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LETTER TO THE EDITOR

Comment on "Effects of Combined Uphill–Downhill Sprinting Versus Resisted Sprinting Methods on Sprint Performance: A Systematic Review and Meta-analysis"

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Dear Editor,

We read with great interest the systematic review and meta-analysis by Hamad et al. [1], which aimed to analyze the effects of combined uphill–downhill sprinting (UDS) and resisted sprint training (RST) on sprint performance and presented a theoretical model. The authors concluded that RST improves early mean propulsive force compared with traditional sprint training. In contrast, assisted sprint training (AST) primarily improves mean velocity in the maximum-velocity phase (> 20 m). Simultaneously, the authors revealed that UDS was significantly more effective than traditional sprinting (small differences). These findings were highly innovative and practically significant, providing valuable insights for coaches and practitioners. However, we identified several methodological issues and potential errors in the article [1] that may have influenced these conclusions.

We were highly interested in the meta-regression analysis presented in the article [1]. The meta-regression analysis further highlighted that RST serves as a method to train the acceleration phase (< 20 m) of a sprint, with the effectiveness diminishing as the sprint distance increases. However, we encountered challenges when attempting to replicate the authors' meta-regression analyses (Fig. 1). We replicated in full the authors' meta-regression for heavy and very heavy loading conditions (Fig. 2). Unfortunately, we were unable to reproduce the results for the low and moderate loading conditions. Consequently, an explanation might be needed from the authors on the following issues:

1. Blue point in Fig. 1: The authors excluded the 10-m effect size from Luteberget et al. [2] as an outlier. However, after removing that effect size, only 18 groups remain. It is not clear from which study these two blue point effect sizes originate.
2. The authors included data from Alcaraz et al. [3] 0–50-m sprint distance in the article, which was not reflected in the regression plots (Fig. 1).
3. Red point in Fig. 1: The standardized mean difference (SMD) for the 30-m sprint performance from Luteberget et al. [2] is 0.60. Upon extracting the data for the red point using graph digitizing software (WebPlotDigitizer, version 4.5; https://apps.automeris.io/wpd/, $r = 0.99$, $p < 0.001$) [4], we observed that the actual SMD for this point is 0.39.
4. Green point in Fig. 1: McMorrow et al. [5] found that after 6 weeks of training, the RST group showed a moderate effect size (0.91) on 0–5 m sprint performance in soccer players and the traditional sprinting group similarly achieved a moderate effect size (0.92). Upon extracting the figure data and comparing the two groups, we discovered that the SMD is 0 (Fig. 2). The SMD of the green point is − 0.15 (Fig. 1).
5. The moderate loading conditions comprises a total of 12 groups, namely Rodríguez-Rosell et al. [6] (0–10 m, 0–20 m, 0–30 m); McMorrow et al. [5] (0–5 m, 0–10 m, 0–20 m); Pareja-Blanco et al. [7] (0–10 m, 0–20 m, 0–30 m); and Sinclair et al. [8] (0–5 m, 0–10 m, 0–20 m). The authors included only 10 groups in moderate loading conditions (Figs. 1, 2).
6. In the original article, the author mentioned "the 10 m effect size from Luteberget [43] was identified as an outlier using the rstatix package in R. Meta." Due to the lack of disclosure of more specific methodological

