https://doi.org/10.5817/StS2025-2-4

Changes in Velocity Decrement at Different Phases of a 30-Meter Resisted Sprint

Daniel Marčan[1], **Adam Lipčák**[1], **Marián Škorik**[2], **Petr Tomek**[1], **Tomáš Kalina**[1]

[1]Faculty of Sports Studies, Masaryk University, Brno, Czech Republic
[2]Faculty of Sports Science and Health, Matej Bel University, Banská Bystrica, Slovakia

ABSTRACT

Resisted sprint training is one of the most studied methods for developing speed capabilities, especially for elite-level athletes. While traditional sled training relies on a fixed load based on the percentage of body mass, recent research suggests that resistance based on velocity decrement (V_{dec}) may be a more practical option. This study examines whether V_{dec} at a given resistance remains consistent or varies across different phases of a 30 m sprint. Twelve male participants with a speed-focused training history were involved in this study. Participants performed 30 m sprint trials, with time splits recorded at 10 m intervals (0–10 m, 10–20 m, 20–30 m) and additional segmental analysis for distances 0–20 m, 10–30 m and the entire 0–30 m sprint. Each participant completed two repetitions at five different resistance levels provided by a cable-driven motorised resistance system (1080 Sprint). The analysis of horizontal force-velocity-power parameters showed moderate variation in force generation of the subjects, with an average theoretical maximal force of 6.33 ± 0.85 N/kg and a relatively consistent maximal velocity of 9.39 ± 0.42 m/s. The study revealed a statistically significant difference in % V_{dec} ($p \leq 0.05$) across different sprint phases, with higher resistance leading to increased differences in the individual phases of the run. Segmental analysis showed a greater % V_{dec} as sprint distance increased across all resistance levels. These findings highlight the need for a deeper understanding of resisted sprint training for more effective speed development.

Keywords: resistance sprint; acceleration; performance; external load; V_{dec}

INTRODUCTION

Sprint performance is a critical factor in various sports where the ability to reach high horizontal velocity rapidly often determines success (Haugen, 2017; Watkins et al., 2021). One method used to enhance lower limb muscle force and power output is resisted sled sprinting. This method may improve immediate sprint performance due to its specificity and transferability (Petrakos et al., 2016). It is biomechanically specific to sprinting, targeting the horizontal force vector while preserving kinematic patterns, particularly during acceleration (Morin & Samozino, 2016).

Resisted sled pulling is a widely studied method of resisted sprinting (Cahill et al., 2019). Traditionally, researchers advised using external loads that resulted in no more than a 10 % reduction in maximum sprint velocity or a load of ≤ 12.6 % of body mass (% BM) to minimise disruptions in sprint mechanics. However, more recent studies have explored the immediate effect of varying sled loads on sprint kinetics, ranging from light to heavy, to target specific force-velocity training zones during horizontal movement (Cahill et al., 2020; Cross et al., 2018). These training zones represent either force- or velocity-dominant profiles and have been associated with different phases of the sprint acceleration curve (Samozino et al., 2016). In a systematic review of resisted sled-pulling training, Petrakos et al. (2016) concluded that heavy sled-pull training enhances the initial sprint acceleration phase. The effectiveness of sled training for improving acceleration or maximal sprint velocity depends on load selection, as it influences the ability to generate high horizontal forces at low velocities or vice versa.

The limitation of traditional sled-pull training has been the reliance on a fixed % BM to determine loading for all individuals. This approach does not account for friction, strength levels, training background and physiological development, which influence an athlete's capacity to handle external resistance (Cahill et al., 2019; Kawamori et al., 2013). A more individualized method involves adjusting the load based on the decrement in velocity (V_{dec}), representing the percentage reduction in maximal sprint speed compared to unresisted sprinting (Lipčák & Kalina, 2024; Petrakos et al., 2019). Lahti et al. (2020) found that eleven weeks of sled-resisted training with a 50 % V_{dec} improved sprint performance and horizontal force production. This finding is further supported by Morin et al. (2022), who analysed the effects of sled-resisted training programs utilising a 50 % V_{dec}. After ten weeks of training at 50 % V_{dec}, athletes exhibited enhanced 30-meter sprint performance and notable gains in horizontal force production and maximal horizontal power. Moreover, individualised loading based on V_{dec} allows athletes to target specific regions of the force–velocity spectrum and maximise mechanical effectiveness during sprinting (Cross et al., 2018; Morin & Samozino, 2016).

