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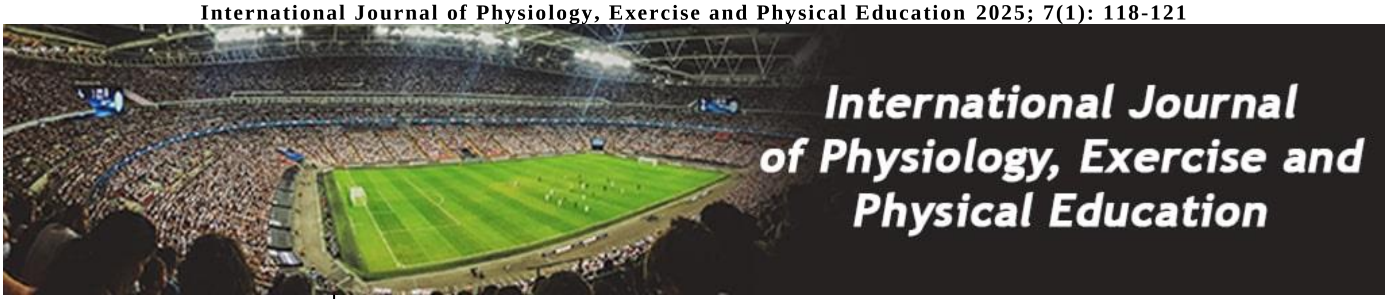

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Effect of uphill-downhill training on kinematics of high school students

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Abstract
This is an experimental study of 12-weeks uphill-downhill training program for developing kinematics in high school students. A random group design was adopted to divide the thirty (30) subjects into two groups (experimental group and control group) of fifteen (15) subjects in each. The Controlled Group (CG) was not allowed to participate in the training programme except in their daily routine. The experimental group was administered an uphill-downhill training program to develop kinematics in high school students. The kinematic variables are steps & stride length in 30 metre and 50 metre sprints. Data were collected in two parts as pre and post of 12 weeks training program using the Kinovea Software. Subjects were informed about the purpose of the study and how to execute the test by demonstration. To compare the mean differences between the pre and post test scores in each criterion measure, a paired 't'-test was applied by using SPSS. To test this hypothesis, the level of significance was set at 0.05. Based on the findings of this study, it is concluded that 12 weeks of uphill-downhill training showed significant improvement in the steps and stride length in both 30 metre and 50 metre sprints of high school students. However, no significant improvement was observed in either of the control groups.

Keywords: Kinematics, uphill-downhill, steps, stride length

Introduction

Kinematics, the study of motion concerning time and space, plays a pivotal role in understanding and enhancing athletic performance, particularly in sprinting (Cronin & Templeton, 2008) [3]. Key kinematic variables such as stride length and step frequency are critical determinants of sprint speed, as they directly influence an athlete's ability to generate force and optimise movement efficiency (Weyand *et al*., 2000) [14]. The success in many actions in team sports is determined by the player's ability to develop high speed and acceleration. There are many resistance methods for training, the strength within the specific running technique, each one with different applications according to the characteristics of the overload. Uphill sprinting is one of these methods. A criticism related to the use of resisted methods is that the athletes may use a modified running technique and subsequently alter their movement pattern if repeated in time, showing that some methods modify the body lean (Alcaraz *et al*., 2008) [1].

Many different sprinting training programs, including uphill and downhill sprints, resisted and assisted sprint methods, have been used with the aim of improving maximal sprint running performance by changing step length and step rate, which are the components of speed (Dintiman, 1974; Paradisis *et al*., 2006) [4, 9]. Training programs using short sprints have shown an improvement in the performance of adolescents in 10 metre and 30 metre straight-line sprints (Venturelli *et al*., 2008) [13]. Pettersen and Mathisen (2012) [11] found improvement in speed and agility in 11 to 12 years old soccer players with a program consisting of short-burst high-intensity activities. Paradisis *et al*. (2006) [9] the novel combined uphill-downhill training method is significantly more effective in improving the maximum running velocity at 35 m and the associated horizontal kinematic characteristics of sprint running than the other training methods. Sprint running can effectively improve explosive leg power and dynamic athletic performance (Markovic *et al*., 2007) [6].

Resistance and over speed training modalities, including uphill and downhill running, have been explored as methods to enhance biomechanical efficiency. Uphill running, which increases muscle activation and force production, and downhill running, which promotes faster stride turnover, are hypothesised to improve stride dynamics synergistically (Paradisis *et al.*, 2015) [10]. Despite the recognised importance of kinematics in sprint performance, few studies have investigated the effects of combined uphill-downhill training on adolescent populations. Existing research primarily focuses on adult athletes or isolated training methods, leaving a gap in understanding how integrated programs influence youth athletes (Bonacci *et al.*, 2013) [2]. This study addresses this gap by evaluating the efficacy of a 12-week uphill-downhill training program on steps and stride length in 30 metre and 50 metre sprints among high school students.

