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A pilot study of ten sessions of overspeed training with motorized towing system: a methodological proposal

Pau Cecilia-Gallego[1,2*], Adrián Odriozola[3,4,5], José Vicente Beltrán-Garrido[6], Josep Maria Padullés-Riu[2] & Jesús Álvarez-Herms[3,4,5]

[1] Health and Sport Sciences University School (EUSES), Rovira i Virgili University, Amposta (Spain).
[2] National Institute of Physical Education (INEFC), University of Barcelona (Spain).
[3] Sport Genomics Research Group, Department of Genetics, Physical Anthropology and Animal Physiology, Faculty of Science and Technology, University of the Basque Country (UPV/EHU), Leioa (Spain).
[4] KDNA Genomics®, University of the Basque Country UPV/EHU, Joxe Mari Korta Research Center, Donostia-San Sebastián (Spain).
[5] Phymo Lab, Physiology and Molecular laboratory, Collado Hermoso (Spain).
[6] Physical Exercise and Performance Research Group, Department of Education Sciences, School of Humanities and Communication Sciences, Universidad Cardenal Herrera-CEU, CEU Universities, Castellón de la Plana (Spain).

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***Corresponding author:**
Pau Cecilia-Gallego
pcecilia1975@gmail.com

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Laura Kluge fighting for the puck in the match between Germany and Hungary during the Eishockey Deutschland Cup, in Landshut, Germany, on November 9, 2024
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Abstract

The current motorized towing system devices are highly precise when selecting loads and achieving results. An increased use could expand the theoretical body on the effects of overspeed methods. Our objectives were to analyze the results of an overspeed intervention with a motorized towing system on the maximum running speed (MRS), the step length and rate, the flight and contact time, and the distance to the first support from the vertical projection of the center of masses, as well as to make a methodological proposal. Six young athletes (age: 16.71 ± 2.00 years) performed ten overspeed sessions with the assistance of 5.05 ± 0.53% of body weight at 105.83 ± 1.79% of maximum running speed, using the 1080 Sprint device. After the intervention, non-significant ($p > .05$) increases of 2.94% (95% CI: 0.25 – 5.62) of the voluntary maximum running speed were obtained with a large effect size (r_B: 0.71; 95% CI: 0.00 – 0.95). The distance to the first support from the vertical projection of the center of masses presented significant differences ($p < .05$; dr_B: 1; 95% CI: 1 – 1). The non-significant maximum running speed increases cannot be neglected in high-level competition, where small differences in performance separate athletes. To choose the appropriate training load is key, and so a standardized methodology allowing the comparison of results is necessary.

Keywords: assisted sprint, ecological approach, effect size, individualization, responders.

Introduction

In the field of sports training, overspeed (OS) is widely used by coaches (Schiffer, 2011) for the improvement of maximum running speed (MRS). One of the most widely used methods to generate OS stimuli is the towing system (TS), which consists of pulling the athlete from the front, both with non-motorized (Clark et al., 2009; Kristensen et al., 2006; Mero & Komi, 1985; Stoyanov, 2019) and motorized devices (Cecilia-Gallego et al., 2022a; Clark et al., 2021; Mero et al., 1987; Sugiura & Aoki, 2008; Van den Tillaar, 2021). Among the motorized TS devices currently available on the market, we highlight the 1080 Sprint (1080 motion, Lidingö, Sweden; https://www.1080motion.com/products/sprint2) and the Dynaspeed (Ergotest Technology AS, Langesund, Norway; https://www.musclelabsystem.com/dynaspeed/), which allow the loads to be selected through an electromechanical system, based on an electric motor controlled by its software, which gives us clear and immediate results (Cecilia-Gallego et al., 2022a; Clark et al., 2021; Lahti et al., 2020; Van den Tillaar, 2021).

There is currently little scientific evidence in this field of study that allows determining the real validity of OS training with TS for the improvement of the MRS. Most of the available studies offer acute data on OS exposure in athletes (Cecilia-Gallego et al., 2022b), and the main conclusions are: 1) these effects are principally due to the action of the athlete's forward pulling system (Gleadhill et al., 2024), and 2) many more studies with intervention periods are needed to determine whether OS training with TS produces adaptations that allow to improve the MRS or not. In addition, these studies present great methodological variability in the TS used, in the participants, in their athletic level, age, sex, or grade of familiarity with the devices, as well as in the scale and expression of the training load. Among the rare studies found that include a training period for OS with TS are those by Majdell and Alexander (1991) with American football players, Kristensen et al. (2006) with physical education students, Lahti et al. (2020) with rugby players, or Stoyanov (2019) with young sprinters.