In addition to traditional sled-pull methods, cable-driven motorised resistance systems such as the 1080 Sprint offer a novel and precise alternative. These devices eliminate surface-dependent friction variability and provide accurate, consistent resistance across the sprint distance (Rakovic et al., 2022). Furthermore, they enable real-time feedback and programmable load profiles, making them suitable for both testing and training applications. Despite these advantages, few studies have investigated how velocity loss induced by such devices behaves across different phases of a sprint.

This study aims to examine whether the velocity decrement induced by a constant resistance using the 1080 Sprint remains uniform throughout the 30-meter sprint or varies between sprint segments. Identifying such variability could improve precision in resistance prescription and help optimise phase-specific sprint development.

METHODS

Participants

Twelve male participants, all students of sports-related disciplines, were recruited for this study. The participants had (mean ± SD) an average height of 179.25 ± 4.81 cm, a body mass of 79.58 ± 8.90 kg, and an average age of 24.62 ± 1.43 years. Participants were recruited through convenience sampling from students enrolled in sports science programs at the university. Their training history included regular speed-focused training, and they specialised in sports such as athletics and team sports. Participants were required to be actively engaged in speed training and provide informed consent for participation. The exclusion criterion was the presence of neuromuscular injuries that would prevent them from completing the sprint protocol. All participants provided written informed consent regarding the potential risks associated with the study. Ethical approval was obtained from the UMB Ethics Commission for a broader validation study (Approval No. 217/2025).

Experimental Design

This study employed a quasi-experimental design without a control group. The dependent variables were mean sprint velocity and top speed, while the independent variable was horizontal resistance applied during sprints. The testing sessions were conducted in the morning in an indoor gymnasium, where the temperature was maintained between 18-20°C. Participants wore standard indoor sports shoes to ensure consistency in running conditions.

Procedures

Participants underwent a standardised warm-up protocol that included dynamic stretching, plyometric exercises, and a series of practice sprints under both resisted and unresisted conditions. Following the warm-up, each participant performed 30 m sprints, with intermediate time splits recorded at 10 m intervals (0–10 m, 10–20 m, 20–30 m). Additionally, aggregated segment analyses were conducted for distances of 0–20 m, 10–30 m, and the entire 0-30 m sprint. The velocity and time parameters were measured using the 1080 Sprint (1080 Motion, Sweden). Each participant completed two sprint repetitions at five different resistance levels: 1 kg, 5 kg, 8 kg, 11 kg, and 15 kg, using an isotonic resistance mode provided by a cable-driven motorised resistance system (1080 Sprint, Västerås, Sweden). A three-minute rest period was enforced between trials to minimise the effects of fatigue. All sprints were initiated from a static start position to ensure trial consistency.

Data Analysis

The best trial, defined as the fastest recorded time over 30 m, was used for analysis for each participant. The key performance metrics include mean velocity (m/s) for each measured segment, top speed achieved during the sprint, and speed decrement for resistance levels greater than or equal to 5 kg.

The velocity decrement was calculated using the formula: (v1kg-vxkg)/v1kg, where x corresponds to the resistance. Additionally, a force-velocity profile was computed using data from the sprint with 1 kg resistance, allowing for determining key profile parameters. Descriptive statistics, including mean, standard deviation (SD), minimum (min), maximum (max), median, and 25th and 75th percentiles (25th perc. and 75th perc., respectively), were calculated. The non-parametric Friedman test for repeated measures evaluated differences between the velocity decrement (V_{dec}) variables within each concentric load condition (5, 8, 11, and 15 kg). This test was selected due to violations of normality assumptions (verified by the Shapiro–Wilk test) and the within-subjects design involving multiple variables.

If the Friedman ANOVA indicated a statistically significant effect ($p < 0.05$), post-hoc pairwise comparisons were performed using the Wilcoxon signed-rank test for all combinations of V_{dec} variables. A Bonferroni correction was applied to control Type I errors in multiple comparisons. Data processing was conducted using Microsoft Excel (USA), while statistical analysis was performed in RStudio 2024.12.0 build 467 (Posit Software, PBC) with R version 4.3.2. The significance level was set at $p \leq 0.05$.