This study aims to contribute evidence-based insights into adolescent-specific training protocols. The findings may inform coaches and educators on optimising training regimens to enhance sprint performance during critical developmental stages.

Statement of the problem

The main purpose of the study was to find out the effect of 12 weeks of uphill-downhill training on the kinematics of high school students.

Methods and Procedure

This is an experimental study of 12-weeks uphill-downhill training program for developing kinematics of high school students. A random group design was adopted to divide the thirty (30) subjects into two groups (experimental group and control group) of fifteen (15) subjects in each. The Controlled Group (CG) was not allowed to participate in the training program except in their daily routine. The experimental group was administered an uphill-downhill training program to develop kinematics of high school students. The kinematics variables are steps & stride length in 30 metre and 50 metre sprints. Data were collected in two parts as pre and post of 12 weeks training program using the Kinovea Software. Subjects were informed about the purpose of the study and how to execute the test by demonstration. To compare the mean differences between the pre and post test scores in each criterion measure, a paired 't'-test was applied by using SPSS. To test this hypothesis, the level of significance was set at 0.05.

Results and Findings

The Analysis of all the collected data, their results and discussion are systematically presented as follows.

A comparative analysis of pre-test and post-test of uphill-downhill training group on kinematic variables (steps and stride length) of high school students is shown in Table 1.

Table 1: Comparison of pre-test and post-test of uphill-downhill training group on kinematic variables (steps and stride length) of high school students

Variable	Testing Condition	Mean	SD	SEM	't'	Sig.
Steps in 30M Sprint	Pre-Test	18.06	1.25	0.32	16.73	0.00*
	Post-Test	17.26	1.22	0.32		
Steps in 50M Sprint	Pre-Test	30.77	1.41	0.36	8.49	0.00*
	Post-Test	29.53	1.21	0.31		
Stride Length in 30M Sprint	Pre-Test	1.67	0.11	0.03	15.92	0.00*
	Post-Test	1.74	0.12	0.03		
Stride Length in 50M Sprint	Pre-Test	1.63	0.07	0.02	8.01	0.00*
	Post-Test	1.69	0.07	0.02		

*Significant at 0.05

Table 1 shows the Mean ± SD of pre-test and post-test of uphill-downhill training on steps in 30m sprint as 18.06±1.25 & 17.26±1.22 and steps in 50M Sprint as 30.77±1.41 & 29.53±1.21. The p-values were found to be statistically significant as the values obtained were 0.00* and 0.00*, which were less than the 0.05 level of significance.

Further, Table-1 shows the Mean ± SD of pre-test and post-test of uphill-downhill training on stride length in 30m sprint as 1.67±0.11 & 1.74±0.12 and stride length in 50m sprint as 1.63±0.07 & 1.69±0.07. The p-values were found to be statistically significant as the values obtained were 0.00* and 0.00*, which were less than the 0.05 level of significance.

A comparative analysis of pre-test and post-test of control group on kinematic variables (steps and stride length) of high school students is shown in Table 2.

Table 2: Comparison of pre-test and post-test of control group on kinematic variables (steps and stride length) of high school students

Variable	Testing Condition	Mean	SD	SEM	't'	Sig.
Steps in 30M Sprint	Pre-Test	21.20	1.67	0.43	1.73	0.10
	Post-Test	21.08	1.67	0.43		
Steps in 50M Sprint	Pre-Test	33.23	1.35	0.35	0.68	0.50
	Post-Test	33.16	1.30	0.34		
Stride Length in 30M Sprint	Pre-Test	1.42	0.10	0.03	1.63	0.12
	Post-Test	1.43	0.11	0.03		
Stride Length in 50M Sprint	Pre-Test	1.51	0.06	0.01	0.41	0.69
	Post-Test	1.51	0.06	0.01		

*Significant at 0.05

Table-2 shows the Mean ± SD of pre-test and post-test of the control group on steps in 30m sprint as 21.20±1.67 & 21.08±1.68 and steps in 50m sprint as 33.23±1.35 & 33.16±1.30. The p-values were found to be statistically

insignificant as the values obtained were 0.10 and 0.50, which were more than the 0.05 level of significance.
Further, table-2 shows the Mean ± SD of pre-test and post-test of control group on stride length in 30m sprint as 1.42±0.10 & 1.43±0.11 and stride length in 50m sprint as 1.51±0.06 & 1.51±0.06. The p-values were found to be statistically insignificant as the values obtained were 0.12 and 0.69, which were more than the 0.05 level of significance.
The graphical representation of pre-test and post-test of uphill-downhill training group and control group on kinematic variables (steps) of high school students is depicted in Figure 1.