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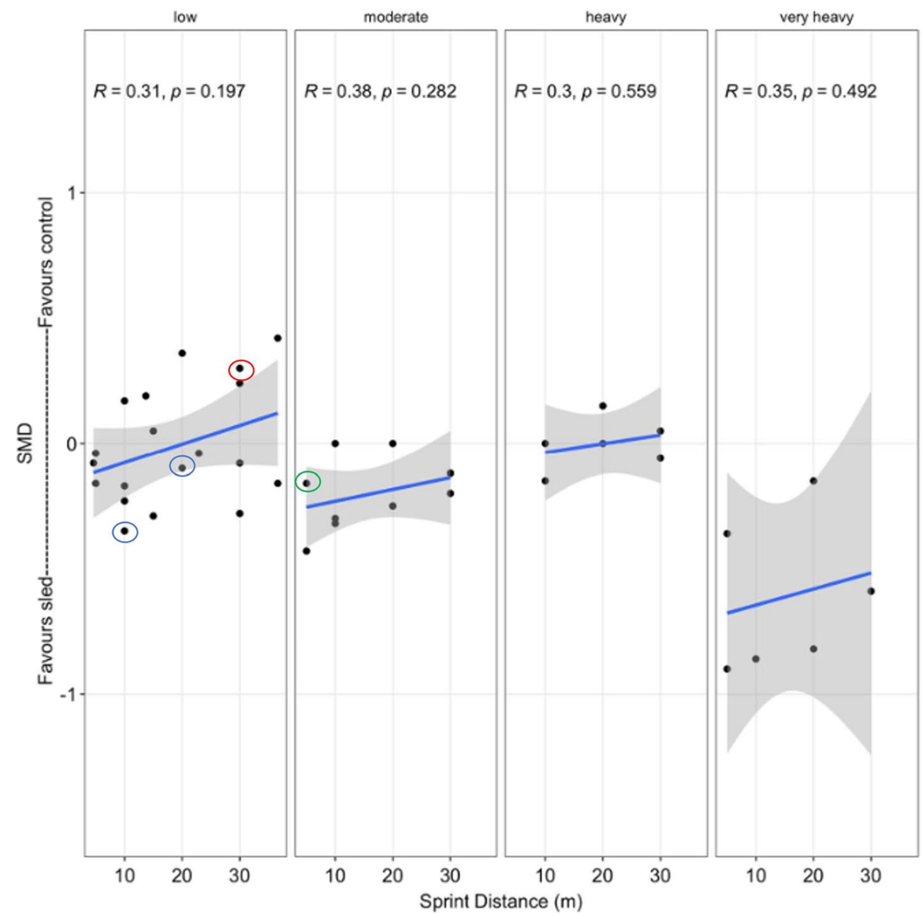

Fig. 1 Comparison of the SMD (negative in favor of RST, positive in favor of control group) and the sprint distances tested across each loading prescription. *SMD* standardized mean difference, *RST* resisted sprint training