RESULTS

The analysis of horizontal force-velocity-power (FVP) parameters among the tested athletes reveals important insights into their performance characteristics. The average theoretical maximal force (F0) is 6.33 ± 0.85 N/kg, indicating a moderate variation in the athletes' ability to generate force. The average theoretical maximal velocity (v0) is 9.39 ± 0.42 m/s, suggesting that most athletes have similar top-speed capabilities. The mean maximal power output (Pmax) is 14.84 ± 2.07 W/kg. The peak ratio of force (RFmax) averages 44.72 ± 4.25%, and the decrease in force ratio (D_{RF}) has an average value of -5.70 ± 0.72 % showing some variability in the effectiveness of force application during movement and a relatively consistent decline in force production across athletes respectively.

The results of descriptive statistics of the average velocities of selected segments of the 30m run and top speed (TS) are shown in Tables 1 to 5. Table 6 and Figure 1 show the descriptive statistics and post-hoc comparison of velocity decrement metrics across resistances.

Table 1. The results of descriptive statistics of the average speeds of selected segments of the 30 m run and top speed (TS) with 1 kg resistance

variable	mean	SD	min	25th perc.	median	75th perc.	max
Time [s]	4.83	0.30	4.42	4.62	4.80	5.05	5.34
TS [m/s]	8.05	0.41	7.49	7.74	7.99	8.39	8.70
0–10m [m/s]	4.52	0.40	3.89	4.24	4.56	4.76	5.17
10–20m [m/s]	7.45	0.30	7.05	7.25	7.32	7.67	7.96
20–30m [m/s]	7.95	0.40	7.38	7.67	7.94	8.21	8.65
0–20m [m/s]	5.62	0.38	5.01	5.36	5.65	5.90	6.16
10–30m [m/s]	7.69	0.34	7.21	7.44	7.64	7.91	8.29
0–30m [m/s]	6.23	0.38	5.61	5.94	6.25	6.49	6.79

Table 2. The results of descriptive statistics of the average speeds of selected segments of the 30 m run and top speed (TS) with 5 kg resistance

variable	mean	SD	min	25th perc.	median	75th perc.	max
Time [s]	5.26	0.36	4.83	4.92	5.25	5.51	5.98
TS [m/s]	7.26	0.48	6.48	6.92	7.23	7.59	7.97
0–10m [m/s]	4.18	0.36	3.52	3.96	4.15	4.45	4.75
10–20m [m/s]	6.87	0.36	6.34	6.63	6.79	7.15	7.44
20–30m [m/s]	7.23	0.47	6.40	6.89	7.23	7.50	7.95
0–20m [m/s]	5.20	0.36	4.53	4.94	5.18	5.53	5.63
10–30m [m/s]	7.05	0.41	6.37	6.73	6.99	7.32	7.69
0–30m [m/s]	5.73	0.39	5.02	5.45	5.71	6.10	6.21

Table 3. The results of descriptive statistics of the average speeds of selected segments of the 30 m run and top speed (TS) with 8 kg resistance

variable	mean	SD	min	25th perc.	median	75th perc.	max
Time [s]	5.57	0.42	4.96	5.26	5.55	5.93	6.23
TS [m/s]	6.72	0.51	5.96	6.40	6.61	7.15	7.45
0–10m [m/s]	4.02	0.36	3.52	3.75	4.03	4.32	4.59
10–20m [m/s]	6.44	0.42	5.84	6.12	6.38	6.84	7.00
20–30m [m/s]	6.69	0.52	5.94	6.35	6.53	7.12	7.51
0–20m [m/s]	4.95	0.38	4.39	4.61	4.97	5.24	5.55
10–30m [m/s]	6.56	0.47	5.89	6.25	6.42	6.98	7.24
0–30m [m/s]	5.42	0.40	4.81	5.06	5.41	5.70	6.05

Table 4. The results of descriptive statistics of the average speeds of selected segments of the 30 m run and top speed (TS) with 11 kg resistance

variable	mean	SD	min	25th perc.	median	75th perc.	max
Time [s]	5.89	0.45	5.22	5.58	5.91	6.18	6.63
TS [m/s]	6.18	0.50	5.47	5.78	6.08	6.59	6.96
0–10m [m/s]	3.92	0.31	3.39	3.79	3.93	4.11	4.46
10–20m [m/s]	6.00	0.43	5.45	5.66	5.88	6.39	6.67
20–30m [m/s]	6.12	0.56	5.25	5.68	6.00	6.55	6.97
0–20m [m/s]	4.73	0.34	4.23	4.52	4.75	4.94	5.31
10–30m [m/s]	6.06	0.49	5.35	5.68	5.93	6.47	6.81
0–30m [m/s]	5.12	0.39	4.52	4.86	5.08	5.38	5.74