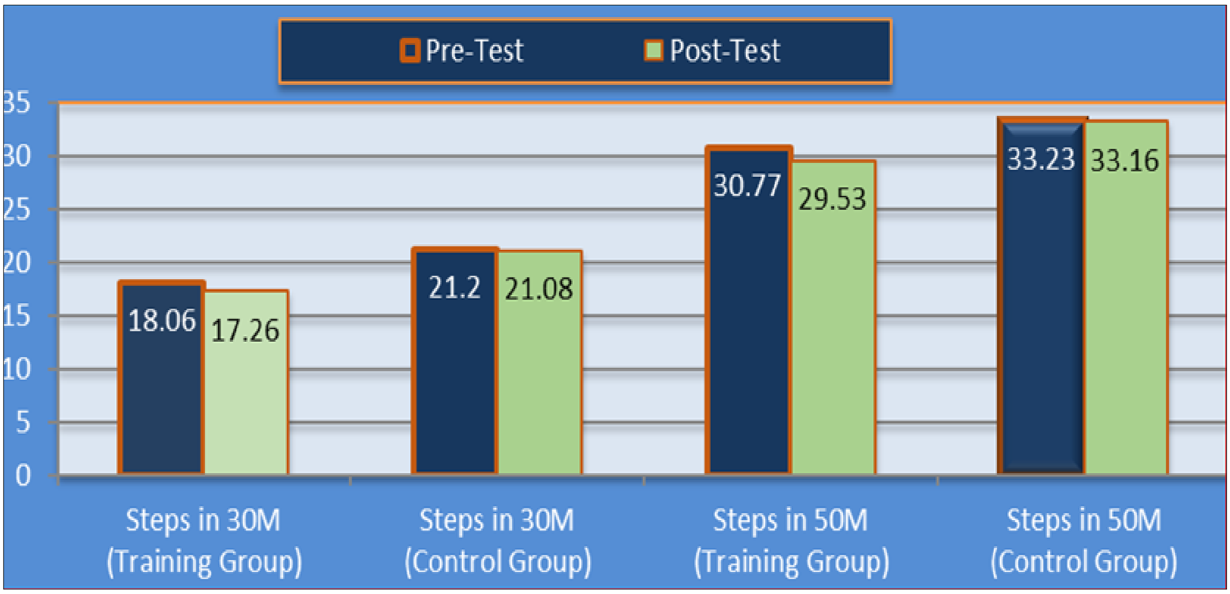

Fig 1: Graphical presentation of pre-test and post-test of uphill-downhill training group and control group on kinematic variables (steps) of high school students

The graphical representation of pre-test and post-test of uphill-downhill training group and control group on kinematic variables (stride length) of high school students is depicted in Figure 2.

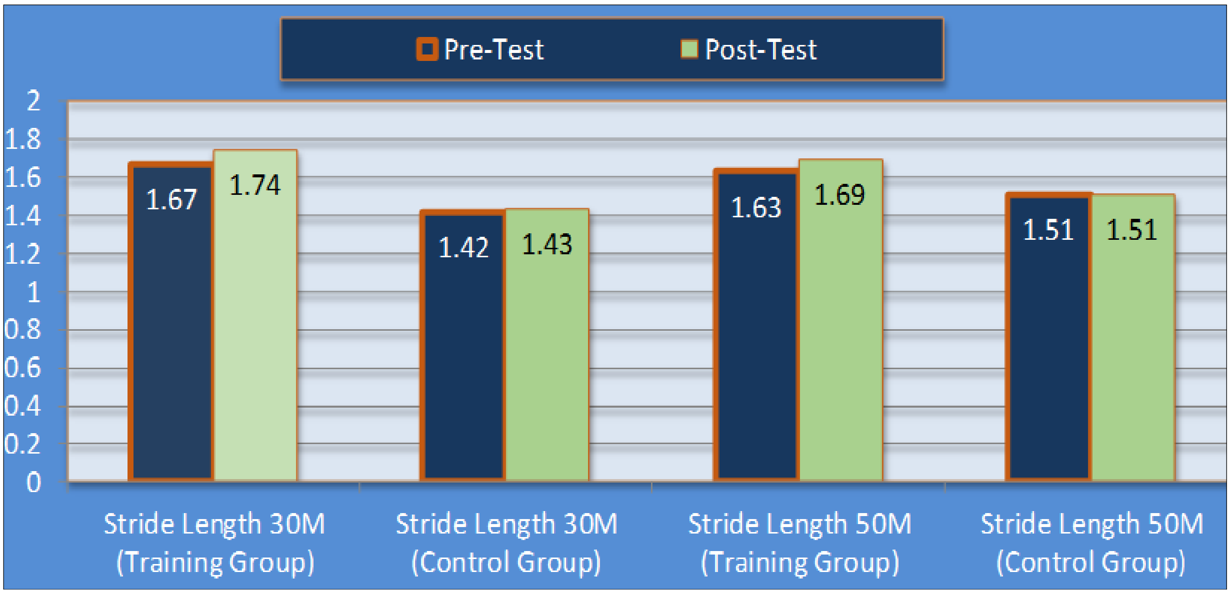

Fig 2: Graphical presentation of pre-test and post-test of uphill-downhill training group and control group on kinematic variables (stride length) of high school students

