnico nas análises e resultados apresentados, pelo que não é possível a partir desse estudo compreender o perfil concreto de atividades dos diretores. No mesmo ano, o trabalho de Campos et al. (2021) procurou expor e clarificar o enquadramento legal em vigor para o desempenho das funções do TEF e do diretor técnico. Analisou-se também de forma breve a aplicabilidade "prática" (entenda-se, operacional) da Lei n.º 39/2012, onde se estabeleceram algumas críticas específicas, tais como o número de diretores técnicos por espaço e possível conflitualidade de ações e responsabilidades, e a incapacidade de o diretor técnico garantir a segurança das práticas, tal como expressa na lei, quando não existe um posicionamento claro sobre a necessidade da existência de um TEF permanentemente no período de funcionamento dos ginásios. Em 2022, surge uma dissertação de mestrado (Valagão et al., 2022) que se focou no enquadramento jurídico das habilitações dos TEF e diretor técnico, assim como na opinião de agentes e grupos de interesse relevantes no âmbito da intervenção dessas funções técnicas (tamanho total da amostra= 35 participantes). Nesse trabalho foi feita uma exploração qualitativa sobre a figura jurídica do diretor técnico, função, acesso ao título de diretor técnico, entre outros fatores. Dos resultados pôde-se verificar que a maior parte dos inquiridos considerou relevante a existência do diretor técnico (sim= 91.4%), e que concordavam com a existência de todas as funções definidas em lei para o diretor técnico (artigo 6.º, todas as alíneas; amplitude das respostas: 88.6–97.1%). Por fim, no mesmo ano, um estudo de Soares et al. (2022) procurou perceber e descrever o perfil funcional dos diretores técnicos dos centros de fitness na região Norte de Portugal. Nesta exploração foram questionados 128 diretores técnicos que reportaram limitações na sua formação como um dos problemas para o desempenho das suas tarefas. Ademais, indicaram que apesar das funções de direção técnica estarem descritas na lei, nem todos as cumpriam.

Este balanço da literatura que se debruçou sobre as características e funções do diretor técnico apresenta frontalmente várias lacunas na compreensão do seu real impacto nos ginásios e *health clubs*. À parte de algumas explorações com questionamento direto aos diretores técnicos, apenas um estudo se debruçou sobre a perceção dos TEF (Valagão et al., 2022), os agentes que, de acordo com a lei supracitada, atuam sob a orientação e supervisão dos diretores técnicos, e mais impactam a intervenção direta com os clientes (Campos et al., 2021; Teixeira et al., 2021). Acresce que esse estudo teve como amostra de TEF apenas 15 elementos, que quando questionados se concordavam com as funções do diretor técnico expressas na lei, tinham apenas uma opção dicotómica

1 *Low cost*: os clubes com mensalidade média menor ou igual a 30,00€; *Middle Market*: os clubes com mensalidade média entre 30,00€ e 65,00€; *Premium*: os clubes com mensalidade média superior a 65,00€.

de resposta (sim ou não), uma abordagem manifestamente insuficiente para compreender o grau de relevância de cada função, assim como da sua concordância, e contraste, com a sua realidade profissional.

Num contexto onde a taxa de atrito internacional tende a ser superior a 50% nos primeiros 6 meses de prática (Sperandei et al., 2016), e de 63% (em média anual) em Portugal (Pedragosa et al., 2022), e sendo os TEF os principais agentes de interação com os clientes, uma boa supervisão da sua prática seria certamente um caminho para a melhoria do serviço prestado e redução desta taxa de atrito. Dos vários motivos que usualmente são reportados como fatores para o abandono ou interrupção, os relacionados com as dinâmicas interpessoais (e.g., relação com outros clientes ou profissionais; suporte técnico) são geralmente destacados (Gjestvang et al., 2020; Rand et al., 2020). Sendo a supervisão da prática (do ponto de vista macro) uma responsabilidade do diretor técnico, seria relevante compreender como veem os TEF este apoio nas suas tarefas regulares.

Adicionalmente, a segmentação do mercado (por preço; doravante designado apenas como segmento de mercado) do fitness tem diferenciado a oferta e potencialmente a qualidade dos serviços prestados (Teixeira et al., 2020), algo passível de ser observado na capacidade de manutenção de sócios ativos (para dados concretos no período 2018-2021, ver Pedragosa et al., 2022). Ao apresentar diferentes características do local e atividades desenvolvidas, assume-se que diferentes perceções da qualidade da prática, tanto do ponto de vista do cliente como dos profissionais, possam existir. Se essas diferenças se manifestam ou derivam da ação concreta do diretor técnico, é algo ainda não explorado na literatura nacional, mas que carece de aprofundamento célere.

Presente estudo

Contemplando a escassa a literatura nacional que procurou explorar de que forma as alterações introduzidas pela Lei n.º 39/2012 se manifestaram no contexto e prática profissional, e assumindo como lacuna a compreensão de como os diretores técnicos desenvolvem as suas atividades, o presente estudo pretende de forma exploratória realizar uma análise sobre: i) as perceções dos TEF sobre a importância das funções dos diretores técnicos (tal como definidas na lei), e ii) a perceção dos TEF sobre a forma como os diretores técnicos cumprem e desenvolvem as suas funções, contrastando os resultados por segmento de mercado. Esta exploração permitirá averiguar se críticas prévias à reduzida atuação do diretor técnico assentam em dados objetivos, dando um primeiro passo para a compreensão desta questão e procurando avançar a reflexão sobre o tema.

MÉTODO

Participantes

Uma amostra de conveniência de 194 profissionais de exercício (masculinos= 129; *NS/NR*= 1), com uma média de idades de 34.46 anos (*DP*= 8.78), e com uma média de anos de experiência na área de 9.04 anos (*DP*= 6.84) participou voluntariamente neste estudo de natureza transversal. Nesta amostra, quando questionados sobre a formação académica mais elevada que possuíam, 32% reportaram curso de especialização tecnológica, 42.3% licenciatura, 9.2% pós-graduação, 15.5% mestrado, e 1% doutoramento. Em relação ao segmento de mercado em que dedicavam a maior parte do seu tempo de prática profissional, 41.2% indicaram o segmento *low cost*, 23.2% *middle market*, 23.7% *premium*, e 11.9% em outros modelos de negócio (e.g., ginásios femininos, boutiques, box e estúdios).

Procedimentos

No seguimento de uma linha de investigação mais ampla com o objetivo de compreender a qualidade da experiência subjetiva do praticante de exercício físico, aprovado pela comissão de ética da Faculdade de Educação Física e Desporto da Universidade Lusófona, foi desenvolvido um questionário online através da plataforma *Google Docs* e disponibilizado via redes socais e *mailing lists* de profissionais. Para aceder ao questionário, os participantes tinham de ler previamente uma carta explicativa do estudo que continha também informações sobre o consentimento informado, livre e esclarecido associado ao estudo. Neste documento era indicado, entre outros, que a participação era voluntária, anónima, e que poderia ser interrompida a qualquer momento. Informações sobre o objetivo do estudo e contacto do responsável também foram disponibilizados. Neste documento foi apresentada informação sobre os critérios de inclusão: qualquer TEF em atividade em ginásios e *health clubs* nos últimos 6 meses (sem limite máximo), e que não exercesse atualmente ou no período anterior até 1 ano funções de direção técnica. Para prosseguir e aceder às restantes questões os participantes tinham de selecionar a opção em que declaravam ter lido e aceitado participar na investigação. A coleta decorreu durante os três primeiros meses de 2022.

Instrumentos

Na ausência de instrumentos específicos para compreender o pretendido, um questionário específico para o objetivo do estudo foi preparado. Numa primeira fase, o autor DT desenvolveu um conjunto de perguntas organizadas por domínios e estruturadas com escalas *Likert* de resposta com

5 pontos. De seguida, as perguntas foram avaliadas independentemente por três outros autores definidos para o painel avaliador do instrumento (HP, AS e CC). Os comentários e alterações propostas foram analisadas pelo autor DT e uma nova versão para discussão entre os quatro autores foi apresentada. Por consenso, chegou-se à versão final que constitui o instrumento para este estudo.

O presente questionário continha perguntas de cariz sociodemográfico (idade, sexo, data de nascimento) e profissional (anos de experiência, formação académica, segmento de mercado onde alocava a maior parte do tempo em ação profissional, principais funções exercidas, e experiência prévia como diretor técnico). Posteriormente, o instrumento continha antes do questionamento sobre os domínios em estudo, todas as alíneas sobre as funções do diretor técnico dispostas na Lei n.º 39/2012. Foi solicitado aos participantes que no caso de possuírem mais do que um local onde desempenhavam as suas práticas, considerassem sempre nas suas respostas o local onde alocavam maior tempo de atuação profissional. Os domínios que se pretendiam avaliar foram: i) importância da atuação do diretor técnico de acordo com as funções definidas na lei (por alínea do artigo 6.º), respondidas numa escala *Likert* de 5 pontos (1 [muito baixa], 2 [baixa], 3 [moderada], 4 [elevada], e 5 [muito elevada]); ii) regularidade do apoio e supervisão do diretor técnico às suas funções técnicas, com possibilidade de resposta também em escala *Likert* de 5 pontos (1 [inexistente], 2 [pouco regular], 3 [regular], 4 [muito regular], e 5 [permanente]), e que, no caso de uma resposta entre o 2 e 5, continha em resposta aberta o pedido para quantificar essa regularidade com as opções "diária", "semanal", "quinzenal", "mensal", "trimestral", e "semestral"; iii) avaliação da prestação do diretor técnico no local onde trabalha (por alínea do artigo 6.º), respondida numa escala *Likert* de 5 pontos (1 [muito fraca], 2 [fraca], 3 [razoável], 4 [boa], e 5 [muito boa]), onde no final se pedia uma avaliação global (conjunto das alíneas) dessa mesma prestação usando a mesma escala de resposta; e iv) importância de funções adicionais do diretor técnico às descritas na lei, respondida numa escala *Likert* de 5 pontos (1 [muito baixa], 2 [baixa], 3 [moderada], 4 [elevada], e 5 [muito elevada]), com possibilidade de resposta aberta para identificar essas possíveis funções.

Procedimentos estatísticos

A preparação da base de dados para inspeção visual, identificação de erros e valores omissos, foi realizada através da ferramenta Excel 2021. Análises descritivas de tendência central e dispersão foram realizadas através de médias e desvio padrão. Cálculos percentuais foram também estimados. Estas análises foram realizadas com recurso ao SPSS v. 26.0. Dada à natureza exploratória do estudo não se definiu como pertinente a necessidade de análises inferenciais.

RESULTADOS

Os resultados explorados nas Tabelas 1 e 3 remetem para a avaliação da perceção da importância das funções do diretor técnico definidas na lei (*a) coordenar e supervisionar a prescrição, avaliação, condução e orientação de todos os programas e atividades, da área da manutenção da condição física [fitness], no âmbito do funcionamento das instalações desportivas, aos seus utentes*; *b) coordenar e supervisionar a avaliação da qualidade dos serviços prestados, bem como propor ou implementar medidas visando a melhoria dessa qualidade*; *c) elaborar um manual de operações das atividades desportivas que decorrem nas instalações desportivas que prestam serviços desportivos na área da manutenção da condição física [fitness]*; *d) coordenar a produção das atividades desportivas*; *e) superintender tecnicamente, no âmbito do funcionamento das instalações desportivas, as atividades desportivas nelas desenvolvidas*; e *f) colaborar na luta contra a dopagem no desporto*), e da qualidade do seu cumprimento no espaço de prática profissional de cada TEF. As Tabelas 2 e 4 remetem, respetivamente, para a regularidade do apoio do diretor técnico às tarefas do TEF, e a necessidade de outras funções em acréscimo às definidas em lei.

Quando questionados sobre a importância das funções do diretor técnico tal como definidas na lei, os TEF tendencialmente consideram as funções como tendo uma importância entre "moderada", "elevada", e "muito elevada" (total nestas categorias > 50% das respostas nas três alíneas) (Tabela 1).

Na análise por segmento de mercado sobre a regularidade do apoio do diretor técnico às funções do TEF, o segmento *low cost* apresentou os piores valores percentuais, com 71.25% das respostas dadas entre as categorias "inexistente"

Tabela 1. Resultados percentuais no domínio "Importância da atuação do diretor técnico de acordo com as funções definidas na lei."

%	Funções expressas na Lei n.º 39/2012					
	a)	b)	c)	d)	e)	f)
1 - Muito baixa	5,67	5,67	6,19	5,15	4,12	12,89
2 - Baixa	9,79	4,12	17,53	7,22	7,22	18,56
3 - Moderada	20,10	21,65	18,56	22,68	23,20	**29,38**
4 - Elevada	25,77	27,84	25,77	28,35	**34,02**	14,43
5 - Muito elevada	**38,66**	**40,72**	**31,96**	**36,60**	31,44	24,74

Nota. A negrito estão representados os valores percentuais mais elevados por função do diretor técnico.

Tabela 2. Resultados percentuais globais e por segmento de mercado no domínio "Regularidade do apoio e supervisão do diretor técnico às suas funções técnicas."

%	Segmento de mercado				
	Geral	*Low cost*	*Middle M.*	*Premium*	Outros
1 - Inexistente	23,71	**37,50**	17,78	13,04	8,70
2 - Pouco regular	**24,23**	33,75	17,78	17,39	17,39
3 - Regular	15,46	8,75	20,00	19,57	21,74
4 - Muito regular	22,68	16,25	**22,22**	**28,26**	**34,78**
5 - Permanente	13,92	3,75	**22,22**	21,74	17,39

Nota. A negrito estão representados os valores percentuais mais elevados por segmento de mercado e na amostra geral.