Table 5 The results of descriptive statistics of the average speeds of selected segments of the 30 m run and top speed (TS) with 15 kg resistance

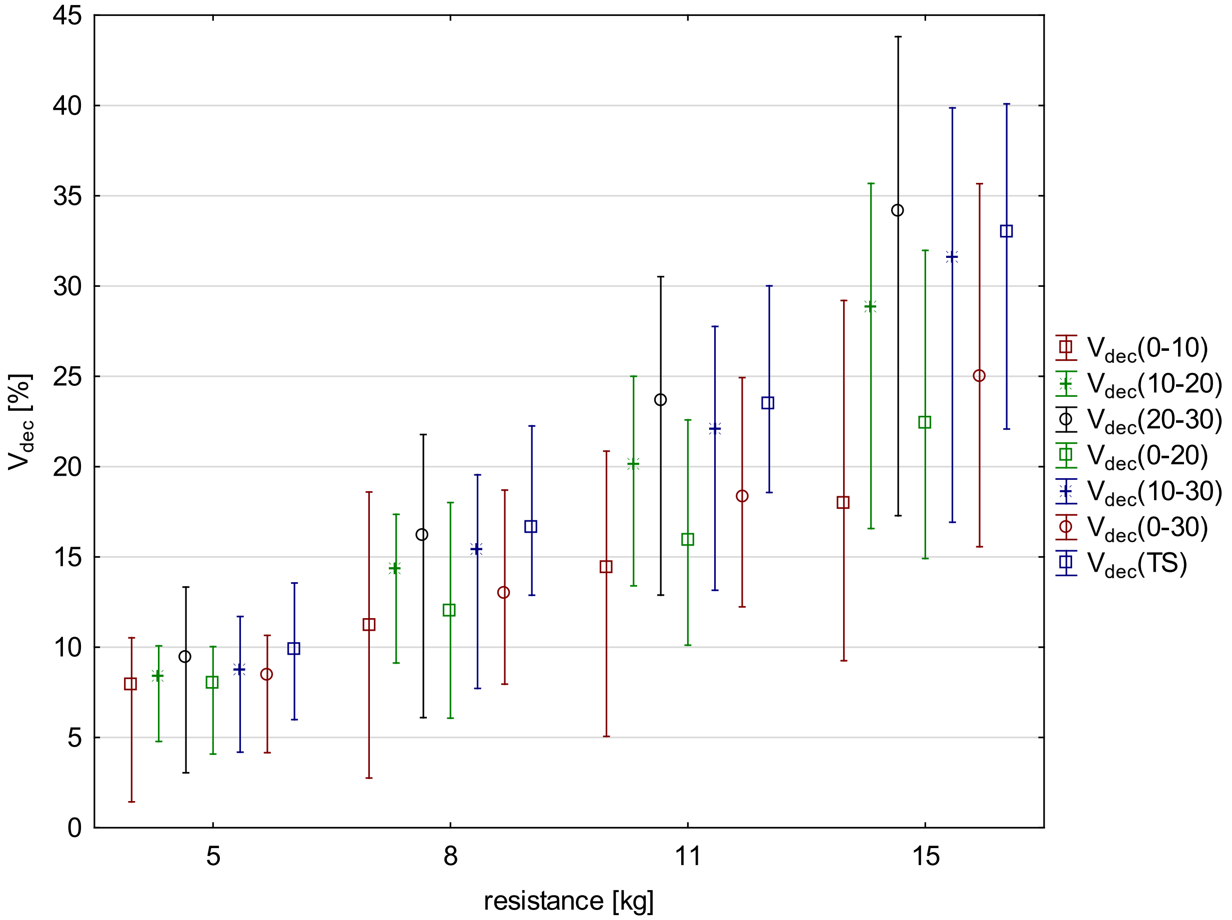
variable	mean	SD	min	25th perc.	median	75th perc.	max
Time [s]	6.47	0.58	5.50	6.09	6.59	6.81	7.44
TS [m/s]	5.50	0.58	4.63	5.09	5.41	5.87	6.66
0–10m [m/s]	3.71	0.29	3.27	3.58	3.62	3.81	4.28
10–20m [m/s]	5.39	0.54	4.57	4.99	5.33	5.71	6.42
20–30m [m/s]	5.36	0.63	4.55	4.94	5.27	5.83	6.62
0–20m [m/s]	4.39	0.37	3.81	4.17	4.28	4.57	5.02
10–30m [m/s]	5.38	0.58	4.56	4.96	5.31	5.77	6.52
0–30m [m/s]	4.67	0.43	4.03	4.40	4.56	4.92	5.46