Discussion of findings

The findings of this study, which demonstrate significant improvements in step and stride length for both 30 metre and 50 metre sprints following a 12-week uphill-downhill training program, align with previous research on the effects of slope training on sprint kinematics. The improvements in steps and stride length are consistent with the results reported by Paradisis and Cooke (2006) [9], who found that a combined uphill-downhill training method significantly improved maximum running velocity and associated horizontal kinematic characteristics of sprint running. Similarly, Paradisis and Cooke (2001) [8] noted that downhill sprint running led to increased step length, which was the primary contributor to changes in running speed. Interestingly, while this study found improvements in uphill and downhill training, some research suggests that downhill training may be particularly practical. For instance, Schwane and Armstrong (1983) [12] found that downhill training was more effective than uphill or level training in preventing muscle injury in rats, which could potentially contribute to improved performance. The lack of significant improvement in the control group is consistent with the findings of Paradisis and Cooke (2006) [9], who also observed no significant changes in their control group. This underscores the specific benefits of slope training for improving sprint kinematics. Therefore, the results of this study support the effectiveness of uphill-downhill training for improving sprint kinematic variables of high school students. Future research could explore the long-term effects of such training and its impact on actual sprint performance in competitive settings (Haugen *et al*., 2017; Markovic *et al*., 2007) [5, 6].

Conclusion

Based on the findings of this study, the following conclusions were drawn:

1. It was concluded from the findings that twelve weeks of uphill-downhill training showed significant improvement in the steps and stride length in 30 metre sprints of high school students. However, no significant improvement was observed in the control group.
2. The finding demonstrated that twelve weeks of uphill-downhill training showed significant improvement in the steps and stride length in 50 metre sprints of high school students. However, no significant improvement was observed in the control group.

References

1. Alcaraz PE, Palao JM, Elvira JL, Linthorne NP. Effects of three types of resisted sprint training devices on the kinematics of sprinting at maximum velocity. J Strength Cond Res. 2008;22(3):890-897.
2. Bonacci J, Chapman A, Blanch P, Vicenzino B. Neuromuscular adaptations to training, injury and passive interventions. Sports Med. 2009;39(11):903-921.
3. Cronin J, Templeton R. Timing light height affects sprint times. J Strength Cond Res. 2008;22(1):318-20.
4. Dintiman G. Sprinting: what research tells the coach about. Washington, DC: AAHPER, 1974.
5. Haugen T, Mcghie D, Ettema G, Sandbakk O, Danielsen J. Kinematic stride cycle asymmetry is not associated with sprint performance and injury prevalence in athletic sprinters. Scand J Med Sci Sports. 2017;28(3):1001-1008.
6. Markovic G, Jukic I, Milanovic D, Metikos D. Effects of sprint and plyometric training on muscle function and athletic performance. J Strength Cond Res. 2007;21(2):543-549.
7. Papaiakovou G, Giannakos A, Michailidis C, Patikas D, Bassa E, Kalopisis V, *et al*. The effect of chronological age and gender on the development of sprint performance during childhood and puberty. J Strength Cond Res. 2009;23(9):2568-2573.
8. Paradisis GP, Cooke CB. Kinematic and postural characteristics of sprint running on sloping surfaces. J Sports Sci. 2001;19(2):149-159.
9. Paradisis GP, Cooke CB. The effects of sprint running training on sloping surfaces. J Strength Cond Res. 2006;20(4):767-772.
10. Paradisis GP, Bissas A, Cooke CB. Effect of combined uphill-downhill sprint training on kinematics and maximum running speed in experienced sprinters. Int J Sports Sci Coach. 2015;10(5):887-897.
11. Pettersen SA, Mathisen GE. Effect of short burst activities on sprint and agility performance in 11-to 12-year-old boys. J Strength Cond Res. 2012;26(4):1033-1038.
12. Schwane JA, Armstrong RB. Effect of training on skeletal muscle injury from downhill running in rats. J Appl Physiol. 1983;55(3):969-975.
13. Venturelli M, Bishop D, Pettene L. Sprint training in preadolescent soccer players. Int J Sports Physiol Perform. 2008;3(4):558-562.
14. Weyand PG, Sternlight DB, Bellizzi MJ, Wright S. Faster top running speeds are achieved with greater ground forces not more rapid leg movements. J Appl Physiol. 2000;89(5):1991-1999.