An important concept provided by the study by Lahti et al. (2020) is the response capacity of athletes to OS training with TS. The concept of responders, or participants that respond to training in the expected sense, has been widely studied (Mann et al., 2014; Pickering & Kiely, 2017; Pickering & Kiely, 2019) and one of the main conclusions reached is that the problem does not lie in the existence of responders (or high-responders) and non-responders (or low-responders) (Pickering & Kiely, 2019), but in the training load used and its dosage (Mann et al., 2014). In other words, if an athlete does not respond to a certain training, it is possibly due to a poor choice and dosage of the training load (Pickering & Kiely, 2019). The parameters should then be adjusted until finding those that produce changes in performance, and the individualization of the training load must be sought (Pickering & Kiely, 2017).

Currently, some studies propose an ecological approach to training, further removed from laboratory conditions (Araújo et al., 2006; Torrents, 2005), and introducing OS training into the global planning of athletes (Lahti et al., 2020; Stoyanov, 2019). It should be noted that the existing literature on OS does not particularly recommend overspeed training in young or inexperienced athletes, mainly due to the risk of injury and the possibility of not having a stable technical pattern that could be negatively modified (Schiffer, 2011). Therefore, it is necessary to know the maturity status of the participants (Mirwald et al., 2002), as well as to ensure familiarity with the devices and OS conditions.

Seeking an ecological approach, it was decided to carry out a pilot study, with an intervention within the overall training planning, of 10 OS sessions using the 1080 Sprint device. The main objective of the study was to analyze the effects of OS training with TS on the MRS of the participants and other kinematic and biomechanical variables that could explain the effects produced. The proposed hypothesis was that the intervention would produce an increase in the MRS of the participants, although with different effects depending on their characteristics. In addition, we understand this pilot study as a proposal for a training methodology that can be replicated to compare results and establish broader conclusions about OS training with motorized TS.

Materials and Methods

Participants

A convenience sample of eight young athletes was recruited. Two of them did not finish due to muscular problems, so in the end six athletes were included in the study (2 males / 4 females). Anthropometric data were recorded by an International Society for Advancement of Kinanthropometry (ISAK) Level 1 certified evaluator (Esparza-Ros et al., 2019) following the ISAK protocol. The calculation of the maturity status of the participants was carried out by collecting anthropometric data following the protocol proposed by Mirwald et al. (2002). The characteristics of the sample can be consulted in Table 1.

The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Ethics Committee of the University of the Basque Country (protocol code M10_2021_191). Informed consent and assent were obtained from all participants and their parents when the participants were minors.

Table 1
Participants characteristics and % of body weight of every assisted load.

Athletes	Chronological Age (y)	Years to PHV	Years of training	Height (cm)	Weight (kg)	% Body Fat	% BW 2 kg	% BW 4 kg	% BW 5.25 kg	PB 60 m (s)
F1	19.5	+ 5.8	7	170.0	63.4	16.7	3.2	6.3	8.3	8.33
F2	18.7	+ 4.3	5	150.4	57.8	22.6	3.5	6.9	9.1	8.94
M1	16.7	+ 2.9	6	179.6	65.8	7.6	3.0	6.1	8.0	7.69
F3	15.5	+ 3.4	4	166.0	56.7	12.3	3.5	7.1	9.3	8.13
F4	15.1	+ 2.0	5	151.3	39.4	11.6	5.1	10.2	13.3	8.35
M2	14.7	+ 1.6	4	176.7	60.2	7.3	3.3	6.7	8.7	7.63
Mean ± SD	16.71 ± 2.00	3.33 ± 1.54	5.17 ± 1.17	165.6 ± 12.45	57.2 ± 9.38	13.0 ± 5.83	3.6 ± 0.75	7.2 ± 1.50	9.4 ± 1.97	8.18 ± 0.48

Note. PHV: peak height velocity; % BW: percentage of body weight of every overspeed load; F: female; M: male; PB: personal best for 60 m-dash; SD: standard deviation.

Table 2
Weekly training schedule during the intervention.

Week	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Week -1			Fam 1 / Anth 1	Rest	Fam 2 / Anth 2	Rest	Rest
Week 1	Pre-Test	ST & TT	OS S1	TT	OS S2	Rest	Rest
Week 2	OS S3	ST & TT	OS S4	TT	OS S5	Rest	Rest
Week 3	OS S6	ST & TT	OS S7	Rest	OS S8	Rest	Rest
Week 4	OS S9	ST & TT	OS S10	Rest	TT	Rest	Rest
Week 5	ST & TT	Rest	Post-Test				

Note. Fam: familiarization session with 1080 Sprint; Anth: anthropometric measures; ST: strength training; TT: technical training; OS S: overspeed sessions.