Table 6 Descriptive Statistics and Post-hoc Comparison of velocity decrements (V_{dec}) Metrics Across Loads, segments and top speed (TS)

	5 kg	8 kg	11 kg	15 kg
ANOVA	p < 0.01	p < 0.01	p < 0.01	p < 0.01
V_{dec}(0–10m) [%]	7.45 ± 2.59	10.97 ± 3.91 (g)	13.19 ± 4.82 (bcdefg)	17.74 ± 5.6 (bcdefg)
V_{dec}(10–20m) [%]	7.77 ± 1.77 (g)	13.61 ± 3.2 (g)	19.57 ± 3.63 (acdeg)	27.7 ± 5.66 (acdeg)
V_{dec}(20–30m) [%]	9.18 ± 2.54	15.95 ± 4.13	23.11 ± 4.96 (abdef)	32.63 ± 6.6 (abdef)
V_{dec}(0–20m) [%]	7.57 ± 1.89	12.0 ± 2.97 (g)	15.72 ± 3.67 (abcefg)	21.84 ± 4.79 (abcefg)
V_{dec}(10–30m) [%]	8.46 ± 1.99 (g)	14.77 ± 3.51 (g)	21.33 ± 4.25 (abcdfg)	30.18 ± 6.1 (abcdfg)
V_{dec}(0–30m) [%]	8.0 ± 1.91	13.08 ± 3.04 (g)	17.81 ± 3.76 (acdeg)	25.0 ± 5.19 (acdeg)
V_{dec}(TS) [%]	9.83 ± 1.98 (be)	16.58 ± 3.26 (abdef)	23.28 ± 3.73 (abdef)	31.81 ± 5.17 (abdef)

V_{dec} *values are presented as mean ± standard deviation in percentages; parameter numbers in parentheses indicate measured segments or top speed (TP). Letters in parentheses indicate statistically significant differences (p < 0.005) between variables within the same load condition based on Wilcoxon signed-rank tests with Bonferroni correction. The following letter codes were used: a =* V_{dec}*(0–10 m), b =* V_{dec}*(10–20 m), c =* V_{dec}*(20–30 m), d =* V_{dec}*(0–20 m), e =* V_{dec}*(10–30 m), f =* V_{dec}*(0–30 m), and g =* V_{dec}*(TS). Friedman's ANOVA p-values represent the overall effect of deceleration variables for each concentric load.*

Figure 1. Velocity decrements (V_{dec}) Metrics Across Loads (displayed as median and min-max range), segments and top speed (TS)



DISCUSSION

Higher resistance has naturally led to an increasing percentage decrease in velocity (% V_{dec}) over the entire run. However, it also led to increasing differences in the individual phases of the run. The data indicate that there is a statistically significant difference ($p \leq 0.05$) in V_{dec} between individual sections of the sprint trial using resistance (Tab. 1–4). In comparison, at 5 kg resistance, the % V_{dec} was 7.45 ± 2.59 in the first phase of the run (0–10 m) and 9.18 ± 2.54 in the last phase (20–30 m). While for 15 kg resistance, this difference increased from 17.74 ± 5.6 % V_{dec} in the first phase (0–10 m) to 32.63 ± 6.6 % V_{dec} in the latter portion of the run (20–30 m). Overall, with increasing sprint length regardless of the resistance (although with a greater difference with a higher resistance), there is a tendency for increasing %V_{dec} in the results. A detailed view of the % V_{dec} for each section and the resistance used may be seen in the Results part in Table 6.