Tabela 3. Resultados percentuais gerais, por segmento de mercado, e por função definida na lei no domínio "Avaliação da prestação do diretor técnico no local onde trabalha."

	%	Segmento de mercado				
		Geral	Low cost	Middle M.	Premium	Outros
a)	1 - Muito fraca	15,98	28,75	8,89	4,35	8,70
	2 - Fraca	18,56	**40,00**	2,22	2,17	8,70
	3 - Razoável	12,37	12,50	6,67	10,87	26,09
	4 - Boa	25,77	15,00	40,00	32,61	21,74
	5 - Muito boa	**27,32**	3,75	**42,22**	**50,00**	**34,78**
b)	1 - Muito fraca	18,56	30,00	11,11	13,04	4,35
	2 - Fraca	**22,68**	**38,75**	15,56	10,87	4,35
	3 - Razoável	19,07	12,50	**28,89**	13,04	34,78
	4 - Boa	19,59	13,75	24,44	26,09	17,39
	5 - Muito boa	20,10	5,00	20,00	**36,96**	**39,13**
c)	1 - Muito fraca	13,92	15,00	15,56	15,22	4,35
	2 - Fraca	11,86	6,25	15,56	17,39	13,04
	3 - Razoável	**33,51**	**43,75**	**26,67**	21,74	**34,78**
	4 - Boa	21,65	23,75	**26,67**	17,39	13,04
	5 - Muito boa	19,07	11,25	15,56	**28,26**	**34,78**
d)	1 - Muito fraca	12,89	15,00	15,56	10,87	4,35
	2 - Fraca	**25,77**	**41,25**	20,00	13,04	8,70
	3 - Razoável	23,20	25,00	17,78	23,91	26,09
	4 - Boa	18,56	11,25	22,22	23,91	26,09
	5 - Muito boa	19,59	7,50	**24,44**	**28,26**	**34,78**
e)	1 - Muito fraca	**22,68**	**37,50**	15,56	10,87	8,70
	2 - Fraca	20,10	32,50	15,56	10,87	4,35
	3 - Razoável	20,10	13,75	24,44	15,22	**43,48**
	4 - Boa	17,53	7,50	17,78	**36,96**	13,04
	5 - Muito boa	19,59	8,75	**26,67**	26,09	30,43
f)	1 - Muito fraca	29,90	33,75	20,00	30,43	**34,78**
	2 - Fraca	**30,93**	**43,75**	**24,44**	**23,91**	13,04
	3 - Razoável	19,07	13,75	**24,44**	19,57	26,09
	4 - Boa	5,15	3,75	8,89	2,17	8,70
	5 - Muito boa	14,95	5,00	22,22	**23,91**	17,39
Avaliação global	1 - Muito fraca	17,53	27,50	13,33	10,87	4,35
	2 - Fraca	**27,32**	**46,25**	22,22	10,87	4,35
	3 - Razoável	17,01	12,50	17,78	15,22	**34,78**
	4 - Boa	17,01	7,50	17,78	30,43	21,74
	5 - Muito boa	21,13	6,25	**28,89**	**32,61**	**34,78**

Nota. A negrito estão representados os valores percentuais mais elevados por segmento de mercado e função expressa na lei (alíneas).

e "pouco regular". Os segmentos *premium* e "outros" obtiveram aproximadamente 50% das respostas nas categorias "muito regular" e "permanente" (Tabela 2). Na amostra geral, 52.06% das respostas situam-se entre "regular" e "permanente". Em opção de resposta aberta a quem indicou uma opção entre o 2 (pouco regular) e 5 (permanente), das possíveis 148 respostas, obtiveram-se 102 válidas. A frequência reportada pelos TEF (geral) foi: diária= 23.53%; semanal= 35.29%; quinzenal= 4.90%; mensal= 19.61%; trimestral= 6.86%; e semestral= 9.80%.

Os resultados por segmento de mercado da avaliação dos TEF à prestação do diretor técnico de acordo com cada função definida em lei estão expressos na Tabela 3. Na amostra geral, à exceção da função expressa pela alínea a), tendencialmente classificada como "boa" ou "muito boa" (com o somatório dos valores > 50% das respostas), as restantes alíneas apresentam percentuais de destaque nas categorias "muito fraca" (alínea e)), "fraca" (alíneas b), d), e f)), e moderada (alínea c)). Globalmente (considerando todas as funções), os TEF tendencialmente classificam o desempenho dos diretores técnicos no cumprimento das suas funções como estando entre "razoável", "boa" e "muito boa" com 55.15% das respostas. No entanto, a categoria com maior percentagem de resposta foi o "fraco" (27.32%).

Da análise por segmento de mercado também expressa na Tabela 3, o *low cost* apresentou-se como tendo na maioria das funções (alíneas a), b), d), e), e f)), valores no somatório das categorias "muito fraca" e fraca" > 55% das respostas (amplitude 56.25–77.5%). Na avaliação global feita pelos profissionais deste segmento, 73.75% das respostas foram atribuídas às categorias de prestação "muito fraca" e fraca". Os segmentos *premium* e "outros" apresentaram valores opostos ao *low cost*, com exceção da alínea f).

Por fim, os resultados da perceção dos TEF sobre se os diretores técnicos deveriam desempenhar outras funções para além das descritas na lei estão expressas na Tabela 4. Na amostra geral, verifica-se a tendência em atribuir importância a outras funções do diretor técnico para além da desempenhada. Esta perceção é apresentada em todos os segmentos, apesar de ter menor expressão no segmento *low cost*. No entanto, apesar da importância atribuída, apenas 26 dos 194 inquiridos apresentaram em questão aberta sugestões. Desses, oito focaram-se em apresentar sugestões em tarefas de gestão (comercial, negócio/satisfação cliente, financeira e marketing), cinco no desenvolvimento de tarefas profissionais (treino personalizado, aulas de grupo, outras funções de coordenação), dois indicaram formação aos pares, outros dois apoio às funções definidas na alínea a), e os restantes nove em desabafos não categorizáveis para este estudo.

DISCUSSÃO

O presente estudo exploratório de natureza transversal procurou analisar as perceções dos TEF sobre i) a importância das funções dos diretores técnicos expressas na lei, e ii) a forma como os diretores técnicos cumprem e desenvolvem as suas funções. Para este esforço, foi também feita uma exploração por segmento de mercado (por preço). Tendencialmente, verificou-se que os TEF consideram as funções do diretor técnico definidas em lei como sendo importantes. Já em relação à regularidade do apoio e perceção da qualidade, os dados da amostra geral tendem a ser heterogéneos em quase todos os domínios. Aproximadamente 50% dos respondentes consideram a regularidade do apoio do diretor técnico às suas funções como sendo inexistente e pouco regular, e os outros 50% variando entre regular, muito regular e permanente. No global, cerca de 45% dos TEF consideram a prestação dos diretores técnicos como estando entre muito fraca e fraca, e os restantes 55% classificam a prestação de razoável, bom ou muito bom. Por fim, cerca de 52% dos TEF consideram que os diretores técnicos deveriam desempenhar outras funções para além das definidas por lei.

Nos domínios onde se verificou maior dispersão de resultados (i.e., regularidade do apoio e avaliação da prestação), a análise por segmento de mercado tende a evidenciar diferenças percentuais entre o segmento *low cost* e os restantes. Genericamente, a perceção dos TEF a desenvolver as suas atividades em ginásios *low cost* apresentou os piores indicadores.

Tabela 4. Resultados percentuais no domínio "Importância de funções adicionais do diretor técnico às descritas na lei."

%	Segmento de mercado				
	Geral	Low cost	Middle M.	Premium	Outros
1 - Muito baixa	13,40	15,00	15,56	13,04	4,35
2 - Baixa	14,43	23,75	6,67	6,52	13,04
3 - Moderada	20,62	**25,00**	22,22	15,22	13,04
4 - Elevada	**29,38**	22,50	**28,89**	**32,61**	**47,83**
5 - Muito elevada	22,16	13,75	26,67	**32,61**	21,74

Nota. A negrito estão representados os valores percentuais mais elevados por segmento de mercado.

Os resultados serão discutidos de seguida com base nas premissas da investigação à data, implicações para a área profissional, e sugestões de reflexão e melhoria.

A perceção dos TEF sobre as funções e atuação do diretor técnico

O facto de a maioria dos TEF ter destacado todas as funções como sendo importantes permite uma primeira leitura do que se passa no contexto e das necessidades que os TEF atribuem ao diretor técnico no decorrer da sua prática. Por outro lado, permite ainda orientar esforços futuros que se relacionem com a ação do diretor técnico e seu enquadramento legal.

Um ponto identificado neste estudo que deve ser visto com preocupação é o balanço obtido sobre a regularidade do apoio do diretor técnico ao trabalho dos TEF. Cerca de 50% dos profissionais reportou que o apoio do diretor técnico é inexistente ou pouco regular, sendo que este resultado negativo é mais pronunciado no segmento *low cost*. De facto, esta ausência de apoio já tinha sido previamente identificada por Teixeira et al. (2020), referindo que os ginásios ainda estariam a aguardar o regresso do seu D. Sebastião, ou seja, uma figura de direção técnica efetivamente presente, preparada, ativa, e promotora da elevação da qualidade das práticas, e que poderia ser um dos problemas resultantes de alguns modelos de gestão *low cost*, devido, em parte, à falta de supervisão técnica. Isto parece ser consubstanciado pelos resultados associados à avaliação da prestação do diretor técnico, onde uma vez mais existe a tendência do segmento *low cost* apresentar os valores percentuais mais baixos, quando comparado com os outros segmentos. De destacar que os valores percentuais gerais (amostra de todos os segmentos) e globais (prestação global do diretor técnico) tendem a ser baixos, mesmo havendo uma diferença do tamanho da amostra por segmento que deveria suportar resultados mais positivos. Ou seja, de acordo com dados de 2021 (Pedragosa et al., 2022), o segmento *low cost* constitui aproximadamente 50% dos clubes em Portugal, o *middle market* 42%, e o *premium* 9%. No presente estudo, a amostra dos espaços *low cost* é ligeiramente inferior (41.2%) aos dados representativos nacionais, e o *premium* bastante superior (23.7%). Mesmo assim, a dimensão da amostra de TEF em espaços *low cost* tendeu a arrastar os resultados dos valores gerais e globais para baixo, mesmo quando o segmento *premium* da amostra, onde se obteve sempre os melhores indicadores percentuais, é superior à realidade nacional.

Isto reflete dois aspetos relevantes a considerar na interpretação dos resultados e considerações futuras. Primeiro, a dimensão do crescimento nacional do segmento *low cost* (23% em 2018 para 50% em 2021) deve preocupar a forma como a qualidade do serviço é prestada (profissionais) e percecionada (clientes; público). Não havendo indicadores objetivos destas questões, importa frisar que a perceção de alguns profissionais afetos à área é tendencialmente negativa (Teixeira et al., 2020), e que os dados das taxas de retenção de sócios por segmento de mercado são marcadamente piores no segmento *low cost* (período 2018-2021; Pedragosa et al., 2022). Sendo este o segmento com maior expressão nacional, é expectável que também seja o que mais contribuirá para a perceção pública do que deverá ser o serviço prestado por este espaço (ginásios) e profissionais, algo que merece ser clarificado urgentemente em explorações científicas futuras. A verificar-se que estes espaços estarão aquém do que seria o ideal e necessário, urge atuar na resolução dos problemas identificados. De realçar que não se antevê que um modelo de gestão *low cost* seja necessariamente negativo num ginásio quando se procura a promoção da prática de exercício físico. O que se poderá ter de explorar futuramente é se esse modelo de gestão se manifesta apenas no espaço, equipamento, oferta de serviços, entre outros relacionados, e não no serviço prestado pelos profissionais. Sendo relativamente fácil compreender e aceitar que um espaço *low cost*, *middle market*, e *premium* tenham condições diferentes a oferecer aos praticantes (e.g., qualidade dos balneários, dos equipamentos, do atendimento), tal não deve acontecer na qualidade do serviço prestado pelos TEF e, consequentemente, pelo diretor técnico. Numa analogia com outra área profissional, é possível comparar companhias aéreas *low cost* com outras de outra tipologia. Apesar de se verificar diferenças nos preços e serviços prestados (custo da alimentação a bordo, reserva de lugares, bagagens permitidas), a regulamentação de segurança, treino dos pilotos e equipa de bordo, e os próprios aviões, são aspetos virtualmente idênticos independentemente da tipologia da companhia. Se assim não fosse, alguém consideraria viajar num avião *low cost*?

Por fim, um dos resultados também relevante de interpretação mais cuidada diz respeito à avaliação da perceção dos TEF sobre se o diretor técnico deveria realizar outras funções para além das definidas na lei. A tendência verificada nas respostas de natureza fechada foi de valorizar essas funções. No entanto, das poucas respostas de natureza aberta, emergem algumas sugestões de que os TEF veem o diretor técnico em proximidade a outras funções de gestão (gestão geral, financeira, marketing, recursos humanos). Este posicionamento parece sugerir desalinhamento e/ou dificuldade na interpretação das responsabilidades e funções legalmente definidas nos artigos 5.º e 6.º da Lei n.º 39/2012. Eventualmente, por exemplos históricos muitas vezes anteriores à lei, ou pela natureza de alguns espaços (ginásios "familiares", onde o diretor técnico é

muitas vezes o proprietário, técnico de manutenção, rececionista, *marketer*, entre outros), onde existem poucos recursos e a organização existente implica um desdobramento de alguns profissionais, visões distintas poderão existir. No entanto, na formulação legal, é claro que o diretor técnico deverá estar associado às necessidades de direção e supervisão técnica. Poderá assim existir a necessidade de clarificar futuramente o que são as funções de um diretor de clube e demais (a existirem) diretores, delimitando que o diretor técnico, apesar de trabalhar em articulação com outros departamentos, é uma figura responsável pelas dimensões técnicas e organizativas da prática, uma distinção necessária de forma a evitar uma dispersão no campo de atuação.