Design

Following a within-participant design, 10 OS training sessions were performed with a motorized TS. The time variables in a 5-m flying sprint (T5 m), MRS in a 5-m flying sprint (V5 m), step length (SL), step rate (SR), contact time (CT), flight time (FT) and horizontal distance from the first contact of the support on the ground to the vertical projection of the center of masses (HD) were recorded in a maximum unassisted sprint and three assisted sprints with different loads. The results obtained in the different conditions, before and after training, were compared to assess their effect. The results between conditions at each moment were also compared to determine the effect of each OS load on the different variables concerning the MRS. The intervention took place during the mesocycle before the indoor competitions. Table 2 shows the schedule for the entire intervention period.

Procedures

The athletes carried out two familiarization sessions with the motorized TS before the intervention. Anthropometric data collection was also conducted during these sessions. From these sessions on, the loads chosen for the pre-test were those that could produce approximately 3-5% increases over the athletes' MRS (Cecilia-Gallego et al., 2022a).

On the pre-test and post-test data collection days, the athletes performed a standardized warm-up similar to that of Clark et al. (2021). Then, they performed one maximal unassisted sprint and three assisted sprints with progressively higher loads (2 kg, 4 kg, and 5.25 kg). Recovery time between repetitions was 8–10 minutes. The % of the loads concerning the body weight of each participant is shown in Table 1.

Table 3
Intervention parameters.

Athlete	ΔVel OS1 (%)	ΔVel OS2 (%)	ΔVel OS3 (%)	Load S1 (kg)	Sessions (n)	OS runs (n)	Exp Time (s)	Mean Load (kg)	% BW Load	Mean Time (s)	Mean Velocity (m/s)
F1	0.11	4.12	5.86	3	10	64	228.99	2.99	4.7	3.58	8.39
F2	5.90	6.33	6.19	2	10	63	242.42	2.81	4.9	3.85	7.80
M1	2.87	2.65	3.72	5	10	63	208.75	3.68	5.6	3.31	9.06
F3	6.45	4.15	15.09	3	10	63	216.79	2.63	4.6	3.44	8.72
F4	3.23	11.40	10.93	2.5	10	58	214.38	2.30	5.8	3.70	8.11
M2	-2.44	2.78	8.42	4	10	61	201.89	2.78	4.6	3.31	9.07
Mean	2.69	5.24	8.37	3.25		62.00	218.87	2.87	5.05	3.53	8.52
± SD	3.40	3.30	4.11	1.08		2.19	14.64	0.46	0.53	0.22	0.52

Note. F: female; M: male; SD: standard deviation; ΔVel OS: velocity increases for overspeed load (1: 2 kg; 2: 4 kg; 3: 5.25 kg); Load S1: load selected for session 1; OS runs: total runs of overspeed during the intervention; Exp Time: total time of exposure to overspeed conditions; Mean Load: mean load values of all overspeed runs; % BW Load: % body weight of mean load values; Mean Time: mean time values of all overspeed runs; Mean Velocity: mean velocity values of all overspeed runs.

From the pre-test on, individual loads were selected for the training sessions, and those that produced an approximate increase of 3–5% in the athlete's maximum speed were used (Cecilia-Gallego et al., 2022a; Clark et al., 2009; Sedlácek et al., 2015). However, the load used during the races of the training sessions could be modified depending on the result obtained in the MRS test for each one of them, increasing or decreasing it to adjust it to the objective of 103–105% in each race. In other words, the important element was not the load, but its result. This could be done thanks to the Quantum software (v3.9.9.5, 1080 motion, Lidingö, Sweden) that incorporates the device used, which immediately offers values of time and speed over the distance traveled. The average load of all the races performed by each athlete is shown in Table 3, expressed in absolute terms (kg) and as a percentage relative to the athlete's body weight.

The OS sessions were held on an outdoor synthetic running track and were planned as follows: 1) standardized warm-up (Clark et al., 2021) and; 2) main part of the training consisting of a race with the 1080 Sprint device and zero load as an initial test of the session, plus 6–8 assisted races with the selected load for each athlete with 8–10 minutes recovery time between races. The number of races for each athlete was individually adjusted according to fatigue and the % of MRS achieved. All athletes performed a total of 10 sessions. The number of races attended by each athlete and the total exposure time are shown in Table 3.