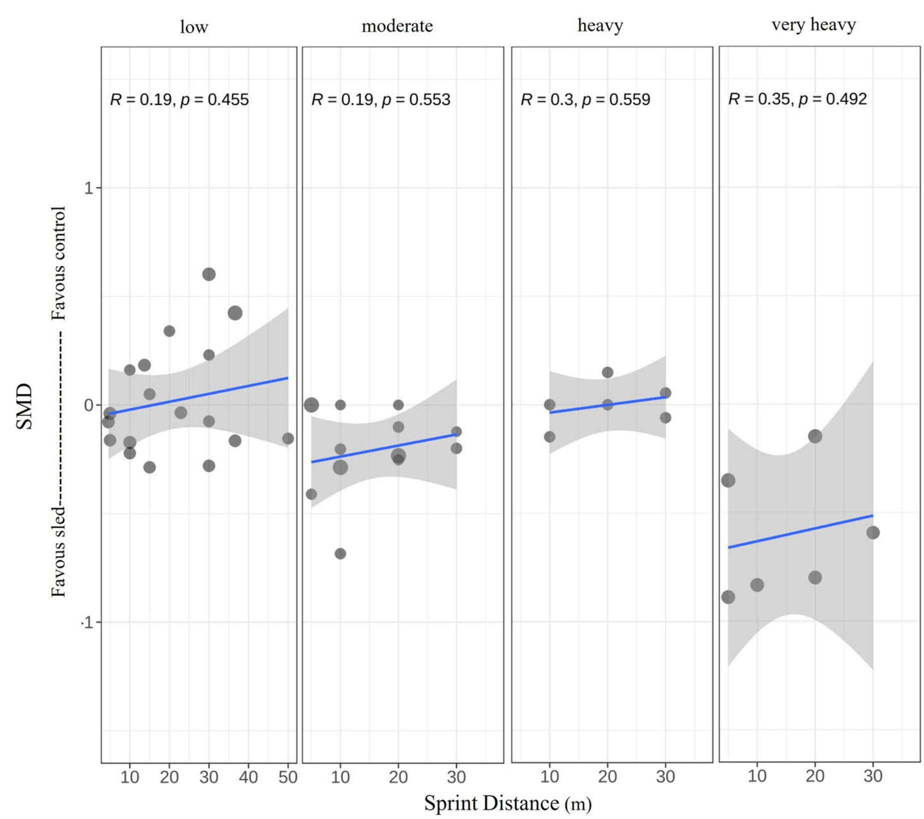

Fig. 2 Corrected meta-regression for each load. Comparison of the SMD (negative in favor of RST, positive in favor of control group) and the sprint distances tested across each loading prescription. *SMD* standardized mean difference, *RST* resisted sprint training

details, we employed the commonly used box plot to identify outliers and found a total of seven such values (Fig. 3). Additionally, the Z-score was applied to detect outliers (with the range of normal values set to 2 standard deviations), revealing a total of five outliers. Outliers examined by both methods included the Luteberget et al. [2] 10-m group (SMD 0.59) and the 30-m group (SMD 0.60). Interestingly, the authors chose to remove only the 10-m group effect size.

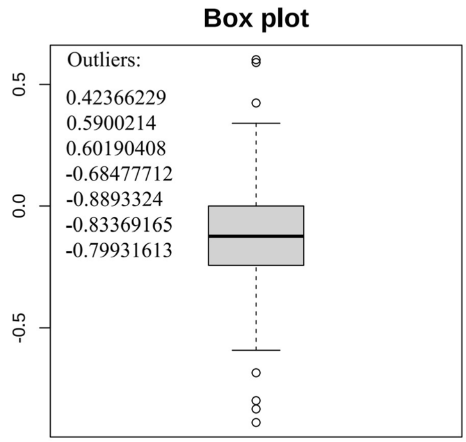

Fig. 3 Determination of outliers by box plot, there are seven outliers in the RST dataset. *RST* resisted sprint training

7. We utilized the R package 'ggplot2' to rerun the meta-regression (Fig. 4). A total of 43 groups without excluding any outliers did not exhibit a significant overall effect (Pearson, $r=0.22$, $p=0.154$, Fig. 4A); The effect approached significance after excluding the 10-m effect size of Luteberget (Pearson, $r=0.28$, $p=0.072$, Fig. 4B); However, there was no significant effect after excluding the five outliers identified by the Z-score test (Pearson, $r=0.17$, $p=0.318$, Fig. 4C) or seven outliers identified by box plot (Pearson, $r=0.01$, $p=0.952$, Fig. 4D). None of these results have been adjusted for data. Notably, a clear difference exists between our replicated results and those reported by the authors.
8. The authors did not reflect the within-study variance in the original literature in the meta-regression (Figs. 2, 4). Although the absence of variance may have a small