As funções legais do diretor técnico: aspetos de crítica relevantes resultantes do entendimento das perceções dos TEF

Apesar da importância atribuída pelos TEF às funções dos diretores técnicos, e em parte consubstanciadas por indicadores de outros estudos (e.g., Valagão et al., 2022), importa refletir sobre a forma como estas estão descritas, estruturadas e apresentadas em lei. Das seis funções, as apresentadas nas alíneas a) e b) tendem a ser macro, englobando várias atividades, focadas na dinâmica das práticas e na qualidade dos serviços. Já as alíneas restantes parecem estar orientadas para objetivos e tarefas específicas (e.g., alínea c), elaborar um manual de operações; alínea d) coordenar a produção de atividades). Acresce ainda que algumas das funções definidas parecem ser redundantes. Por exemplo, a alínea d) remete para a coordenação da produção das atividades, que de certa forma está expressa na alínea a), que por ser de maior amplitude, tende a englobar esta tarefa (alínea a) *"Coordenar e supervisionar a prescrição, avaliação, condução e orientação de todos os programas e atividades (…) nas instalações desportivas."*). Isto também é visível na alínea e), (*"Superintender tecnicamente, no âmbito do funcionamento das instalações desportivas, as atividades desportivas (…)"*), que uma vez mais se encontra expressa na coordenação e supervisão descritas na alínea a).

Num outro ponto de crítica, é possível verificar alguma dificuldade na diferenciação conceptual entre desporto e exercício físico. Isso nota-se, por exemplo, na utilização de terminologia em desuso (e.g., alínea a), *"manutenção da condição desportiva (fitness)"*), e na formulação da intenção expressa na alínea f) (*"colaborar na luta contra a dopagem no desporto"*), comummente associada à prática desportiva competitiva, mas existente também no contexto do exercício físico para fins, por exemplo, estéticos. Ainda neste ponto, é provável que esta falta de clareza e definição operacional justifique o motivo pela qual esta função obteve os menores valores percentuais no questionamento sobre a importância da ação específica do diretor técnico nesta matéria. Não fica claro se esta função é de largo espectro, dentro de uma lógica de combate ao doping no desporto/atletas (numa visão epistemológica em que o termo desporto engloba todo o tipo de atividades, incluindo o fitness), e, portanto, mais afastada da realidade de interação do diretor técnico em ginásios, ou se seria circunscrita ao uso nos clientes de ginásios. Sabendo que é um problema sério de saúde pública que se encontra identificado no comportamento de vários praticantes em ginásios (EHFA, 2012; SICAD, 2015), e que passa ao lado das fiscalizações regulares a que o meio desportivo (i.e., competitivo; atletas) está sujeito, a boa intenção na introdução desta função de cariz pedagógico e de supervisão pode perder relevo entre os TEF e diretores técnicos quando não percecionada devidamente. Acresce, tal como referido por Mestre (2019), que a ausência de clarificação legal nesta matéria nos ginásios e *health clubs*, para além de não contribuir adequadamente na luta contra este flagelo, incentiva a proliferação do estigma do uso de "drogas" nestes espaços, algo que uma vez mais não contribui para a perceção positiva do que estes espaços e profissionais podem trazer à saúde individual e pública.

Esta aparente sobreposição de tarefas e redundância linguística expressa nas funções do diretor técnico pode levantar dúvidas na forma como efetiva e operacionalmente o diretor deverá realizar as suas funções, mas também sobre o que os TEF deverão esperar da sua ação. Esta confusão será exacerbada se a hipótese levantada anteriormente sobre a falta de formação específica nos cursos que conferem cédula profissional se verificar, algo que carece ainda de exploração adequada.

Limitações e estudos futuros

Para uma adequada compreensão dos resultados e possível impacto deste estudo na comunidade associada ao exercício físico em ginásios, algumas considerações devem ser expressas. Do ponto de vista metodológico, a natureza exploratória e de cariz geral deste trabalho permite uma leitura da realidade em estudo, mas carece de aprofundamento das questões levantadas, que podem ser resolvidas através da obtenção de uma amostra com maior representatividade profissional (em tamanho e por segmento), cruzamento com informações de natureza qualitativa (e.g., entrevistas), realização de observação direta com critérios de avaliação, e definição de aspetos prioritários agora conhecidos e que necessitam de maior refinamento dos meios de coleta e análise.

A nível operacional, outros aspetos relevantes para a compreensão deste e de estudos futuros passarão i) pelo grau de

entendimento (e não apenas o conhecimento) que os TEF têm efetivamente sobre cada função (legal) do diretor técnico, e a forma como essa compreensão, a redundância na formulação legislativa, e possível ausência de formação especifica para a função, poderão estar a justificar os resultados obtidos; ii) exploração contextual e complementar à existente à data sobre o que é e deveria ser, do ponto de vista dos TEF e diretores técnicos, a função de direção técnica; e iii) fornecer indicadores para aferir a qualidade das funções desempenhadas.

Numa nota final às limitações, não é possível deixar de realçar a aparente falta de investigação neste e em temas próximos escritos em português e no contexto nacional. Isto deverá ser uma preocupação para a ciência em Portugal. Até se encontrar soluções para o problema da progressão das carreiras dos professores e investigadores no ensino superior nacional, assim como da obtenção de fundos para investigação, que estão dependentes de métricas que favorecem a publicação em revistas estrangeiras e em inglês, temas como a promoção da saúde pública através do potencial que os ginásios e *health clubs* apresentam têm pouca possibilidade de serem explorados. Para contrariar esta tendência e subversão de produção científica, cabe a todos os envolvidos (entenda-se, todos os *stakeholders*) a tentativa de criar sinergias que visem o avanço do estudo deste e outros temas que podem vir a ter um forte contributo em vários *outcomes* mas, acima de tudo, na saúde das populações.

CONCLUSÃO

Em suma, o presente estudo evidenciou que os TEF, genericamente, valorizam as funções atribuídas ao diretor técnico expressas na lei. Verificou-se que a regularidade do apoio do diretor técnico às funções dos TEF é bastante heterogénea, sendo que em quase 50% dos respondentes a classificação atribuída foi de inexistente ou pouco regular. Verificou-se ainda que cerca de 45% dos TEF consideram a prestação dos diretores técnicos como sendo muito fraca ou fraca. Da análise por segmento de mercado pelo preço, o *low cost* apresentou na maior parte dos parâmetros avaliados os piores resultados percentuais, e o *premium* os melhores. Os atuais resultados reforçam indicações prévias sobre a existência de problemas na função de direção técnica em ginásios, e que estas se manifestariam maioritariamente em ginásios do segmento *low cost*. Recomendações de aprofundamento da compreensão destas questões são apresentadas para futura melhoria das práticas profissionais e elevação da área profissional.

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Familiarização, reprodutibilidade e análise de concordância da altura do salto vertical com contramovimento na plataforma de força em homens jovens

Familiarisation, reproducibility and agreement analysis of vertical jump height with countermovement on the force platform in young men

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RESUMO

O objetivo do presente estudo foi analisar a familiarização, reprodutibilidade e análise de concordância do salto vertical com contramovimento obtido na plataforma de força. Vinte e três homens adultos (24,0± 4,8 anos) participaram do estudo. Na primeira sessão, foram realizados três saltos de familiarização e três saltos de teste (medida 1). Na segunda sessão foram realizados somente três saltos de teste (medida 2). Os valores da altura do salto vertical não apresentaram diferenças estatisticamente significantes entre a familiarização, medida 1 e 2 (p> 0,05). A altura do salto vertical apresentou uma melhor reprodutibilidade e sensibilidade entre a medida 1 e 2 (*CV*= 5,0%; *ET*= 1,4 cm; *MMD*= 3,9) do que entre a familiarização e medida 1 (*CV*= 5,8%; *ET*= 1,6 cm; *MMD*= 4,5 cm). A plotagem de Bland e Altman demonstrou viés de 0,9± 2,3 cm (−5,4−3,6 cm) entre a familiarização e a medida 1 e viés de 0,1± 1,9 (−3,6−3,8 cm) entre as medidas 1 e 2. Os achados do presente estudo demonstraram que a familiarização não influenciou a altura do salto vertical. Todavia, uma melhor sensibilidade da medida foi verificada ao realizar os procedimentos de familiarização.
PALAVRAS-CHAVE: desempenho muscular; erro típico; coeficiente de variação; mínima mudança detectável.

ABSTRACT

The aim of the present study was to analyse the familiarisation, reliability and agreement analysis of the vertical jump with counter movement obtained on the force platform. Twenty-three adult men (24.0± 4.8 years) participated in the study. In the first session, three familiarisation jumps, and three test jumps (measure 1) were performed. In the second session, only three test jumps were performed (measure 2). The vertical jump height values did not show statistically significant differences between familiarisation, measures 1 and 2 (p> 0.05). The vertical jump height showed higher reliability and sensitivity between measurements 1 and 2 (*CV*= 5.0%; *TE*= 1.4 cm; *MMD*= 3.9 cm) than between familiarisation and measure 1 (*CV*= 5.8%; *TE*= 1.6 cm; *MMD*= 4.5 cm). The Bland and Altman plot showed a bias of 0.9± 2.3 cm (−5.4−3.6 cm) between familiarisation and measure 1 and a bias of 0.1± 1.9 (−3.6−3.8 cm) between measures 1 and 2. The findings of the present study showed that familiarisation did not influence vertical jump height. However, a better sensitivity of the measurement was verified when familiarisation procedures were performed.
KEYWORDS: muscle performance; typical error; coefficient of variation; minimal detectable change.

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INTRODUÇÃO

A execução de saltos verticais pode ser definida como a capacidade de elevar o centro de massa do corpo a partir de uma aceleração vigorosa produzida pelos músculos dos membros inferiores (Ugrinowitsch et al., 2007). Klavora (2000) sugere que testes de saltos verticais fornecem uma medida eficaz de potência e uma medida indireta de desempenho físico. Para tanto, vários tipos de testes de saltos verticais são realizados, tais como os unipodais, drop, squat e o com contramovimento (Pauli et al., 2016; Souza et al., 2020). Especificamente o salto vertical com contramovimento tem sido utilizado para testar o desempenho físico de atletas, avaliar a função e fadiga neuromuscular, monitorar a carga de treino e verificar alterações oriundas de programas de treinamento (Cormie et al., 2010; Gathercole et al., 2015; Moreira et al., 2006; Singh et al., 2014). Nesta perspectiva, o salto vertical é uma valiosa ferramenta de teste e monitoramento de treinamento, convencionalmente, utilizada por pesquisadores, treinadores e atletas em diferentes cenários (Watkins et al., 2017, 2020).

Uma variável avaliada frequentemente em saltos verticais com contramovimento é a altura do salto vertical (Souza et al., 2020). A avaliação da altura do salto vertical usando uma plataforma de força pode ser considerada o padrão-ouro (Garcia-Lopez et al., 2013; Requena et al., 2012). Todavia, apesar deste equipamento registrar maiores níveis de precisão e exatidão em testes de salto vertical, é importante analisar a reprodutibilidade e sensabilidade das medidas [ex.: coeficiente de correlação intraclasse (ICC), coeficiente de variação (CV), erro típico da medida (ETM) e mínima mudança detectável (MMD)]. Souza et al. (2020), por exemplo, observaram valores aceitáveis na reprodutibilidade na altura do salto vertical com contramovimento em homens fisicamente ativos avaliados em uma plataforma de força (*ICC*= 0,94; *CV*= 5.8%; *ETM*= 1,74). Embora esses achados tragam informações valiosas em relação a reprodutibilidade do salto vertical com contramovimento na plataforma de força, os valores das medidas da familiarização (i.é.: realização prévia de procedimentos do teste com o objetivo de reduzir a variação intra-sujeito) realizada na primeira sessão neste estudo não foram reportados.

Os estudos que investigaram os efeitos da familiarização nos valores da altura do salto vertical têm apresentado resultados contraditórios (Claudino et al., 2013; Moir et al., 2004; Nibali et al., 2015; Szmuchrowski et al., 2012). Moir et al. (2004), por exemplo, não verificaram nenhuma diferença significativa nos valores da altura do salto com contramovimento, determinados em cinco sessões de teste composta de três tentativas, em um tapete de salto. Por outro lado, Claudino et al. (2013) demonstraram que o processo de familiarização, composto por no mínimo 16 saltos com contramovimento por sessão, produziu uma redução do CV e no erro padrão da medida (EPM) nos valores da altura do salto avaliados em uma plataforma de contato. É importante ressaltar que, uma quantidade variada e elevada de saltos verticais utilizada neste estudo também pode ocasionar uma redução significativa no desempenho muscular e dificultar um padrão de avaliação. Assim, torna-se importante analisar os efeitos dos procedimentos de familiarização utilizando uma menor e padronizada quantidade de saltos verticais com contramovimento, na plataforma de força, no intuito de verificar a reprodutibilidade e sensibilidade das medidas para detectar pequenas alterações do desempenho muscular.