The assistance in the sprint was carried out using the 1080 Sprint device, which is provided with 90 m of cable that is mechanically rolled or unrolled by a servo motor (2,000 rpm G5 Series Motor; OMRON Corp. Kyoto, Japan) and is controlled by the Quantum software (1080 motion). The 1080 Sprint device was placed at a height of 80 cm so that the trajectory of the assistance was as horizontal as possible, and the athlete was attached with a belt and a carabiner to the device's fiber cable. In the Isotonic assisted mode, the device allows to adjust the load between 1 and 15 kg, with variations of 0.1 kg. This device allows choosing the times it should offer assistance. It was decided not to apply assistance during the first 20 meters of the race, so as not to affect the acceleration phase, but also taking into account that Van den Tillaar (2021) comments that he does not observe differences between MRS and supramaximum speed in the first acceleration phase. The athlete then received assistance for the next 30 meters. At meter 50, the device stopped offering assistance and the athlete progressively braked for approximately 20 meters until movement came to a complete stop. During the assisted 30 meters, the Quantum software provided time and speed data for that interval. These data were used to control the load based on the results of the pre-test and each of the races of the intervention sessions.

Assessments

The T5m (s) and V5m (m/s) variables were obtained with single-beam timing gates (www.chronojump.org/product-category/races/) (Vicens-Bordas et al., 2020), located at a height of 1 m and connected to a laptop (Toshiba Satellite Pro R50-B-10v) with the Chronojump software (version 1.9.0, www.chronojump.org/software/) and were recorded between meter number 40 and meter number 45 of each sprint (Padullés-Riu, 2011). To obtain the SL (cm), CT (s), FT (s) and HD (cm) variables, the attempts were recorded with a Casio Exilim F1 camera (http://arch.casio-intl.com/asia-mea/en/dc/ex_f1/) at 300 fps (Buscà et al., 2016) and analyzed twice in two consecutive steps, approximately between meter number 42.5 and meter number 47.5, with Kinovea 2D analysis software (stable version 0.8.15, www.kinovea.org/download.html) (Puig-Diví et al., 2017; Reinking et al., 2018). The values of these variables correspond to the average value of the two legs in two consecutive steps. The camera was placed perpendicular to meter number 45 of the race at a distance of 13 m from the race line and a height of 1.5 m. The Parallax effect was counteracted by putting references between meter number 40 and meter number 50, in the projection where athletes were shown on camera when they crossed that distance (Romero-Franco et al., 2017). Markers were placed on the femoral head and metatarsal of the right leg. The SR variable was calculated indirectly (number of steps/step time [CT + FT]).

Statistical analyses

The normality of the distribution of the data was checked using the Shapiro-Wilk test. To assess within-group changes from the pre-test to the post-test of the kinematic variables scores, Wilcoxon signed-rank test were used. To quantify within-group differences following the intervention, the matched rank biserial correlation (r_B) and the percentage change was computed. r_B values were interpreted as follow: < .1 = trivial; .1 - .3 = small; .3 - .5 = moderate; and > .5 = large (Cohen, 2013). The level of significance was set at .05 for all tests. All statistical analyses were performed using JASP for Mac (version 0.16.4; JASP Team (2021), University of Amsterdam, The Netherlands).

Results

The pre-test to post-test changes of the kinematic variables scores at different OS conditions are shown in Table 4. The plot with the ESs (effect sizes) of the kinematic variables at the V0 condition is shown in Figure 1. Pre-post changes of the V5m, SL, SR, CT, FT, and HD variables are shown in Figure 2.

Table 4
Pre-test to post-test changes of the kinematic variables scores at different overspeed conditions and percentage change at V0 condition after training period.

Variable	Pre	Post	r_B (95% CI)	Qualitative assessment	Percentage change (95% CI)
V0					
V5m (m/s)	8.10 ± 0.53	8.33 ± 0.57	0.71 (0, 0.95)	Large	+2.94 (0.26, 5.62)
SL (cm)	197.60 ± 13.40	198.33 ± 15.40	0.20 (–0.64, 0.82)	Small	+0.37 (–2.83, 3.56)
SR (steps·s^{-1})	4.27 ± 0.24	4.25 ± 0.19	–0.07 (–0.78, 0.72)	Trivial	–0.22 (–4.49, 4.04)
CT (s)	0.11 ± 0.01	0.11 ± 0	–0.60 (–0.93, 0.27)	Large	–2.98 (–7.46, 1.49)
FT (s)	0.12 ± 0.01	0.13 ± 0.01	0.57 (–0.24, 0.91)	Large	+2.81 (–0.98, 6.61)
HD (cm)	33.18 ± 4.24	36.55 ± 4.53*	1 (1, 1)	Large	+10.51 (3.36, 17.67)
OS1					
V5m (m/s)	8.31 ± 0.48	8.65 ± 0.50*	1 (1, 1)	Large	
SL (cm)	205.92 ± 14.81	207.32 ± 15.83	0.14 (–0.63, 0.78)	Small	
SR (steps·s^{-1})	4.28 ± 0.31	4.27 ± 0.21	–0.05 (–0.73, 0.69)	Trivial	
CT (s)	0.11 ± 0	0.10 ± 0*	–0.87 (–0.98, –0.34)	Large	
FT (s)	0.13 ± 0.02	0.13 ± 0.01	0.81 (0.23, 0.97)	Large	
HD (cm)	34.83 ± 3.51	36.78 ± 4.40	0.81 (0.23, 0.97)	Large	
OS2					
V5m (m/s)	8.52 ± 0.45	9.19 ± 0.53*	1 (1, 1)	Large	
SL (cm)	210.70 ± 17.46	220.37 ± 18.23	0.81 (0.23, 0.97)	Large	
SR (steps·s^{-1})	4.25 ± 0.29	4.23 ± 0.23	–0.05 (–0.73, 0.69)	Trivial	
CT (s)	0.11 ± 0	0.10 ± 0	–0.52 (–0.90, 0.30)	Large	
FT (s)	0.13 ± 0.02	0.13 ± 0.01	0.71 (5.55×10–3, 0.95)	Large	
HD (cm)	37.48 ± 3.88	40.50 ± 2.80*	0.90 (0.54, 0.98)	Large	