Factors influencing performance in resisted sprints could be increasing time under load. The overall sprint time will extend because of the higher resistance and naturally higher initial %V_{dec}, which may cause greater fatigue with increasing length. Another factor worth considering is the force-velocity (F-V) profile. Although this was not measured as part of this study, it may help guide practitioners towards a more individualised approach to athletes within the training process. Since the F-V profile varies from individual to individual, one athlete may be more strength-oriented and another more speed-oriented. This data can help us with decision-making in training and, therefore, more accurately determine the resistance used or what specific locomotor capacity to target (Morin & Samozino, 2016). In this context, it may be a choice of greater resistance in the more speed-oriented athlete. Who, although achieving high maximal sprinting speed (MSS), has lower maximal horizontal force production (F0) or ratio of force (RF) in the initial phase of the run and a higher rate of decrease in RF (D_{RF}) with increasing velocity. On the other hand, in a more strength-oriented individual, choosing a lower resistance will result in a higher Top Speed and, therefore, a higher % MSS value. Top Speed refers to the highest speed achieved during a given exercise. It represents the maximum speed measured during the test, though it does not necessarily reflect an athlete's absolute maximum capacity (MSS) (Buchheit & Eriksrud, 2024).

To our knowledge, no prior studies have specifically examined velocity decrements across multiple sprint segments under varying resistive loads. However, the study by van den Tillaar et al. (2023) investigated the use of load–velocity relationships to predict maximal sprint velocity by applying both resisted and assisted loads over full-length sprints. Their approach used regression analyses to model overall peak sprint velocity (V_{max}). In contrast, our study employed a segmental velocity analysis based on average speeds across defined intervals (e.g., 0–10 m, 10–20 m, 20–30 m), specifically emphasising how increasing resistance affects velocity decrement within each sprint segment. This allowed us to assess how resistive loads alter sprint performance patterns throughout sprint phases. This methodological distinction yields complementary perspectives: whereas the approach by van den Tillaar et al. (2023) facilitates load–velocity profiling aimed at optimising overall sprint performance, our segment-based analysis offers a more detailed understanding of how varying resistive loads influence sprint mechanics at different stages of the sprint performance.

Based on the findings of Lahti et al. (2020), both groups using heavy resisted sprint training showed overall improvements in sprint performance. However, only the subgroup using a load corresponding to a 50% velocity decrement (HS50 %) demonstrated statistically significant improvements compared to the control group, and this was limited to the 0–10 m segment. These findings highlight the importance of phase-specific monitoring, as adaptations may differ across sprint segments. Our results support this perspective by demonstrating that velocity decrements vary across sprint segments. This reinforces the need to assess segmental sprint responses rather than relying solely on whole-sprint metrics when individualising resistance training protocols.

Limitations

This study utilised 1 kg of resistance during the 30 m sprint test to determine Top Speed (as the maximum speed observed) using the 1080 Sprint. This baseline measurement derived the velocity decrement for other resistance levels (5, 8, 11, 15 kg). It is one of the limitations of the present study as we cannot measure without resistance on this device. However, the selected 1 kg can be considered negligible and, therefore, very close to the true MSS capacity of a subject that would be achieved in an unresisted sprint over 30–40 m (Buchheit & Eriksrud, 2024; Cross et al., 2018). Although 1080 Sprint operates only for testing and training with resistance, considering the above-mentioned (very low resistance resulting in comparable results to true MSS), it may give us more valuable parameters and greater insight into speed development than simple timing gates. Within such testing, we can determine, among other parameters, the F-V profile of an individual. According to the manufacturer (1080 Motion, Sweden), this can be determined already at a low resistance of 1–3 kg and a minimum sprint distance of 30 m. As reported by other authors (Cross et al., 2018), the pre-training F-V profile may impact the overall results and individual adaptations observed in athletes to resisted sprint training. These findings suggest the need for further research, using a larger and more homogeneous sample while considering the F-V profiles of the subjects tested.

CONCLUSION

Segmental analysis of 30 m resisted sprint using the 1080 Sprint device found statistically significant differences in the percentage of velocity decrement (% V_{dec}). As sprint distance increased, % V_{dec} increased across all resistance levels (5, 8, 11, 15 kg). These findings highlight the importance of a deeper understanding of this concept for more effective speed development, particularly in elite sports.

Based on the existing literature, resisted sprint training appears to be an effective method, especially for developing acceleration speed. However, research gaps remain regarding the optimisation of resistance levels, whether using the % V_{dec} or % BM. We believe this study contributes to future research, which should focus on the effect of resistance level on % V_{dec}, considering the individual F-V profile and its subsequent application in training practice.

One potential approach is using variable resistance with the 1080 Sprint system, allowing for dynamic adjustments in resistance from higher to lower (or vice versa) depending on the movement speed. This method may allow a more individualised approach to individual athlete profiles by targeting specific sprint phases or focusing on particular speed qualities and performance parameters.