Nesta perspectiva, o objetivo do presente estudo foi analisar o efeito da familiarização, reprodutibilidade e análise de concordância dos valores da altura do salto vertical obtidos na plataforma de força em homens adultos jovens. A hipótese do presente estudo é que: a) ocorram diferenças nos valores a altura do salto vertical entre a familiarização, medida 1 e medida 2 e, b) os valores de reprodutibilidade e análise de concordância da altura do salto vertical melhorem posteriormente a familiarização.

MÉTODO

Um delineamento transversal foi utilizado para verificar o efeito da familiarização na reprodutibilidade e sensibilidade dos valores da altura do salto vertical com contramovimento obtidos na plataforma de força.

Participantes

Participaram do estudo 23 homens adultos jovens (24,0± 4,8 anos). Os participantes eram fisicamente ativos e não possuíam contraindicações ósseas, articulares e musculares dos membros inferiores. Os participantes que não completaram todas as sessões de teste foram excluídos do estudo. O estudo foi aprovado pelo Comitê de Ética do Centro Universitário local (CAAE: 18356619.0.0000.5430). Todos os participantes foram informados em relação aos procedimentos e riscos do estudo e assinaram um Termo de Consentimento Livre e Esclarecido.

Instrumentos

O salto vertical com contramovimento foi realizado em uma plataforma de força (Plataforma de Força SV, Cefise biotecnologia esportiva), com capacidade vertical total de 800 kgf ou 8.000 N. Os dados foram analisados no software do próprio fabricante (Software Vertical Jump Power), com frequência de amostragem de 600 hz. Inicialmente, os

participantes permaneceram sentados durante um período de 15 minutos. O salto com contramovimento consistiu de uma ação excêntrica com a maior velocidade possível, com flexão da articulação dos joelhos em aproximadamente a 90°, seguida por uma ação concêntrica máxima. Os participantes foram instruídos a manter as mãos na cintura durante todo o salto e os joelhos estendidos e os tornozelos em flexão plantar na fase do voo. Os saltos foram realizados com o máximo de esforço e, na aterrissagem, os pés deveriam tocar simultaneamente o solo. Um pesquisador analisou visualmente todos os saltos, fornecendo *feedback* os participantes em relação à cada tentativa. O maior valor das três tentativas da familiarização, medida 1 e medida 2 foi adotado nas análises.

Procedimentos

Todos os participantes visitaram o laboratório dois dias, com intervalos de 24 a 48 horas entre as sessões. Na primeira sessão, os participantes responderam um questionário com os critérios de inclusão e assinaram o Termo de Consentimento Livre e Esclarecido. Na sequência, os participantes realizaram três saltos de familiarização e mais três saltos de teste (medida 1). Na sessão subsequente, foram realizados somente três saltos de teste (medida 2). Em ambas as sessões, um intervalo de recuperação de um minuto foi adotado entre as tentativas. Todos os participantes realizaram as sessões na mesma hora do dia para evitar possíveis variações circadianas da força muscular. Os participantes também foram orientados a não realizar exercícios físicos envolvendo os membros inferiores nas 24 horas precedentes as sessões de teste.

Análise estatística

A homogeneidade dos dados foi testada utilizando o teste de *Levene* e a distribuição de normalidade dos dados por meio do teste de *Shapiro-Wilk*. Os dados foram apresentados com média e desvio-padrão. A análise de variância (ANOVA) *one--way* foi empregada para a comparação dos valores do salto vertical entre as medidas da familiarização, medida 1 e medida 2. O teste *post hoc* de Scheffé, para comparações múltiplas, foi empregado quando necessário. A reprodutibilidade do salto vertical entre as medidas da familiarização, medida 1 e medida 2 foram calculadas por meio do erro típico (*ET*= desvio-padrão das diferenças entre as medidas 1 e 2/√2), coeficiente de variação (*CV*= ET/média das medias 1 e 2*100) e mínima mudança detectável (*MMD*= √2*1,96*ET). A plotagem de Bland e Altman (1986) foi empregada para verificar as análises de concordância dos valores do salto vertical entre as medidas da familiarização, medida 1 e medida 2. O nível de significância adotado nas análises foi de $P< 0,05$. Os procedimentos estatísticos foram realizados no programa *Statistica*™, versão 7.0.

RESULTADOS

Na Figura 1 são apresentados à altura do salto vertical com contramovimento da familiarização, medida 1 e medida 2. Não foram observadas diferenças estatisticamente significantes nos valores do salto vertical entre a familiarização, medida 1 e medida 2 (F= 0,28; P> 0,05; *ES*= 0,0).

O coeficiente de variação, erro típico da medida e mínima mudança detectável são apresentados na Tabela 1. O salto vertical apresentou uma melhor reprodutibilidade e sensibilidade entre os valores da medida 1 e medida 2 do que entre os valores da familiarização e medida 1.

A plotagem de Bland e Altman (1986) demonstrou viés de 0,91± 2,3 cm com limites de concordância de −5,45−3,62 cm entre a familiarização e a medida 1 (Figura 2A) e viés de 0,11± 1,91 com limites de concordância de −3,64−3,87 cm entre as medidas 1 e 2 (Figura 2B).

DISCUSSÃO

O objetivo do presente estudo foi examinar o efeito da familiarização, reprodutibilidade e análise de concordância dos valores da altura do salto vertical obtidos na plataforma de força em homens adultos jovens. Os presentes achados não apresentaram diferenças nos valores do salto vertical entre as medidas da familiarização, medida 1 e medida 2. A reprodutibilidade e sensibilidade do salto vertical observada entre a familiarização e a medida 1 (*CV*= 5,83%; *ETM*= 1,63 cm; *MMD*= 4,53 cm) apresentou maiores valores do que entre a medida 1 e medida 2 (*CV*= 5,01%; *ETM*= 1,41 cm; *MMD*= 3,91 cm). Uma melhor análise de concordância também foi observada entra as medidas 1 e 2 (viés de 0,11± 1,91 com limites de concordância de −3,64−3,87 cm;

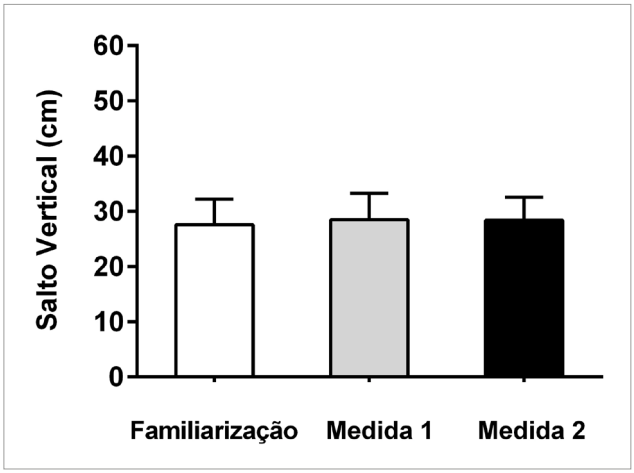

Figura 1. Valores do salto vertical com contramovimento da familiarização, medida 1 e medida 2 (n= 23). Valores expressos em média± DP.

Tabela 1. Reprodutibilidade dos valores do salto vertical com contramovimento da familiarização, medida 1 e medida 2 (*n*= 23).

	Familiarização – Medida 1			Medida 1 – Medida 2		
	CV (%)	ET (cm)	MMD	CV (%)	ET (cm)	MMD
Altura do salto	5,83	1,63	4,53	5,01	1,41	3,91

ET: erro típico da medida (desvio-padrão das diferenças entre as medidas 1 e 2/√2); CV: coeficiente de variação (ET/média das medias 1 e 2*100); MMD: mínima mudança detectável (√2*1,96*ET).

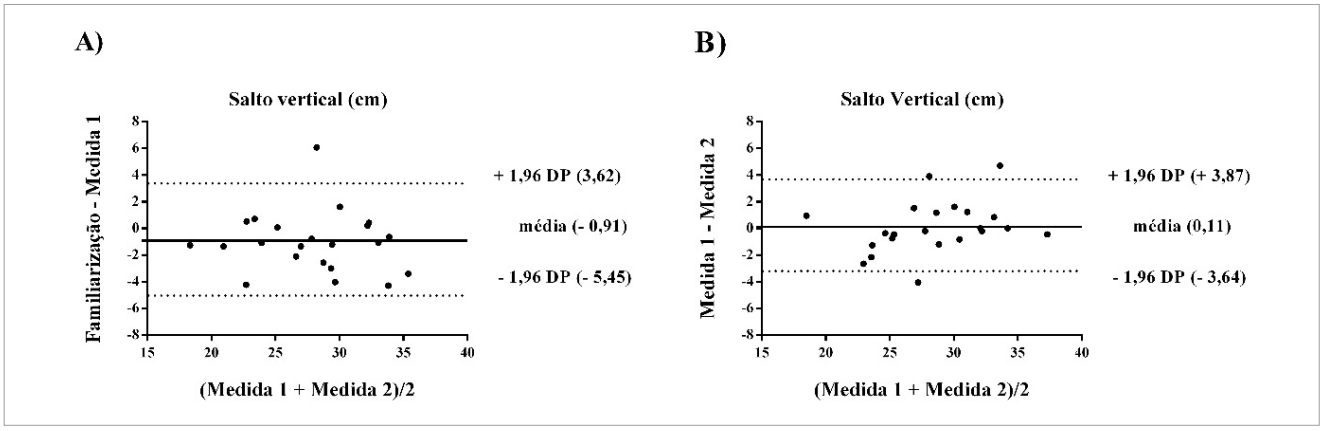

Figura 2. Plotagem de Bland e Altman dos valores do salto contramovimento entre (A) a familiarização e medida 1 e (B) medida 1 e medida 2 em homens adultos jovens (*n*= 23).

Figura 2B) do que entre a familiarização e a medida 1 (viés de 0,91± 2,3 cm com limites de concordância de –5,45–3,62 cm; Figura 2A). Similarmente aos nossos achados, Souza et al. (2020) observaram valores aceitáveis na reprodutibilidade na altura do salto vertical com contramovimento em homens fisicamente ativos (*ICC*= 0,94; *CV*= 5.8%; *ETM*= 1,74). A análise de concordância verificada neste estudo (viés de 0,7 cm com limites de concordância de –4,1–5,5 cm) foi maior do que a observada no presente estudo entre as medidas 1 e 2. Knihs et al. (2021) também verificaram que os valores da altura do salto apresentam excelente confiabilidade e boa sensibilidade (*ICC*= 0,98; *ETM*= 1,39). Em conjunto, estes achados indicam que a avaliação da altura do salto vertical é uma interessante estratégia para analisar o desempenho muscular por apresentar uma boa reprodubibilidade, sensibilidade e análise de concordância.

Inúmeros estudos têm investigado os efeitos de procedimentos da familiarização nas avaliações da altura do salto vertical com contramovimento (Claudino et al., 2013; Moir et al., 2004; Nibali et al., 2015; Szmuchrowski et al., 2012). Moir et al. (2004) analisaram os efeitos da familiarização e a reprodutibilidade da altura do salto vertical em homens fisicamente ativos. Foram realizadas cinco sessões de teste compostas de três saltos de com contramovimento, sem carga e com carga de 10 quilos, em um tapete de salto. O maior valor da altura do salto vertical de cada sessão foi utilizado nas análises. Uma alta reprodutibilidade foi observada nos valores da altura dos saltos verticais com contramovimento sem carga (*ICC*= 0,93; *CV*= 2,4%) e com carga de 10 kg (*ICC*= 0,95; *CV*= 2,1%), sem diferenças significativas entre as sessões de teste para nenhuma das medidas analisadas. Esses achados indicam que altos níveis de confiabilidade podem ser alcançados sem a necessidade de sessões de familiarização ao usar saltos com contramovimento com e sem carga.

Por outro lado, Claudino et al. (2013) demonstraram que o processo de familiarização avaliado em uma plataforma de contato, composto por no mínimo 16 saltos com contramovimento por sessão, produziu uma redução do CV de 4,5% para 2,6% e no erro padrão da medida (EPM) de 1,35 cm para 0,83 cm para os valores da altura do salto. Szmuchrowski et al. (2012) analisaram o número mínimo de saltos verticais realizados para monitorar as respostas ao treinamento pliométrico, por meio da comparação dos valores do terceiro, quarto, quinto, sexto e sétimo saltos com os valores do oitavo salto. Os valores do oitavo salto apresentaram diferenças significativas comparado aos valores dos três primeiros saltos, indicando a necessidade de quatro saltos com contramovimentos para monitorar as respostas ao treinamento pliométrico em um tapete de contato. Em conjunto, os resultados destes estudos demonstraram que o processo de familiarização e a realização de várias tentativas pode melhorar a reprodutibilidade e sensibilidade da medida. Embora os achados da presente investigação não observaram diferenças significativas nos valores da altura do salto vertical entre as medidas da

familiarização, medida 1 e medida 2, é importante observar que a reprodutibilidade e a análise de concordância diminuíram quando analisadas entre a medida 1 e medida 2, indicando a necessidade de várias tentativas para obter uma melhor sensibilidade da medida.

A presente investigação apresenta algumas limitações. As tentativas de familiarização (três tentativas) foram realizadas no mesmo dia das três tentativas da medida 1. Embora inúmeros estudos têm adotado esse procedimento (Claudino et al., 2013; Szmuchrowski et al., 2012), seria interessante analisar esses procedimentos em dias distintos e, se possível, com um maior número de tentativas e dias de testes. Além disso, no presente estudo não foram avaliadas outras variáveis dependentes fornecidas pela plataforma de força (Ex.: força e potência pico). A avaliação dos procedimentos de familiarização em outras variáveis fornecidas pela plataforma de força poderia, de fato, poderia apresentar importantes implicações para pesquisadores, treinadores e atletas quanto a sensibilidade dessas medidas para o uso científico e clínico.