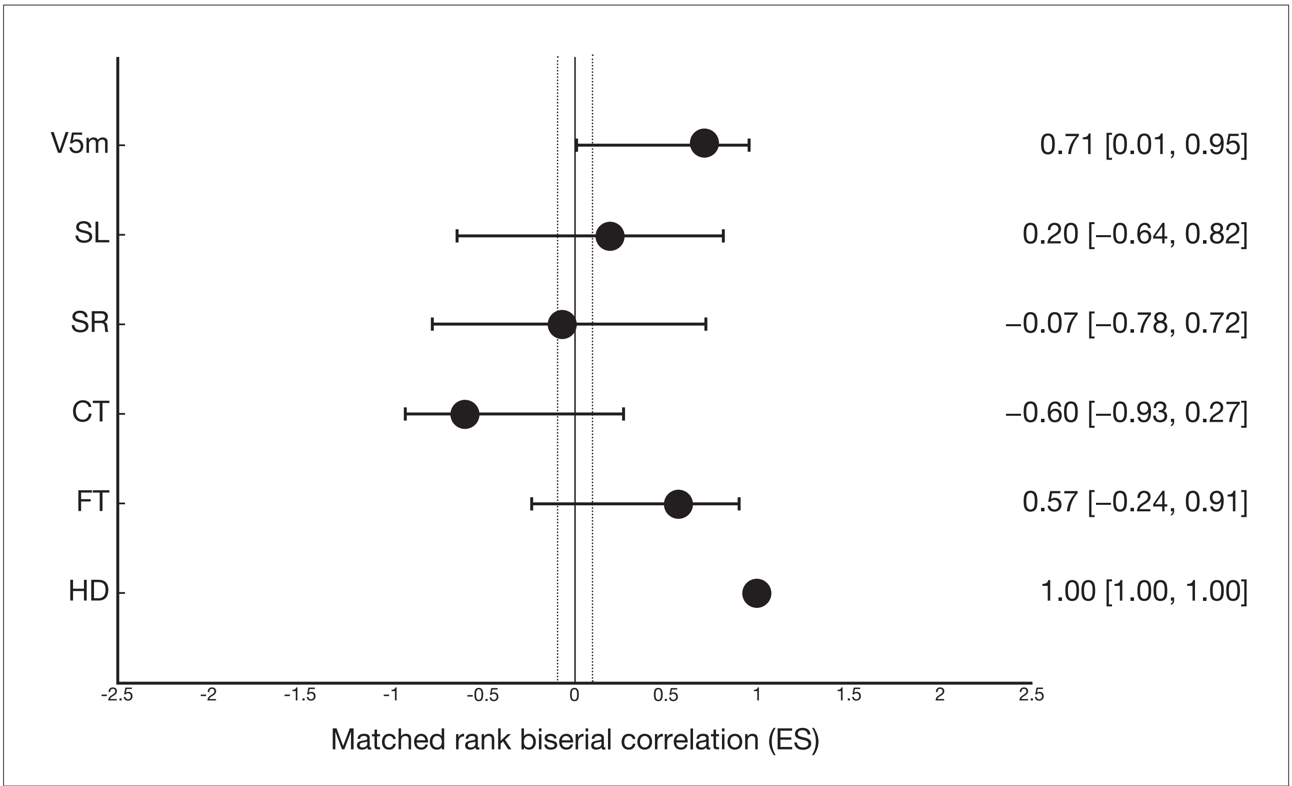
Note. Values are presented as mean ± standard deviation. V0: No overspeed load; OS: overspeed load (1: 2 kg; 2: 4 kg; 3: 5.25 kg); V5m: Mean velocity between 40-m and 45-m from a flying start; SL: Step length; SR: Step rate; CT: Contact time; FT: Flight time; HD: Horizontal distance between the first contact point and the vertical projection of center of masses. $r_{(B)}$: matched rank biserial correlation effect size. *: $p \leq .05$ different to pre-test values; CI: Confidence interval.