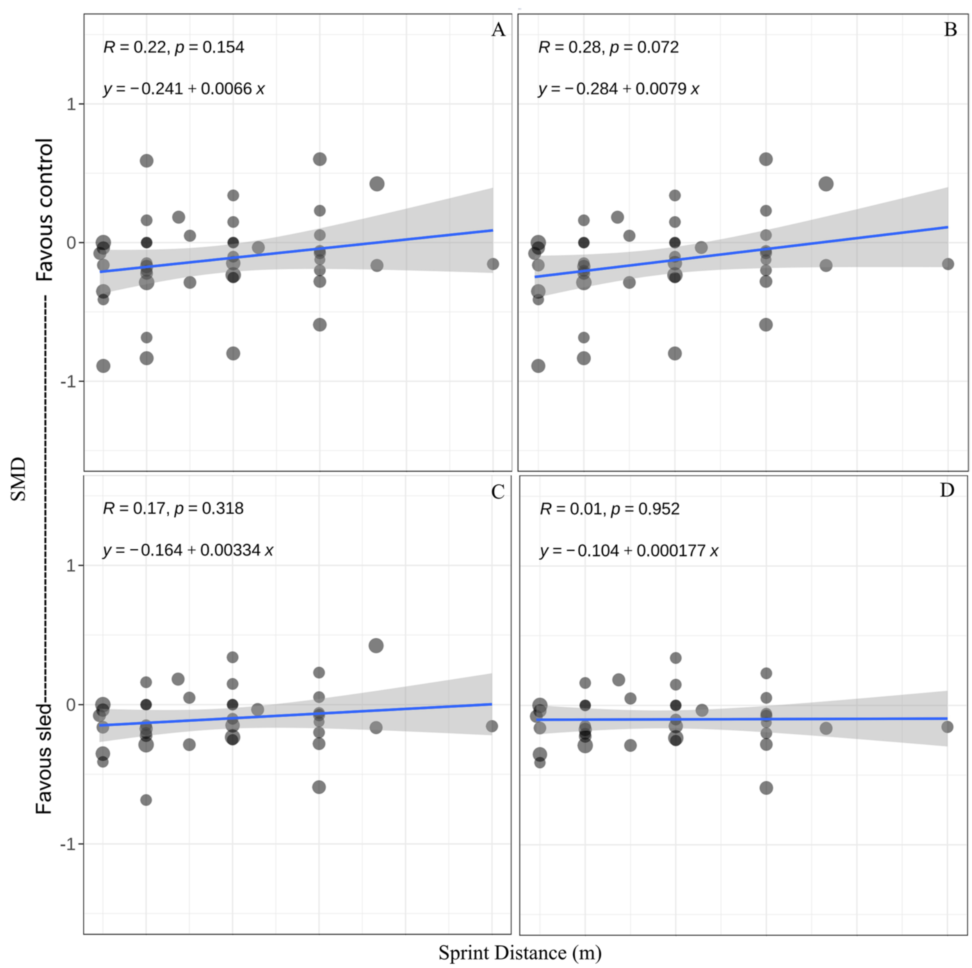

Fig. 4 **A** Relationship between sprint test distance and SMD, unadjusted for load. **B** Relationship between sprint test distance and SMD after removal of Luteberget 10-m effect size. **C** Relationship between sprint test distance and SMD after removal of Z-score test outliers. **D** Relationship between sprint test distance and SMD after removal of box plot outliers. *SMD* standardized mean difference

effect on the results, it may be better to perform a meta-regression using a specialized "metafor" package for meta-analysis [9].

9. The main objective of the authors was to explore the training effects of UDS and RST compared with traditional sprinting [1]. Curiously, they included AST in their proposed theoretical modeling. The authors suggested that AST would be more effective than traditional sprinting only during the maximum velocity phase. However, Upton [10] demonstrated that AST had the greatest effect on sprint performance from 0 to 5 m, with diminishing returns as the sprint distance increased. Furthermore, the authors did not perform a meta-analysis and regression analysis for the AST group. Therefore, it may not be appropriate to include AST in the theoretical model.
10. In the course of our reading, we noticed that the authors appeared to have omitted several studies apparently available at the time of their systematic analysis. We conducted a new search using the formula provided by the authors and excluded all studies published after December 19, 2022 (Fig. 5). In their exclusion criteria, the authors mention “Sprint intervention group performed other exercises (plyometrics, change of direction, strength-training).” However, in the included study by Cetin et al. [11], both the UDS group and the traditional sprinting group performed the same general strength exercises within the first 1–2 weeks. According to the authors' criteria, it seems that this study should also be excluded. We suspect that the authors might have thought that identical training for all did not affect the comparison between the sprint intervention group and traditional sprinting. Athletes certainly engage in other forms of exercise during the process of periodized training. Thus, this logical extension by the authors appears to omit the studies of Cahill et al. [12] and Gil et al. [13]. Additionally, five more studies [14–18] seemed to meet the authors' exclusion criteria for inclusion. Furthermore, the authors did not provide an explanation for the training involving pushing a sled, which is, at the same time, a common method of sprint-specific training [19, 20].
11. In the original article, the author mentioned “Of note, the very heavy group also contained some reasonable variability due to the study by Derakhti et al. [52], which may have seen strong effects due to their sample being professional adolescent athletes.” The authors attribute the strong effect found by Derakhti et al. [21] to the fact that the subjects were professional adolescent athletes. However, studies by Cahill et al. [12, 20], Escobar et al. [16], and a more recent study by Stavridis et al. [22], conducted with athletes of varying proficiency levels, found that a very heavy group was more effective than traditional sprinting over sprint distances of 5–30 m. Several other studies [23, 24] have reported that the very heavy groups had a similar