Os achados da presente investigação apresentam importantes aplicações práticas, demonstrando que a altura dos três primeiros saltos verticais com contramovimento na plataforma de força não apresentam diferenças comparados com os valores dos saltos subsequentes (quarto ao nono salto). Esses achados indicam que é extremamente prático e rápido para determinar os valores da altura do salto vertical na plataforma de forma. Todavia, é importante observar que uma melhor reprodutibilidade, sensibilidade e análise de concordância das medidas são observadas ao realizar uma maior quantidade de tentativas. Assim, para detectar menores alterações no desempenho muscular utilizando este equipamento, um número maior de tentativas deve ser realizado.

CONCLUSÕES

Os achados do presente estudo indicam que os valores do salto vertical com contramovimento na plataforma de força não recebem influência de procedimentos de familiarização. Todavia, é importante ressaltar que a reprodutibilidade e a análise de concordância das medidas diminuíram quando várias tentativas foram realizadas, indicando que realizar procedimentos de familiarização pode melhorar a sensibilidade da medida. Sugerem-se que futuros estudos investiguem uma maior quantidade de dias e tentativas por sessões de teste e em outros tipos de saltos (e.g., sem contramovimento e *drop jump*) nos valores da altura do salto vertical. Futuros estudos também devem investigar os efeitos de procedimentos de familiarização em outras variáveis dependentes fornecidas pela plataforma de força (Ex.: força e potência pico).

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Aptidão física funcional e qualidade de vida em pessoas com dificuldade intelectual e desenvolvimental: estudo exploratório

Functional fitness and quality of life in people with intellectual and developmental disabilities: an exploratory study

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RESUMO

Apesar do exercício físico ser um bom indicador para a promoção da saúde, a população com dificuldade intelectual e desenvolvimental tende a apresentar elevados níveis de inatividade física que influenciam a sua aptidão física, saúde e qualidade de vida. Neste sentido, o presente estudo teve como objetivo analisar a aptidão física funcional e a QdV, assim como as associações entre estas mesmas, de uma amostra de população com DID. Foram avaliados 37 indivíduos com DID (42,54± 11,12 anos), através dos testes levantar e sentar na cadeira, timed up and go, caminhar durante 6 minutos, com o propósito de averiguar a aptidão física e a Escala Pessoal de Resultados para mensurar o bem-estar físico. Foram aplicadas correlações de pearson e verificou-se a correlação entre o bem-estar físico e os testes de levantar e sentar e caminhar 6 minutos. Os resultados sugerem uma associação entre as capacidades funcionais medidas através dos testes e o bem-estar físico, sugerindo que a promoção destas competências pode influenciar positivamente o bem-estar físico da amostra utilizada.

PALAVRAS-CHAVE: dificuldade intelectual e desenvolvimental; exercício físico; bem-estar físico; aptidão física funcional.

ABSTRACT

Despite physical exercise is a good indicator of health promotion, the population with intellectual and developmental disabilities tends to have high levels of physical inactivity that influence their physical fitness, health, and quality of life (QoL). The present study aimed to analyse the functional physical fitness and QoL, as well as the associations between them, of a sample of the population with IDD. Thirty-seven individuals (42,54± 11,12 years) with IDD were evaluated through the tests standing up and sitting on a chair, timed up and go and walking for 6 minutes, with the purpose of analysing physical fitness and the Personal Outcome Scale (POS) to measure physical well-being. Pearson's correlations were applied and the correlation between physical well-being and the tests stand up and sit down and walk for 6 minutes was verified. The results indicate an association between functional skills measured through the tests and physical well-being, suggesting that the promotion of these skills can positively influence the physical well-being of the sample used.

KEYWORDS: intellectual and developmental disabilities; physical exercise; physical well-being; functional fitness.

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INTRODUÇÃO

A dificuldade intelectual e desenvolvimental (DID) é um défice de funcionamento intelectual e adaptativo no domínio conceptual, social e prático, que se expressa antes dos 21 anos de idade (Schalock et al., 2021). Os diferentes graus de severidade da DID (leve, moderada, grave ou profunda), são definidos através das capacidades adaptativas, em detrimento de apenas através do score de quociente de inteligência (American Psychiatric Association, 2013). Por capacidades adaptativas entendemos "conjunto de habilidades conceituais, sociais e práticas que foram aprendidas e são executadas por pessoas em suas vidas cotidianas" (Saviani-Zeoti & Petean, 2008). A sua avaliação pode ser realizada através de observação direta, entrevistas e/ou medidas individualizadas, adaptadas culturalmente e psicometricamente adequadas (Saviani-Zeoti & Petean, 2008). Neste sentido, o comportamento adaptativo parece ser o preditor com maior peso na qualidade de vida (QdV) desta população (Simões & Santos, 2017).

A QdV é definida como a perceção que a pessoa tem relativamente à sua posição na vida, aos seus objetivos, valores culturais e pessoais, padrões e expectativas (World Health Organization Quality of Life Group, 1997), numa variedade de dimensões. A sua avaliação permite direcionar o individuo para a vida que valoriza e aprova (Schalock & Verdugo, 2002). O modelo conceptual da QdV na DID envolve oito domínios, iguais para todos, cuja pertinência deve ser determinada pelo indivíduo: desenvolvimento individual e autodeterminação; direitos, relações interpessoais e inclusão social; bem-estar emocional, físico e material que dão origem a 3 fatores — independência, participação e bem-estar, respetivamente (Schalock & Verdugo, 2002; Simões et al., 2016). Relativamente ao domínio do bem-estar físico, o mesmo está relacionado com a saúde no geral e os cuidados referentes à mesma, competências do individuo para cuidar de si próprio, mobilidade e atividades de recreação, lazer e desportivas (Simões & Santos, 2014).

Apesar de o bem-estar físico ser visto como um indicador determinante de QdV (Saviani-Zeoti & Petean, 2008), as pessoas com DID tendem a apresentar níveis mais elevados de excesso de peso/obesidade, diabetes tipo II, hipertensão e doenças cardiovasculares (Haveman et al., 2010; Krahn & Fox, 2014; O'Leary et al., 2018), o que pode levar a perceccionar valores mais baixos neste domínio. Apesar da contribuição de inúmeros fatores para estas condições (Emerson et al., 2014), o sedentarismo surge como um dos fatores de maior risco para a saúde desta população (Bergström et al., 2013; Esposito et al., 2012; McKeon et al., 2013; O'Leary et al., 2018). Como resultado do sedentarismo, as pessoas com DID tendem, também, a apresentar baixos níveis de aptidão física, incluindo níveis mais reduzidos de força, capacidade aeróbia, equilíbrio e flexibilidade (Chow et al., 2018; Wouters et al., 2017) com repercursões ao nível da marcha (Cleaver et al., 2009), controlo postural (Lahtinen et al., 2007), manipulação de objetos (Enkelaar et al., 2013) e conseguinte sucesso na realização de atividade de vida diária (Oppewal et al., 2014).

Apesar das evidências do impacto da AF e EF na prevenção da obesidade, diabetes tipo II, artrite, hipertensão (Bartlo & Klein, 2011), promoção de bem-estar psicossocial (Blick et al., 2015; Crawford et al., 2015; Perić et al., 2022) e físico (Alesi & Pepi, 2017), as pessoas com DID continuam a manter um estilo de vida sedentário, com baixos níveis de prática de AF e EF (Stancliffe & Anderson, 2017; Van der Putten et al., 2017), sendo o fator mais preponderante para o aumento do risco de aparecimento de comorbilidade anteriormente mencionadas (Lynch et al., 2022).

Para além dos beneficios referentes à aptidão física, também têm sido destacados os beneficios da prática regular de AF e EF na QdV desta população, com melhorias significativas ao nível da QdV global (Carbó-Carreté et al., 2016; Pérez-Cruzado & Cuesta-Vargas, 2016; Tomaszewski et al., 2021), saúde geral (Blick et al., 2015), diretamente relacionada com o bem-estar físico (Simões & Santos, 2014) e bem-estar-físico (Carbó-Carreté et al., 2016; Jardim & Santos, 2016). Assim como melhorias no bem-estar geral (Carbó-Carreté et al., 2016; Carmeli et al., 2005, 2008), equilibrio e força musucular (Carmeli et al., 2005; Shields et al., 2008) e competências psicossociais (Blick et al., 2015; Perić et al., 2022).

A capacidade funcional parece estar relacionada com maiores indices de QdV, o que tem sido verificado em alguns estudos, como é o caso do trabalho desenvolvido por Williams et al. (2021), onde os autores verificaram que menores índices de capacidades funcionais estão associados a menor QdV. Corroborando estes resultados, num estudo realizado com idosos, os autores verificaram indices superiores de QdV em idosos com maior capacidade funcional (Costa et al., 2020). Também no estudo realizado por Arnaud et al. (2008), os autores verificaram que níveis mais reduzidos de capacidades funcionais e graus mais elevados de severidade de deficiêcia motora e/ou intelectual, estão associados valores mais reduzidos em diversos dominios da QdV (e.g. bem-estar físico, autonomia).

Desta forma, o presente estudo tem como objetivo analisar a aptidão física funcional e a QdV (nomeadamente no que concerne ao domínio do bem-estar físico) de uma amostra de população com DID, bem como analisar as associações entre estas variáveis.

MÉTODO

Amostra

A amostra foi composta por 37 indivíduos com dificuldade intelectual e desenvolvimental (DID), institucionalizados, com uma média de idade de 42,54 anos (*dp*= 11,12). Destes, 18 (48,6%) são do sexo feminino e 19 (51,4%) são do sexo masculino.

Procedimentos

De acordo com a Declaração de Helsínquia todos os procedimentos éticos foram assegurados. Numa fase inicial estabeleceu-se o contacto com a direção da instituição onde se pretendia pôr em prática a investigação, tendo sido dados a conhecer os objetivos e as diferentes etapas do estudo. Depois de fornecida a autorização por parte da mesma, foram enviados os consentimentos informados aos participantes e respetivos cuidadores/tutores, onde constavam todos os esclarecimentos sobre o estudo, informando que poderiam desistir em qualquer momento e que a participação não comprometeria a integridade física e psicológica dos participantes, assegurando-se a confidencialidade e o anonimato dos dados. Após a recolha dos documentos assinados, deu-se início ao projeto.

Os instrumentos foram aplicados de acordo com os protocolos, na sala de reabilitação da instituição, por um profissional credenciado para tal, de forma individual, sem estímulos distráteis que pudessem comprometer o desempenho do participante.

Instrumentos

O objetivo da Escala de Fullerton é avaliar os principais parâmetros físicos subjacentes associados à mobilidade e capacidade funcional (Rikli & Jones, 2013) e os seus testes encontram-se válidos e fiáveis para a população em estudo (Cabeza-Ruíz et al., 2019; Hilgenkamp et al., 2012; Wouters et al., 2017). No presente estudo foram utilizados os seguintes testes: levantar e sentar na cadeira; sentado, caminhar (2,44 m) e voltar a sentar e andar seis minutos (Rikli & Jones, 2013). De acordo com os autores, para o teste de "levantar e sentar na cadeira" a pontuação implica considerar o número de vezes que o indivíduo executa a tarefa, corretamente, no tempo máximo de 30 s, já no exercício "sentado, caminhar (2,44 m) e voltar a sentar" o desempenho é cotado através do tempo total da tarefa e, no teste "andar 6 minutos", é registado o total de metros percorrido nos 6 minutos (Rikli & Jones, 2013).

A Escala Pessoal de Resultados (EPR) avalia a QdV das pessoas com DID (Simões & Santos, 2017), tendo sido validada a nível nacional (Simões et al., 2016). A escala assume o modelo concetual de oito domínios, desenvolvimento pessoal, autodeterminação, relações interpessoais, inclusão social, direitos, bem-estar emocional, bem-estar físico e bem-estar material, que agrupados entre si dão origem a 3 fatores, independência, participação social e bem-estar. A EPR é contituída por 40 itens cotados por uma escala Likert de 3 pontos que variam consoante os objetivos dos itens (Simões et al., 2016).

A versão portuguesa da escala foi examinada quanto à sua fiabilidade e validade de critério e de constructo. A fiabilidade foi confirmada, bem como a validade de critério (Simões et al., 2016). A análise fatorial confirmatória veio confirmar a multidimensionalidade do constructo encontrando-se oito domínios e 3 fatores (Simões et al., 2016; Simões & Santos, 2017), com valores de fiabilidade compósita superiores a.70 (Simões et al., 2016).

Análise estatística

Considerando que o tamanho da amostra (*n*= 37) assumiu-se a normalidade da distribuição, tendo por base os pressupostos da teoria do limite central (*n*> 30), conforme preconizado por Hair et al. (2019). Posteriormente foi realizada uma análise descritiva, através de algumas medidas de tendência central e de dispersão, incluindo o intervalo de confiança 95%, para a totalidade da amostra.

Foram ainda realizadas correlações de pearson, considerando-se os seguintes intervalos:.10-0,30 (correlação fraca); 0,31-0,50 (correlação moderada); > 0,50 (correlação forte) (Cohen, 1988). Para a referida análise foi assumido um valor de $p < 0,05$ para rejeitar a hipótese nula (Ho, 2014). Os dados foram analisados com recurso ao software estatístico SPSS v.27.