Table 4 (Continuation)
Pre-test to post-test changes of the kinematic variables scores at different overspeed conditions and percentage change at V0 condition after training period.

Variable	Pre	Post	r_B (95% CI)	Qualitative assessment	Percentage change (95% CI)
OS3					
V5m (m/s)	8.78 ± 0.66	9.09 ± 0.35	0.43 (–0.41, 0.87)	Moderate	
SL (cm)	219.10 ± 15.51	225.43 ± 16.74	0.52 (–0.30, 0.90)	Large	
SR (steps·s⁻¹)	4.25 ± 0.27	4.25 ± 0.19	0.00 (–0.75, 0.75)	Trivial	
CT (s)	0.11 ± 0	0.10 ± 0	–0.71 (–0.95, –5.55×10–3)	Large	
FT (s)	0.13 ± 0.01	0.13 ± 0.01	0.52 (–0.30, 0.90)	Large	
HD (cm)	38.78 ± 4.21	41.53 ± 3.67*	1 (1, 1)	Large	

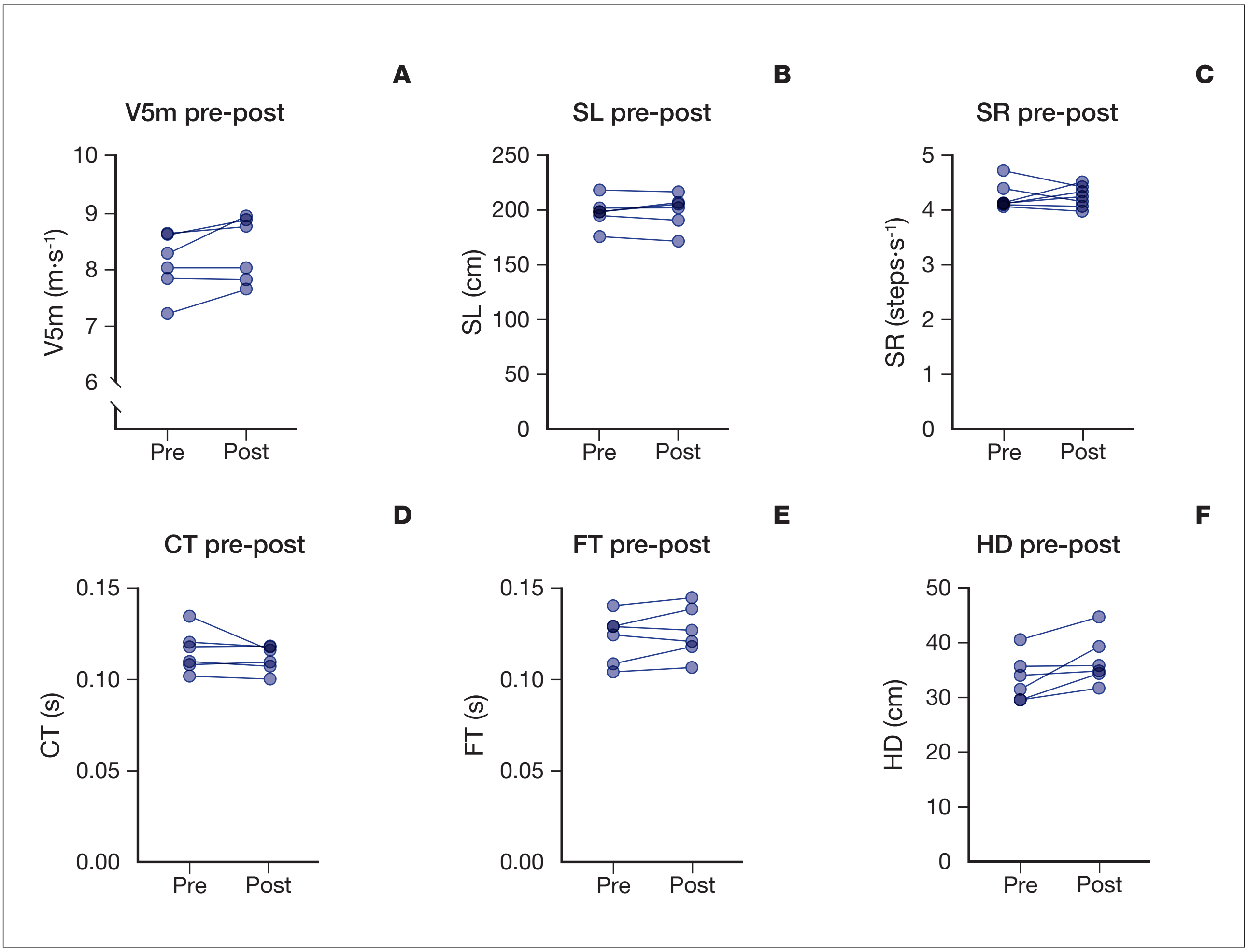
Note. Values are presented as mean ± standard deviation. V0: No overspeed load; OS: overspeed load (1: 2 kg; 2: 4 kg; 3: 5.25 kg); V5m: Mean velocity between 40-m and 45-m from a flying start; SL: Step length; SR: Step rate; CT: Contact time; FT: Flight time; HD: Horizontal distance between the first contact point and the vertical projection of center of masses. $r_{(B)}$: matched rank biserial correlation effect size. *: $p \leq .05$ different to pre-test values; CI: Confidence interval.