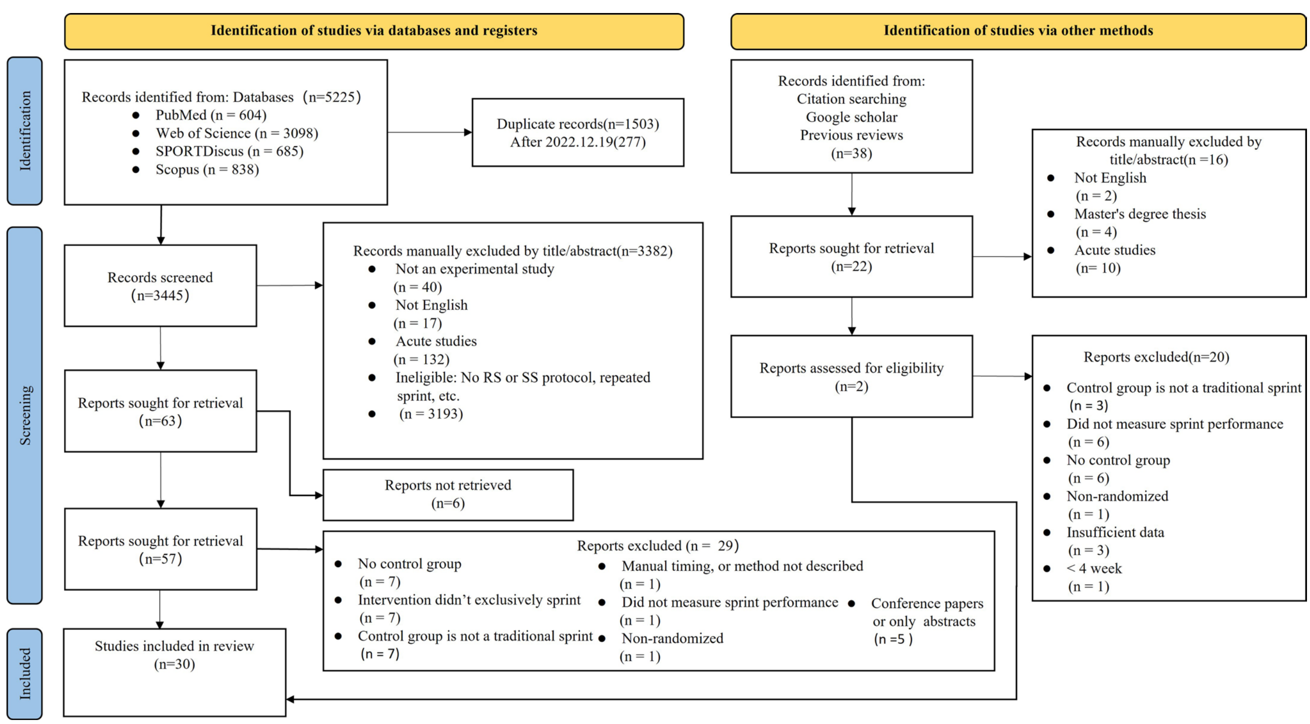

Fig. 5 PRISMA flow diagram of the selection process

enhancement effect compared with traditional sprinting and low groups. Thus, the very heavy load might be a more effective means of enhancing the acceleration phase.

In conclusion, based on the aforementioned potential methodology issues, we express reservations regarding the results and corresponding findings drawn by the authors. Although subject to potential criticism or questioning, we acknowledge their valuable work and contributions to this field. The purpose of this letter is to contribute to the discussion and clarification in this latest research area, allowing for reflection that may lead to a more robust meta-analysis methodology in future studies on this topic.

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Availability of Data Datasets analysed and/or produced during this study are available from the corresponding author.

Declarations

Conflicts of Interest Kai Xu, MingYue Yin, YuMing Zhong, YiMeng Xu, Jing Zhou and Ran Wang declare that they have no conflicts of interest relevant to the content of this letter.

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