RESULTADOS

A Tabela 1 apresenta a estatística descritiva da amostra estudada, onde são apresentados os valores dos testes de

Tabela 1. Estatística descritiva da totalidade amostra estudada (*n*= 37).

	n (%)	Mean	
		média± dp	(IC95%)
Idade (anos)		42,54± 11,12	(38,83–46,25)
Sexo			
Feminino	18 (48,6%)		
Masculino	19 (51,4%)		
Levantar_sentar (repetições)		11,35± 4,39	(9,89–12,82)
TUG (segundos)		10,63± 5,02	(8,95–12,30)
Caminhada (metros)		395,82± 114,98	(357,49–434,16)
Bem-Estar Físico		12,30± 1,78	(11,70–12,89)

Notas: dp: desvio padrão; IC95%: intervalo de confiança 95%.

aptidão física funcionais apresentados bem como o valor do domínio do bem-estar físico, para a totalidade da amostra estudada (*n*= 37).

No que diz respeito à correlação entre as variáveis em estudo, na Tabela 2, destacam-se as correlações significativas entre o bem-estar físico e o teste levantar e sentar, bem como entre o bem-estar físico e a caminhada.

DISCUSSÃO

O presente estudo procurou analisar a aptidão física funcional e a QdV de uma amostra de população com DID, bem como analisar as associações entre estas variáveis.

Apesar de não haver valores de referência para esta população, que nos permita analisar e comparar os valores medidos através dos testes funcionais, é possivel compará-los com outros estudos onde a amostra são, também, pessoas com DID. Neste sentido, foi possivel verificar que, referente ao teste de levantar e sentar, no estudo realizado por Boer e Moss (2016) os valores obtidos mostram-se superiores aos nossos resultados, com uma média de 14,4 repetições no teste e re-teste. No entanto, quando comparado com o estudo elaborado por Hilgenkamp et al. (2012), onde os resultados obtidos variam, em média, de 9 repetições no teste, 9,3 no segundo teste e 8,3 no terceiro, os valores do presente estudo mostram-se ligeiramente superiores e, identicos aos resultados obtidos por Jacinto et al. (2022). Ao sabermos que o envelhecimento tem influência na deterioração das capacidades funcionais das pessoas (Laurienti et al., 2006) os valores superiores no estudo realizado por Boer e Moss (2016) podem eventualemente ser justificados pela diferença de idades e um indice superior de força, uma vez que a sua amostra apresenta uma média de idades de 33,6 e a do presente estudo 42,54. Já o estudo efetuado por Jacinto et al. (2022) apresenta uma média de idades mais próxima dos nossos dados e Hilgenkamp et al. (2012) uma média superior que, por sua vez, pode ser reflexo dos resultados inferiores neste teste.

Relativamente ao TUG, os resultados obtidos parecem ser inferiores quando comparados com outros estudos (Cabeza-Ruíz et al., 2019; Vereeck et al., 2008), o que pode sugerir que a população em estudo apresenta indices inferiores de agilidade, equilibrio dinâmico e mobilidade (Cabeza-Ruíz et al., 2019).

Nos estudos realizados por Boer e Moss (2016), Cabeza-Ruíz et al. (2019), Guerra-Balic et al. (2015), e Jacinto et al. (2022), os valores obtidos no teste de caminhada de 6 minutos variam entre 513 metros e 578 metros, 449,6 metros e 531,7 metros e 463,08 metros e 457,44 metros no re-teste, 354 metros e 617 metros, respetivamente, sendo estes valores superiores aos obtidos pelos autores. Estas diferenças podem eventualmente estar relacionadas com menores indices de força, coordenação motora e capacidade cardiorespiratória (Gibbons et al., 2001).

Os resultados obtidos relativamente ao bem-estar físico mostram-se semelhantes aos valores reportados por Jacinto et al. (2022).

No que diz respeito à análise da correlação entre as variaveis em estudo, identificaram-se associações entre o domínio do bem-estar físico e os testes levantar e sentar e caminhada, não havendo, por outro lado, associações entre o bem-estar físico e o teste de TUG. Uma vez que o bem-estar físico, um dos domínios de avaliação de QdV, se relaciona com a saúde no geral, com as competências do individuo para cuidar de si próprio, a mobilidade e atividades de recreação, lazer e desportivas (Simões & Santos, 2014), parece fazer sentido as associações entre o bem-estar físico e a caminhada e entre o bem-estar físico e o teste de levantar-sentar, apresentados no presente estudo.

Valores mais elevados de força nos membros inferiores contribuem para a redução dos fatores de risco de queda e diminuição da intensidade da dor (Araújo, 2011). A correlação existente entre o teste de levantar e sentar, que avalia essencialmente a força dos membros inferiores (Rikli & Jones, 2013), e o bem-estar físico parece estar associada a este fator já que a força é necessária para diversas tarefas que requerem mobilidade, como é o caso das tarefas domésticas e caminhadas (Carmeli et al., 2005), estando as mesmas interligadas ao bem-estar físico dos indivíduos.

Relativamente à correlação entre o bem-estar físico e o teste de caminhada, que avalia a capacidade cardiorespiratória e a força dos membros inferiores (Rikli & Jones, 2013), esta parece sugerir a importância destes fatores de aptidão física no presente dominio da QdV, uma vez que a capacidade cardiorespiratória está em parte relacionada com a capacidade de realizar atividades da vida diária (Guralnik et al., 1995), e à saúde em geral (Al-Mallah et al., 2018).

Estes resultados reforçam a importância da aplicação de programas de exercício físico na promoção das habilidades

Tabela 2. Correlação bivariada entre as variáveis em estudo.

	1	2	3	4
1. Levantar_sentar	1	–	–	–
2. TUG	−0,73**	1	–	–
3. Caminhada	0,73**	−0,66**	1	–
4. Bem-Estar Físico	0,43**	−0,17	0,48**	1

*p< 0.001.

funcionais e QdV desta população. Nesse sentido, Carmeli et al. (2005) realizaram um estudo onde analisaram a influência de um programa de exercício físico em diversas capacidades físicas e, para além da relação positiva entre a perceção de bem-estar e o exercício físico, obtiveram melhorias nas capacidades físicas. Também no estudo elaborado por Pérez-Cruzado e Cuesta-Vargas (2016), onde aplicaram um programa de atividade física, verificaram um aumento na aptidão física e na QV dos individuos com DID. Através da promoção de programas de exercício físico que contenham exercícios de força, é possível potenciar o aumento da mesma, seja nos membros inferiores ou superiores, contribuindo para a diminuição da massa gorda e promoção da massa livre de gordura (Jacinto et al., 2022).

Parece assim importante que sejam considerados, em futuras investigações, a realização de estudos de intervenção (e.g., RCT's) que analisem a influência da prática de exercício físico nas capacidades funcionais e QdV de pessoas com DID, dando enfase ao bem-estar físico, com amostras significativas e diferentes graus de severidade de DID. Para além disso, parece ser pertinente a criação de uma escala que avalie a aptidão física, especificamente adaptada a pessoas com DID, tendo como referência as suas caraterísticas motoras, que permita a correta comparação de dados, uma vez que esta população não apresentam as mesmas caraterísticas e competências motoras que a população geral.

CONCLUSÕES

Apesar das ainda escassas evidências nesta área, são vários os estudos que analisam a QdV nesta população. Nesse sentido, o presente estudo visa contribuir para o desenvolvimento desse conhecimento, destacando-se a correlação encontrada entre o bem-estar, o domínio da QdV e, os testes levantar e sentar e caminhada de 6 minutos. Estes resultados sugerem, que para a presente amostra, determinadas capacidades funcionais parecem estar associadas e influenciar o bem-estar físico.

Estes resultados parecem reforçar a ideia da importância do EF e capacidades funcionais para a saúde, bem-estar e QdV desta população. No entanto e apesar das evidências sobre este tema, esta população continua a apresentar comportamentos sedentários que podem contribuir para o declínio da sua saúde e QdV. Neste sentido, é fundamental que o EF comece a ser visto como uma mais valia para esta população e lhes seja oferecida a oportunidade de conhecer, experimentar e praticar, seja na comunidade, instituições, clubes ou até nas suas próprias casas.

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REVIEW ARTICLE

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An overview of the effects of physical exercise programs on individuals with Intellectual and Developmental Disabilities

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ABSTRACT

Being aware of the relevance of physical exercise in individuals with Intellectual and Developmental Disabilities (IDD), we intend to conduct a brief review on the importance of regular physical exercise for this population. An approach will be taken in order to acknowledge the barriers to the high rates of sedentary lifestyles in this population, the potential benefits of physical exercise, and the essential aspects for a correct assessment, prescription, and implementation of these programs in the population with IDD, through a reflection supported by scientific evidence. The current overview aims to provide relevant information regarding the health benefits of physical exercise in individuals with IDD, as the basis for QoL promoting more active and healthier lifestyles, namely through structured physical exercise. In addition, it is also a useful tool for consultation by exercise professionals since adjusted indoor and outdoor exercise programs are listed.

KEYWORDS: intellectual and developmental disabilities; physical exercise; strength training; cardiorespiratory training; quality of life.

BRIEF REVIEW

Intellectual and Developmental Disabilities (IDD) are characterised by a deficit in intellectual and adaptive functioning in the conceptual, social, and practical domains, being identified in profound, severe, moderate, and mild degrees, developing before the of 22 years old (Schalock et al., 2021). Although the average life expectancy of these individuals has been increasing in recent years (Dieckmann et al., 2015), they still experience shorter longevity when compared to individuals without IDD (Glover et al., 2017; Heslop & Glover, 2015; McCallion & McCarron, 2014). In addition, they age prematurely, much due to the complications of the disability itself (Coppus, 2013), as well as health problems such as mental health or multimorbidity (Cooper et al., 2015; Hermans & Evenhuis, 2014; Timmeren et al., 2017). The continuous need for medical care and the acquisition of medication, among others, also results in high financial costs for their health (Anderson et al., 2013; Krahn & Fox, 2014; Lunsky et al., 2018).

On the other hand, sedentary lifestyles are prevalent in this population, and low engagement in physical activity practices (Dairo et al., 2016) fails to meet the guidelines suggested by Bull et al. (2020). This sedentary lifestyle and low engagement in active practices do not promote desirable physical fitness. Several studies indicate that individuals with IDD have low levels of physical fitness (Borji et al., 2014; Chow et al., 2018; Gawlik et al., 2016), which increases the risk of developing other comorbidities, including metabolic and cardiovascular diseases (de Winter et al., 2012). However, one of the reasons reported in the literature for this lifestyle is the presence of barriers to the practice of physical activity. In order to identify these barriers, Jacinto et al. (2021b) conducted a systematic

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review, updating a previously published one (Bossink et al., 2017), aiming to carry out a specific survey of the barriers, analysing whether it was decreasing or increasing compared to the last study. More specifically, the main barriers to physical activity perceived by individuals with IDD, their families, caregivers/technicians, or even from the perspective of project leaders can be systematised into personal (6 barriers were found), family (4 barriers were found), social (13 barriers were found), financial (1 barrier was found), and environmental (1 barrier was found) factors. All these barriers (25) have already been mentioned in a previously published systematic review (Bossink et al., 2017). However, the total number of barriers to physical activity perceived by individuals with IDD decreased compared to those perceived in the previous published review. This fact may presume that baseline work was carried out with strategies and recommendations in order to promote the practice of physical activity.

Although there are barriers for an individual with IDD to practice physical activity, it is agreed that any increase in physical activity or structured exercise for a sedentary and inactive lifestyle increases the chances of positive physiological improvements and consequent quality of life (QoL). In individuals with IDD, adopting active lifestyles and regular exercise seem to positively affect physical capacities (strength, aerobic, balance and flexibility), overall health, and QoL (Bartlo & Klein, 2011; Calders et al., 2011). On the other hand, knowing that one of the barriers to physical activity in this population is the lack of adapted exercise programs (Jacinto et al., 2021b), there is a need for studies that clearly identify recommendations for the assessment and prescription of physical exercise adjusted for individuals with IDD and which training method best meets their needs and the purpose of the exercises simultaneously. This information is a useful tool for promoting physical exercise among individuals with IDD, reducing this identified barrier.

Since this population has relatively high body mass index and waist circumference values (de Winter et al., 2012; Vancampfort et al., 2020) and aiming to identify the most effective type of training to promote this variable mentioned previously (related to metabolic and cardiovascular diseases), a systematic review with meta-analysis was conducted (Jacinto et al., 2023c). Performing an exercise program for the body mass index seems to have positive effects (p= 0.049), with strength training being the most effective (Z= 1.197 and p= 0,231). On the other hand, for the waist circumference variable, an exercise program also seems to have positive effects on the promotion of the variable (p= 0.001), with cardiorespiratory training being the most effective (Z= 3.092 and p= 0.002). However, the small number of studies included in the meta-analysis does not allow for more robust and concrete conclusions. In the same way, studies on the population without disabilities are also unclear. Skrypnik et al. (2015) found no significant differences between the different training methods. In turn, Garrow and Summerbell (1995) state that cardiorespiratory training reduces fat mass but has little effect on preserving muscle mass. In that sense, Willis et al. (2012) conclude that it is the most effective training method for reducing body mass (cardiorespiratory training). On the other hand, strength training, in addition to increasing muscle mass, can improve energy expenditure and lipid oxidation rates (Hunter et al., 2000). In turn, combining strength training with cardiorespiratory training in the same session has shown to be a good method to increase muscle mass and reduce fat mass (Ho et al., 2012).