Figure 1
Plot with the effect sizes of the kinematic variables at V0 condition



Note. Black dashed lines delimit the trivial effect size magnitude (i.e., –0.1 to 0.1).

Figure 2
Pre-post change of each participant in the different variables.



Note. A) V5m variable; B) step length (SL), C) step rate (SR), D) contact time (CT), E) flight time (FT), and F) horizontal distance (HD) variables.

Discussion

After the intervention, improvements in the MRS (V5m) of the athletes were observed, although they were not statistically significant ($p > .05$). MRS changes should be observed from an individual perspective and keeping in mind that athletic performance is multi-factorial. For this reason, without being statistically significant, the small percentages of improvement found in some athletes could sometimes be decisive in the final result (Loturco, 2023), especially in sprint events in athletics (Loturco et al., 2022; Salo et al., 2011). In the unassisted MRS condition, significant differences ($p < .05$) were reported in HD with large ES (r_B: 1; 95% CI: 1–1), while in the other variables, the differences were not significant and the ESs were trivial or small (see Table 4), so the natural running pattern was not significantly affected.

In similar studies, increases in MRS appear after the intervention of OS with TS, although the methodological differences make it difficult to compare results. After 6 weeks of training, Majdell and Alexander (1991) obtained significant increases in MRS ($p < .05$) using motorized TS in varsity male football players (age: 23 ± 2.73 years) while Kristensen et al. (2006) also reported significant improvements in the MRS ($p < .05$) in physical education students (age: 22 ± 2.6 years) with non-motorized TS after the intervention. Neither of the two studies showed significant differences in the kinematic variables except for support time (Majdell & Alexander, 1991) and step time (Kristensen et al., 2006), so it can be stated that the technical pattern of the sprint was not affected. On the other hand, Lahti et al. (2020), after 12.5 ± 0.7 OS training sessions with the 1080 Sprint device in 10 male rugby players (age: 20.1 ± 1 years), observed significant increases in MRS of 3.40 ± 4.15% ($p < .03$; ES: 0.47; 95% CI:–0.38 – 1.32) although they point out that only 5 of the 10 members of the group respond positively in the expected direction after training, reinforcing the need for load individualization. It can therefore be argued that the possible changes in the MRS of the athletes are due to neural and coordination improvements within the early phase of training (Kristensen et al., 2006), hence studies with longer intervention periods would be necessary.

However, as mentioned, the methodological heterogeneity of the studies is so wide that it is not possible to conclude OS training with TS beyond the study sample itself. This heterogeneity affects many factors that are typical of the sample such as sex, age, sports specialty, and experience in training, but also the procedures used in the intervention in aspects such as the TS used, the loads, the distances, the intervention time, measurement instruments and procedures, variables analyzed, etc. Therefore, a second motivation of this study is to make some methodological proposals that can be replicated to broaden the knowledge about OS training with TS and its effects. We believe that the fact of having devices such as the 1080 Sprint used in this study should be exploited, especially when carrying out studies, due to their ability to monitor the training load and its effects in an individualized and immediate way (Cecilia-Gallego et al., 2022a; Clark et al., 2021; Lahti et al., 2020; Van den Tillaar, 2021), compared to other systems used, such as non-motorized TS (Kristensen et al., 2006) or elastic ropes (Stoyanov, 2019).