ACKNOWLEDGEMENTS

The authors thank all participants for their time to participate in this research.

REFERENCES

Buchheit, M., & Eriksrud, O. (2024). Maximal locomotor function in elite football: Protocols and metrics for acceleration, speed, deceleration, and change of direction using a motorized resistance device. *Sport Performance & Science Reports*, *238*(1).

Cahill, M. J., Cronin, J. B., Oliver, J. L., P. Clark, K., Lloyd, R. S., & Cross, M. R. (2019). Sled Pushing and Pulling to Enhance Speed Capability. *Strength & Conditioning Journal*, *41*(4), 94–104. https://doi.org/10.1519/SSC.0000000000000460

Cross, M. R., Lahti, J., Brown, S. R., Chedati, M., Jimenez-Reyes, P., Samozino, P., Eriksrud, O., & Morin, J.-B. (2018). Training at maximal power in resisted sprinting: Optimal load determination methodology and pilot results in team sport athletes. *PLoS ONE*, *13*(4), e0195477. https://doi.org/10.1371/journal.pone.0195477

Haugen, T. (2017). Sprint conditioning of elite soccer players: Worth the effort or lets just buy faster players? *Sport Performance & Science Reports*, *4*(v1), 1–3.

Kawamori, N., Nosaka, K., & Newton, R. U. (2013). Relationships between ground reaction impulse and sprint acceleration performance in team sport athletes. *Journal of Strength and Conditioning Research*, *27*(3), 568–573. https://doi.org/10.1519/JSC.0b013e318257805a

Lahti, J., Huuhka, T., Romero, V., Bezodis, I., Morin, J.-B., & Häkkinen, K. (2020). Changes in sprint performance and sagittal plane kinematics after heavy resisted sprint training in professional soccer players. *PeerJ*, *8*, e10507. https://doi.org/10.7717/peerj.10507

Lipčák, A., & Kalina, T. (2024). Effect of Resistance on 20 m Running Performance. *Studia Sportiva*, *18*. https://doi.org/10.5817/StS2024-1-11

Morin, J.-B., Capelo-Ramirez, F., Rodriguez-Pérez, M. A., Cross, M. R., & Jimenez-Reyes, P. (2022). Individual Adaptation Kinetics Following Heavy Resisted Sprint Training. *The Journal of Strength & Conditioning Research*, *36*(4), 1158. https://doi.org/10.1519/JSC.0000000000003546

Morin, J.-B., & Samozino, P. (2016). Interpreting Power-Force-Velocity Profiles for Individualized and Specific Training. *International Journal of Sports Physiology and Performance*, *11*(2), 267–272. https://doi.org/10.1123/ijspp.2015-0638

Petrakos, G., Morin, J.-B., & Egan, B. (2016). Resisted Sled Sprint Training to Improve Sprint Performance: A Systematic Review. *Sports Medicine*, *46*(3), 381–400. https://doi.org/10.1007/s40279-015-0422-8

Petrakos, G., Tynan, N. C., Vallely-Farrell, A. M., Kiely, C., Boudhar, A., & Egan, B. (2019). Reliability of the Maximal Resisted Sprint Load Test and Relationships With Performance Measures and Anthropometric Profile in Female Field Sport Athletes. *Journal of Strength and Conditioning Research*, *33*(6), 1703–1713. https://doi.org/10.1519/JSC.0000000000002228

Rakovic, E., Paulsen, G., Helland, C., Haugen, T., & Eriksrud, O. (2022). Validity and Reliability of a Motorized Sprint Resistance Device. *The Journal of Strength & Conditioning Research*, *36*(8), 2335. https://doi.org/10.1519/JSC.0000000000003830

van den Tillaar, R., Gleadhill, S., Jiménez-Reyes, P., & Nagahara, R. (2023). A Load–Velocity Relationship in Sprint? *Journal of Functional Morphology and Kinesiology*, *8*(3), 135. https://doi.org/10.3390/jfmk8030135

Watkins, C. M., Storey, A., McGuigan, M. R., Downes, P., & Gill, N. D. (2021). Horizontal Force-Velocity-Power Profiling of Rugby Players: A Cross-Sectional Analysis of Competition-Level and Position-Specific Movement Demands. *The Journal of Strength & Conditioning Research*, *35*(6), 1576. https://doi.org/10.1519/JSC.0000000000004027

Contact Information:

Tomáš Kalina, Ph.D.
email: tkalina@fsps.muni.cz