Considering the literature review performed, none of the training methods were discarded, in the sense that both have their potential. A combined exercise program (cardiovascular fitness and strength in the same training session) may be the method with the most wide-ranging benefits for the population in question. In this sense, a literature review of strength and cardiorespiratory training intervention studies was carried out to prescribe exercise programs adapted to individuals with IDD.

Considering strength exercise programs, besides showing increases in upper and lower limb strength, balance and fat-free mass, salivary immunoglobulin concentration, testosterone levels, plasma leptin levels, tumour necrosis factor alpha and interleukins, there is an improvement in the response to systemic inflammation and antioxidant defence system, as well as a decrease in fat mass and waist circumference and oxidative damage. Most studies implemented an exercise program lasting 12 weeks, three times a week, with 45 to 60 minutes sessions. The prescription included two to three sets, six to 12 repetitions (per exercise or maximums), six to seven exercises, focusing on the main muscle groups (such as chest press, low row or lat pull-down, elevation, abduction or shoulder press, and abdominals due to their different variants, flexion of the forearm, the extension of the forearm, and leg extension/leg curl/leg press). This exercise prescription is performed using weight-training equipment to avoid the use of free weights for safety reasons (Jacinto et al., 2021a).

In the same way, cardiorespiratory exercise programs seem to promote an improvement in physical capacity, lipid, hemodynamic and metabolic profile, body composition, neuromuscular and cognitive capacity. Most of the studies included in the systematic review were of 8 to 12 weeks duration, with a weekly frequency of 3 sessions, with a session length of 20 to 60 minutes. The intensity of the sessions is mostly

prescribed according to the maximal heart rate (50% to 80%) or peak oxygen consumption (70% to 80%). The most often prescribed cardiorespiratory exercises are walking/running (a cycle ergometer can also be used as a resource) or cycling (Jacinto et al., 2023d).

Along with the American College of Sports Medicine guidelines (2021), the above results represent a useful tool, including aspects and recommendations that professionals should consider when structuring, prescribing and implementing a strength, cardiorespiratory or combined training program. For a population with a sedentary and inactive lifestyle, early ageing, and prevalence of several associated comorbidities, the recommendations presented are essential to promote QoL by decreasing the risk of the onset of chronic diseases, increasing physical fitness levels and reducing perceived barriers to practice. Therefore, it is essential to implement this type of exercise program into the routine of this population, which, when associated with an appropriate lifestyle, promotes a decrease in clinical expenses, an increase in healthy ageing, and better general health and QoL.

It is recommended that exercise professionals understand how to prescribe programs in an adapted and effective way in terms of methods, structure, and duration of the sessions. At the same time, professionals also need a thorough knowledge of each individual, their comorbidities, limitations and abilities, and preferences before prescribing any type of exercise program.

Since there is a research gap regarding the most appropriate exercise programs for the IDD population based on the previous results, as well as on the American College of Sports Medicine guidelines (2021) and on the CERT recommendations (Slade et al., 2016), two exercise programs were structured and developed. These intervention training programs aim to ensure that the high financial cost of the practice would not be another barrier to exercise (Jacinto et al., 2021b). Monetary barriers may be an obstacle to promoting physical exercise. With the outdoor program (low cost), no financial or costly investment is needed since it can be performed in an outdoor space, using only body weight, recycled materials (plastic bottles with sand) or low-cost materials (TheraBand's and ankle shin guards).

The indoor physical exercise program was carried out in a gym with weight machines. The program was divided into four parts: Part I - playful games or shuttle run (5 to 7 minutes); Part II - aerobic training (treadmill; 10 minutes; 40% to 80% of Heart Rate Reserve; between 12 to 17 according to the Borg RPE Scale (Borg, 1982); between 5 to 8 according to the Borg CR-10 Scale (Borg, 1998); Part III - strength training (around 25 minutes; Leg Press + Chest Press + Leg Extension + Lat Pull Down + Leg Curl + Shoulder Press; 40-80% of 3RM; 10-15 reps; 2-3 sets); Part IV - 4 static stretching exercises (30 to 60 seconds each).

The outdoor physical exercise program was carried out in a natural environment near the institution. For this experimental study, natural environments are defined as "any outdoor spaces with elements of nature, from pure or semi-natural areas to urban green or blue spaces, including green infrastructure" (Silva et al., 2018, p. 4). The program was divided into four parts: Part I - playful or shuttle run (5 to 7 minutes); Part II - aerobic training (walking; 10 minutes; 40% to 80% of Heart Rate Reserve; between 12 to 17 according to the Borg RPE Scale (Borg, 1982); between 5 to 8 according to the Borg CR-10 Scale (Borg, 1998); Part III - strength training (more or less 25 minutes; Sit to stand from the chair + TheraBand's; Low row + TheraBand's; Low row + TheraBand's; Sitting unilateral knee extension + shin guards; Chest press + TheraBand's; Standing unilateral knee flexion + shin guards; High row or seated shoulder press + TheraBand's; ≥ 15 reps depending on the OMNI-RES scale (Robertson et al., 2003); 3 sets); Part IV - 4 static stretching exercises (30 to 60 seconds each). Progression of exercises with changing the resistance of the TheraBand's and shin guards. The previously published study protocol describes all the program assessment and implementation procedures (Ferreira et al., 2022; Jacinto et al., 2022b). Although there is a clear need to carry out more research on healthy lifestyle interventions for people with more severe levels of IDD (profound IDD), our current intervention is limited to participants with mild to severe IDD, so future studies should take different levels of IDD into account. In addition to being adapted to individuals with mild to severe IDD, these programs are accessible to any context and financial availability, for both individual and institutional contexts. In addition, the performance of individuals with IDD in these physical exercise programs can reduce the risk of metabolic and cardiovascular diseases, decrease healthcare costs, and promote physical fitness, functionality, and QoL.

After the development of these two programs, an experimental study was conducted in order to understand if they are effective tools for reducing the barriers that hinder/attenuate the practice. On the other hand, we intend to contribute with recommendations for practice with innovative interventions with physical exercise, prescription and effective strategies, which we believe can positively impact the QoL of individuals with IDD. For that purpose, 21 adults with IDD were recruited. Subsequently, an initial assessment was performed to screen for any chronic disease or other important parameters to be monitored and to identify their initial

physical fitness level. According to the results, in addition to low levels of physical fitness, these individuals are at risk of developing metabolic and cardiovascular diseases (according to the existing literature), highlighting the importance of an intervention with physical exercise. This initial anamnesis is important not only for a "check-up" but also for developing a tailored, effective and safe physical exercise program according to the physiological characteristics of each participant. By performing an adapted and complete anamnesis, besides promoting trust between professionals and participants and mutual knowledge, it also allows us to collect indispensable data for the intervention and identify signs and symptoms that we need to be aware of (Jacinto et al., 2023a). We also highlight that this anamnesis must include a sufficiently robust and valid scientific method according to the literature (American College of Sports Medicine, 2021; Jacinto et al., 2021b). This process should be carried out before implementing any strategy in order to promote QoL in individuals with IDD. The results of the QoL assessment showed incongruence of response, with individuals with IDD perceiving higher values compared to the responses of the proxies. These results highlight the importance of measuring the QoL perceptions of individuals with IDD not only through the perceptions of their family members but also through self-reports, as both are complementary. On the other hand, if self-reports are not considered when planning intervention strategies, it may have a negative impact on the QoL of individuals with IDD (Jacinto et al., 2023e).

After this "initial photograph", the 21 participants were divided by convenience into an indoor training group (*N*= 7) performing exercise in a gym with weight-training equipment, an outdoor training group (*N*= 7) using low-cost materials, and a control group (*N*= 14) which continued with their regular activities. Both intervention programs had more than 75% participation, and the individuals were able to complete all the proposed exercises at the defined intensity, series, and repetitions. All the exercises proved to be adequate, adjusted, easy to perform, and perfectly adapted to the population under study. An outdoor, low-cost intervention in contact with nature seems to be effective in improving Physical Well-Being and fat mass. Finally, an indoor intervention using weight-training machines seems to be a good method to promote functional capacity, namely on *30 seconds Sit to Stand*, *Timed Up and Go* and *6-minute Walk Test* and physical fitness. None of the interventions showed significant differences for dementia/cognitive decline or blood sample variables. To our knowledge, this is the first experimental study with exercise that relates the variables studied to the IDD population in different practice environments. Both exercise programs seem to be effective in several variables and may hinder/attenuate the barriers to practice that this population experiences. These two programs can be implemented by any institution/organisation, considering the economic and environmental possibilities. Finally, the results of the experimental study justify the relevance of regular physical exercise tailored to their individual needs (Jacinto et al., 2023b, 2024).

The use of elastic bands in strength training in the outdoor exercise program has proven to be equipment in which the intensity is difficult to control since the individual can hold the band in different ways (with hands closer or further apart, holding the band in different places between sets) creating different tensions, which can influence the results. Some individuals with DID may not have the capacity to associate a scale to the perceived effort and give a response. The exercise professionals may be able to perceive this intensity through the difficulty of the exercise execution or the *Talk test* (American College of Sports Medicine, 2021; Reed & Pipe, 2014). On the other hand, it was evident that implementing aerobic and strength exercises of a more analytical nature in a gym environment and using equipment facilitates this control of intensity. The strength exercises performed with the use of machines may avoid some injuries because they present a lower degree of amplitude and planes. In order to perform the exercises at the intended speed of execution, the exercise professionals must constantly monitor them because this population sometimes cannot control the movement in the eccentric phase, performing it immediately.

Considering the results of our study, future research that implements these two exercise programs could conduct one session per week of the indoor exercise program and one session per week of the outdoor exercise program. Similarly, the prescription of exercise with cognitive stimulation tasks or multidisciplinary interventions (exercise plus cranial electrotherapy stimulation, socialisation, health education, educational advice) should be the object of study in future investigations in order to reach more robust conclusions in the domains of QoL and/or dementia. Future studies should ensure that evaluators have no knowledge of which group the participant belongs to, minimising the risk of bias. Further studies should recruit larger samples and samples from other age groups, not to limit the findings, and conduct a follow-up to analyse the long-term effects. Similarly, we suggest investigating the effects of sports practice and modalities on all the variables assessed in this study, as well as controlling diet and physical activity outside intervention programs.

For this population to change their sedentary and inactive behaviours, there is a need to raise awareness among people with IDD themselves, parents/families/guardians,

professionals and institutions/organisations that support this population, educating and empowering them with knowledge and healthy and active practices that will contribute to a healthy life and full social participation, namely through regular physical exercise. Both exercise programs can be replicated by all institutions/organisations working with individuals with IDD, being easy to understand and implement. They were structured based on scientific evidence and seemed an effective strategy, as they provoked a set of adaptations and benefits, promoting QoL. In addition, it is necessary that the formation of exercise professionals should include contents such as the dimensions of physical exercise for people with IDD, as well as the characterisation of physical, physiological, psychological, social and emotional aspects (Jacinto et al., 2022a).

The current overview provides relevant information regarding the health benefits of physical exercise in individuals with IDD, proving that structured and adapted exercise programs can be key to promoting more active and healthier lifestyles, increasing physical fitness and functional capacity and consequently improving QoL.

This document refers to several aspects and benefits that support physical exercise as a basis for QoL in an individual with IDD. It includes recommendations for assessing and prescribing physical exercise for individuals with IDD, as well as two intervention proposals. With this document, the lack of exercise programs adapted to individuals with IDD and the financial cost of the practice may no longer be a barrier. On the other hand, the intervention strategies used in this population need to be revised. Integrating physical exercise into their daily lives is a key aspect of maintaining and increasing physical fitness and functional capacity and consequent improvement in QoL.

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METHODOLOGICAL ARTICLE

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Mario Trindade's training method: the journey to 100 metres wheelchair gold medal at European championships in Berlin (2018)

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ABSTRACT

This article aims to present Paralympic athlete Mario Trindade's training to become the European Champion at the 100 meters wheelchair race in Berlin 2018. The lack of information on this specific training has impaired the beginning of this journey. However, the daily monitoring of this athlete over 20 years has permitted us to realise that the training methods of athletes with disabilities are not very different from those of others. Thus, it is important to understand the different responses to exercise. The degree of improvement after a training program depends on the characteristics of the vertebral-medullary lesion, the training history, and the training ability of the athlete, which is determined by the amount of active muscle mass available. Considering these aspects, we aim to describe the summer training macrocycle that is developed for the 100 metres wheelchair race, which is a combined work developed by a multidisciplinary team. We will start by providing a theoretical background on para-athletics events, specifically wheelchair competitions. Afterwards, we will characterise the athlete and discuss his track and strength training, which prepared him to obtain the gold medal in 2018.

KEYWORDS: paralympics; wheelchair; training; strength; biomechanics.

INTRODUCTION

Since 1948, when Sir Ludwig Gutman arranged the first international sports competition for World War II veterans at the English hospital of Stoke Mandeville, wheelchair sports have evolved (Bailey, 2008). What began as a military rehabilitation exercise during WWII has evolved into the world's largest sports event for people with impairments, the Paralympic Games. From as little as 400 athletes representing 23 countries and 8 sports, the Paralympic Games have increased the number of participants, countries, and sports, reaching a total of 4,500 athletes from 176 countries and 22 sports at the Paralympic Games in Rio de Janeiro [2016] (Kolotouchkina et al., 2021). The Paralympic movement has grown in the last few years, which has led to higher competitiveness among athletes and, consequently, stricter discipline and higher training specifics to become professional athletes, more support and technology (Forte et al., 2015).