Studies similar to ours (Kristensen et al., 2006; Majdell & Alexander, 1991; Stoyanov, 2019) present differences in terms of age, sex, and experience in training, with the participants in our study being the youngest (see Table 1). Although there are some recommendations not to use OS training in young and inexperienced participants (Schiffer, 2011), our participants were in the post-PHV period (3.33 ± 1.54 years) (Mirwald et al., 2002), were enough experienced in speed training (5.17 ± 1.17 years) and were provided with 2 familiarization sessions with the device. These data indicate that the participants in the study, especially the girls, have largely overcome the PHV period, so their maturational, physiological and anthropometric characteristics now resemble those of adults. Furthermore, their experience in athletic training would allow these methods to be applied to them.

Normally, the selection of training loads has been made based on the increase produced over the MRS, recommending the use of those that take the athlete to speeds between 3% and 10% higher than the MRS (Clark et al., 2009; Mero & Komi, 1985; Sedlácek et al., 2015; Sugiura & Aoki, 2008). In the case of our study, we have worked with average loads of 5.05 ± 0.53% of body weight, which have produced average speeds of 105.71% of the MRS. For us, it is especially relevant to determine these values for further studies and their comparison. In addition, in our study the load was not fixed but was adjusted inter and intra-session, considering the effect produced, i.e., the objective of 103–105% of the MRS. This aspect is also taken into account in Stoyanov's study (2019) with elastic ropes, which sets its objectives in the resulting speed, from 102–103% to 108–110%, depending on the distance and athlete; and in that of Lahti et al. (2020), where the objective is to obtain speeds of 105% MRS, with a weekly adjustment of the loads.

The intervention carried out is based on an ecological approach (Araújo et al., 2006; Torrents, 2005) to the training of athletes (see Table 2), including it in their actual preparation for competition. We believe that these types of studies, although they are more difficult to control due to the high number of confounding variables that may appear, provide information with greater external validity than studies carried out in analytical or laboratory situations (Kristensen et al., 2006; Majdell & Alexander, 1991). This same line of ecological approach can be found in Stoyanov (2019), with young sprinters, and Lahti et al. (2020) with rugby players. In both studies, they provide us with the data of the intervention and the rest of the training content. Emphasis should also be placed on the need for studies with a control group that perform the same intervention in a more analytical situation, to allow the effectiveness of this type of intervention to be assessed.

A limitation of our study is the size of the final sample, where only 6 participants finished the intervention, out of the 8 who started it. This small sample does not provide enough statistical power to the results obtained, but we believe that is necessary to attend to the individuality of the results (Loturco et al., 2022) and the ES of the treatment, not focusing only on the statistical significance of the results (Hopkins et al., 2009; Swinton et al., 2022; Turner et al., 2021b, 2021a). We can see how in the study by Lahti et al. (2020) an ES of 0.47 (–0.38 – 1.32) is obtained with a $p = .03$ while in ours we obtained a higher ES (0.71 [–0.00 – 0.95]) but a non-significant p-value, due to the greater width of the confidence interval. If we look at the individual response, Lahti et al. (2020) report that 5 of the 10 participants do not respond in the expected direction, which they attribute to an inadequate training load, based on their initial strength-velocity profile, while in ours only 2 out of 6 do not improve their MRS after treatment (F1: –0.12%;

F4: –0.51%), while the rest of the athletes do improve, some considerably in percentage terms (F2: +5.87%; F3: +7.07%; M1: +1.48%; M2: +2.82%). Introducing follow-up tests for a few weeks could also provide us with more information about the effects of training (Bissas et al., 2022; Lahti et al., 2020), as well as taking into account the possible error in the measurement procedures, an aspect that is by no means negligible in research, and which can lead to possible false non-responder or vice versa (Mann et al., 2014; Pickering & Kiely, 2019). Pickering and Kiely (2019) argue that the most important aspect of training is the individual dosage of the training load and that the lack of response to the process may be because it was not adequate to its characteristics. According to these same authors, the terms "Responder" and "Non-responder" should stop being used and should be changed to "Did not respond", thus transferring the reason for the athlete's non-response to treatment. Finally, more studies are needed to be able to determine if there is a specificity of non-response to each type of exercise (Mann et al., 2014), in this case to OS.

Conclusions and practical applications

A period of adaptation or familiarization to the OS conditions generated by the TS is necessary to be able to run at supramaximal speed in a controlled manner. The first repetitions generate insecurity and mistrust in athletes.

OS training with TS can be a good method to reduce CT values, a determining factor in performance for improving MRS since OS conditions imply a greater need for vertical ground reaction forces.

The management and dosage of the loads must be done on an individualized and daily basis, adapting the loads to the proposed objective.

Intervention periods of around 4–6 weeks may be insufficient; longer periods, between 8 and 12 weeks, would be recommended to be able to assess the results beyond the early phase of training.

In research, individual health data should be collected, both physiological and psychological or emotional, during the tests, to determine any possible influence on the results.

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Conflicts of interest

The authors declare no conflict of interest.

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