Since the beginning of the Paralympic movement, wheelchair races have been one of the most spectacular events due to their highly competitive level and the high speeds athletes attain during their performances. Technological evolution has allowed modern wheelchairs to become lighter and more aerodynamic, enabling athletes to run long distances at better times than athletes without disabilities (Tweedy & Diaper, 2010). For example, the marathon's world record is 2:01:09 for walking athletes and 1:20:14 for wheelchair athletes, both male. Wheelchair championships include sprints, middle-distance running, and distance running (from 100 m to the

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marathon), with athletes distributed in four classes: T51, T52, T53, and T54. These classes are defined according to the area of the vertebral-medullary lesion: C5-6, C7-8, T1-7, and T8-S4. For Class T52, the races included in the Paralympic calendar are 100 m, 400 m, and 800 m. Each wheelchair athlete used to compete in different wide range distances. However, the increasing number of participants and improved training methods have made racing more competitive, leading to athletes' specialisation in a specific distance (Goosey-Tolfrey & Price, 2010).

This research note aims to describe the training of the wheelchair athlete Mário Trindade for the European Championship in Berlin. The 2017/2018 season goal was to win the 100 m. Mário won the European title (100 m) with a championship record of 18.53 seconds and also won the silver medal at 400 m (1.08.45 minutes). We will present the training performed by this athlete during the second macrocycle in both training domains (track and strength) and the contribution of biomechanics to increasing his performance. During this season, Mário was also monitored by a physical therapist, a sports psychologist, and a nutritionist.

MAIN TOPIC

Characterisation of the athlete

Mário Trindade was diagnosed with scoliosis at a young age. At 12, he found his passion for sports, started practising athletics, and, after, started cycling. Later, at 17, he presented respiratory issues and had to undergo spine surgery. Prior to surgery, he was informed that the medical intervention was complicated but had a great chance of success. Two days later, he woke up and could not feel his legs. He was admitted to Hospital de So Joo for a year before being transferred to Alcoitão Recovery Centre (Portugal), where he underwent a lengthy 9 month recovery process. Initially, the therapy focused on regaining walking ability and later on achieving independence while using a wheelchair. On December 3rd 2007, he broke a Guinness World Record in which he covered 182,4 km in 24 hours on a 400 m track. His goal was to make the world aware of the struggles that people with disabilities face daily in their lives.

In 2013, Mário had the opportunity to participate in the International Wheelchair & Amputee Sports Federation (IWAS World Games) and competed in the 100 m, 200 m and 400 m. In that competition, they redefined Mario's classification category, and from that moment, he was in T52 class, where he was finally able to compete with people with a similar disability. Mario's track goals for competition were redefined, and he was able to compete in the 100 m and 400 m trials at the 2014 European Championship (Swansea, England). Afterwards, Mário conquered the following accolades in 100 m races: a bronze medal in 2016 (Swansea, Wales), a silver medal in 2017 (Grosseto, Italy) and a golden medal in 2018 (Berlin, Germany). He has achieved 6th place at the Rio de Janeiro Paralympic Games (2016).

A qualitative study conducted on Mário Trindade found that his most notable psychological characteristics are resilience, focus, and motivation to maintain high performance levels and attain his goals (Celestino & Pereira, 2018).

The training method

When Mário started training, there was not much information on wheelchair training, which made the challenge harder. Throughout our work, we found two important aspects to consider in these athletes' training: i) wheelchair athletes suffer no osteoarticular impact from the strength produced on the ground; ii) when they stop pulling the chair, it continues to move. These two points are crucial for training planning because, although these athletes are sprinters, they can tolerate more training volume with active recoveries. It is also noteworthy that these athletes' training is often impaired by comorbidities associated with paraplegia, which frequently affect and make daily training planning difficult.

The daily follow-up has taught us that these athletes' training is not very different from any other. Generally speaking, most training rules applied to wheelchair athletes are the same as those applied to other athletes (Cooper, 1990). Therefore, it is important to understand the different responses to exercise (Goosey-Tolfrey & Price, 2010). Athletes with a vertebral-medullary lesion present changes in metabolic, cardio-respiratory, neuromuscular, and thermoregulatory systems, which reduce their general physiological ability when compared with athletes without disabilities or other types of disabilities (Bhambhani, 2002). Strong evidence suggests that wheelchair athletes have physiological adaptations to aerobic and anaerobic training, similar to athletes without disabilities. However, after a training program completion, the degree of improvement depends on the characteristics of the vertebral-medullary lesion, the training history, and the training ability of the athlete, which is determined by the amount of active muscle mass available (Goosey-Tolfrey & Price, 2010).

According to Goosey-Tolfrey and Price (2010), wheelchair athletes' performance depends on three factors: the athlete, the chair, and the athlete/chair interaction. Tweedy and Diaper (2010) add that the main factors that contribute to the success of these events are physiological and depend on the technical ability to reach and maintain high speeds. Bhambhani (2002) affirms that anaerobic ability, power, and a high strength/weight ratio are fundamental for succeeding in these distances.

For a better understanding of this paper, we divided the training methods into i) track training (on an athletic track) and ii) strength training (in a gym). Due to the lack of information about training for athletes with disabilities, these plans have been developed taking into account the specific characteristics of this athlete.

Track training

Considering the duration of 100 m in a wheelchair (it ranges from 16 to 18 seconds) and the world record in class 52, which is 16.41 (Raymond Martin, EUA), this is a speciality that mainly demands the alactic anaerobic source of energy (Adenosine triphosphate — ATP, and Phosphocreatine — CP). It is also evident that the training of these athletes should focus on the upper body; nevertheless, the available muscle mass and functionality depend on the lesion's level.

Considering the 4 year cycle of Paralympic preparation, the athlete's health and functional status, the tests and competition results, and, finally, the athlete's readiness for training, the cycle was divided into annual plans with intermediate goals. Hence, the annual plan was divided into two macrocycles designed according to the athlete's characteristics. The winter macrocycle took place from September to March, targeting several track competitions in Dubai. Afterwards, the athlete had a week of transition. The summer macrocycle started at the end of March and ended at the European Championship in Berlin (August 2018), and it was divided into 4 periods: general preparation, specific preparation, pre-competition and competition. The second macrocycle is the only one described since it was the most critical to achieving the established goals. Considering that the athlete had a winter macrocycle in which he reached a high level, he started the second macrocycle after two weeks of general preparation. In the third week of April, the specific preparation period was introduced, aiming at the development of anaerobic alactic (repetitions 60-100 m) and lactic (repetitions 150-300 m) capacities, as well as acceleration ability (30-50 m starting from stationary), flexibility, and chair propulsion technique (Table 1).

The pre-competition period took place during the months of June and July, and it was focused on developing the alactic (repetitions 60-100 m) and lactic (repetitions 150-300 m) power, the starts, and finally, the resisted, overspeed, and maximum speed. These can be observed in Table 2.

Table 1. Example of a week from the specific preparation period.

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Morning	Strength			Strength		20′ cr 3× 2× 300 *R*= 8′ *r*= 2′	30′ cr
Afternoon	20′ cr 50-60-80-60-50	20′ cr 2× 3× 150 *R*= 6′ *r*= 2′	30′ cr	20′ cr 2× (30-40-50)	20′ cr 2× 5× 60 *R*= 6′ *r*= 1′30″		

cr: continuous running; R: r -rest time.

Table 2. Example of a week from pre-competition period.

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Morning	Strength			Strength		20′ cr 2× 5× 60 *R*= 6′ *r*= 1′
Afternoon	20′ cr 5× 50 sl 5× 50	20′ cr 300-200-150	20′ cr	20′ cr 8× (40 st+ 30 rx+ 30)	20′ cr 4× 60 dc+ 2× 80-100	20′ cr

R: r -rest time; cr: continuous running; sl: sled; st: start; rx: relaxed; mt: momentum; dc: descent.

Finally, the competitive period, in which we intend to correct some details on the starts, acceleration speed, and maximum speed, can be observed in Table 3.

Strength training

Strength training (ST) integrates Mário's preparation with two specific purposes: improving performance and reducing injury risk. His planning was divided into general and specific preparation periods, and within each period, training blocks were designed with specific purposes. The general preparation period (12 weeks) was divided into an introduction block (4 weeks) and a muscle hypertrophy block (8 weeks). The specific period (12 weeks) was split into a maximum strength block (4 weeks) and a muscle power block (8 weeks). ST sessions were performed twice a week, with a 72-hour interval between them. The preparation was divided into winter and summer periods, respecting an identical structure as described before, with a small change in the general preparation phase (summer period), where the introduction block was reduced to two weeks.

An assessment was carried out to measure the ability to generate tension in the different body segments (trunk, upper limbs, and neck), and the athlete was asked to express his difficulties in the context of the competition. All ST sessions were initiated by one exercise for increasing body temperature and two exercises for isometric muscle activation of the flexor, adductor, and extensor muscles of the shoulders.

We will not mention which exercises were used because every athlete has their own individual characteristics, and the exercise choice must be individualised. Thus, we will describe goals, volume, and training intensity.

Each exercise load was determined by the number of repetitions, as it is well known that completing maximum repetition tests for determining training load is unnecessary. The load varies according to the readiness of the athlete in each session and the accumulated fatigue per set of exercises. In certain blocks, we have asked the athlete to use the load that would allow him to perform the established number of repetitions without allowing the execution of one more repetition; in other blocks, he should have the feeling that he could perform two more repetitions. The athlete would record the load used in each training session to control his progression. To progress the training load, the athlete was asked to increase the load used in the previous week for each exercise every two weeks in each block. One week before each event, the volume and intensity established for that week were reduced by 50%. The following points will characterise Mario Trindade's ST in more detail by period and block regarding the goal, volume, and training intensity.

The general preparation introduction block aims to build an adaptation to ST and minimise the gaps noticed in muscle activation. In this block, nine exercises were conducted in the foundational phase (3 global and 6 isolated), considering the deficits detected. In the first week, the athlete was asked to use a load in each series that allowed him to perform the number of established repetitions but in which he felt he could perform two more repetitions. From the second to the fourth week, he was

Table 3. Microcycle of the competitive period that ends with participation in the European Championship (August 13-26, 2018).

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Morning	Strength			TRIP			20′ cr Training starters: 60+ 80+ 100+ 150
Afternoon	20′ cr 6× (40 st+ 30 rx+ 30 mx) 100	20′ cr 3× 150	20′ cr		20′ cr 6× 100 rx	20′ cr 8× (40 st+ 30 rx+ 30 mx)	
Morning							
Afternoon	20′ cr	20′ cr Starts	Competition: 100 m FINAL				

cr: continuous running; st: start; rx: relaxed; mx: maximal.

Table 4. Variables for the period of general preparation, introductory block.

Number of exercises	Number of series	Number of repetitions	Rest time	Load
9	3	12	90 sec	12 RM

Table 5. Variables for the period of general preparation, hypertrophy block.

Number of exercises	Number of series	Number of repetitions	Rest time	Load
1st to 4th week				
7	3	12	90 sec	12 RM
2 postural	3	15	60 sec	body
5th to 8th week				
7	3	6/8/12	90 sec	6 RM/8 RM/12 RM
2 postural	3	15	60 sec	body

Table 6. Variables for the period of specific preparation, maximum strength block.

Number of exercises	Number of series	Number of repetitions	Rest time	Load
1st to 2nd week				
3	8	4	180 sec	4 RM
2 postural	3	15	60 sec	body
5th to 8th week				
3	8	2	180 sec	2 RM
2 postural	3	15	60 sec	body

Table 7. Variables for the period of specific preparation, muscle power block.

Number of exercises	Number of series per exercise	Number of repetitions	Rest time	Load
4	6	6	150 sec	6 RM/30% of 6 RM

asked to, in all exercises where he felt that the current load would allow him to exceed 12 repetitions, increase the load for the next series and perform at least 8 repetitions. The volume and intensity variables for this block can be observed in Table 4.

The goal of the muscular hypertrophy block was to increase maximum dynamic strength through muscle hypertrophy. We kept the set in the introduction block for the first four weeks, but in terms of load, the athlete was always asked to perform the 12 RM and raise the load anytime he managed to exceed 12 repetitions. The trunk stabiliser muscles (2 exercises) were worked on with a defined number of 15 repetitions, a rest time of 60 seconds between sets, and 3 sets per exercise. We constructed a model of repetitions and load using the ascending pyramid technique for volume (Table 5), retaining the same workouts and model for the trunk stabilisers throughout the next four weeks.

The maximum strength increases with a block of specific preparation aimed at increasing the maximum dynamic strength through predominantly neural stimulation. We have chosen 3 global exercises in this block while keeping the trunk stabilisation exercises with the same characteristics as the previous blocks. The volume and intensity variables can be seen in Table 6.

The muscle power increase block aimed to increase the rate of dynamic force production. In this block, four global exercises were applied. The approach to attaining the goal was the contrast technique, which involves alternating between sets using high loads with low loads and always with a maximum execution speed. The athlete was asked to perform the first repetition of each set, reacting to as many sound signals as possible. The volume and intensity variables can be seen in Table 7.

CONCLUSIONS

Finally, we would like to underline that Mário's European Champion title was the result of a collaborative effort from a multidisciplinary team, as well as the volitional, persistent, and determined attributes that characterise this athlete. As the Paralympic movement evolves in various ways, we emphasise the importance of conducting additional studies in this specific field of adapted athletics. To conclude, this paper allows coaches and athletes to replicate the training methods of this athlete, intending to improve wheelchair-racing athletes' performance.

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