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Short-Term Weight Training Boosts Muscle Strength And Explosive Power In Secondary School Handball Players

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This study investigated the effects of short-term weight training on muscle strength and explosive power of secondary school handball players. Twenty-four players were divided into experimental and control groups (age: 13±0.2 years, height: 1.45±0.6 m, body mass: 40±0.6 kg). Performance was assessed before and after the completion of 6 weeks of weight training program. The results showed a significant increase in muscle strength and explosive power ($p<0.05$) after the implementation of the training. The study concluded that weight training helps in improving physical parameters such as muscle strength and explosive power of handball players.

Key Words: Weight Training, Muscle Strength, Dynamic Stretching.

Introduction

Weight training has been practiced by athletes involved in different sports for the development of muscle strength and other performance outcomes (Steele et al., 2020; McQuilliam et al., 2020; Comfort et al., 2023). Handball, a game played by teams consisting of seven players, is one of the sports associated with high energy demands and long recovery times and is played by specialized players in terms of position in a small handball court. Studies have reported an improvement in the muscle strength and performance of handball players who performed long-term strength-training programs (Bragazzi et al., 2020; Allégue et al., 2023 & Váczi et al., 2022). A study reported that handball players performing 8-12 weeks of strength training revealed significant improvements in explosive power, upper body strength, and thigh muscle strength compared to non-strength participants, suggesting a link between maximal dynamic strength and throwing performance (Van Den Tillaar et al., 2020); Hermassi et al., 2020 & Gaamouri et al., 2023).

Although most of the handball research implemented in the field tends to focus on the applied effects of the strength-training program with short-to-mid duration (4-12 weeks), the vast majority of these studies employed well-trained experienced handball players (Bouagina et al., 2022). In view of most of the strength-training studies implemented in younger athletes requiring a minimum of 6-10 weeks to elicit a positive neuromuscular adaption, thus ensuring minimal training intensities which are adequate enough to stimulate an initial training effect, there is scope to examine the effectiveness of weight training alone but also with other forms of training protocols such as plyometric on secondary school handball players. It is imperative to assess the effects of such training methodology with a younger handball players, considering the time constraints which many schools and amateur sports environments have, as well as the training susceptibilities of younger athletes. Thus, the aim of this study was to assess the effectiveness of short-term weight training on muscle strength and explosive power of secondary school handball players.

Material & methods

The research design of the study was experimental. Random sampling was used in the design for the experimental and control groups. Two familiarisation trials were finished two weeks before weight training was started. Data were collected at the end of the 6-week experiment and before training adjustments were made. To be more precise, the vertical leap test was used to gauge explosive power and the one-minute push-up test was used to gauge muscle strength. The identical experimental setting and time of day were used for all of the testing. The players proceeded to eat and drink as usual before to the test. The trial design and associated risks were explained to participants both orally and in writing before they provided their written informed permission. Participant were free to withdraw from the study at any time.

Participants

Twenty-four healthy competitive handball players volunteered to participate in this study (age: 13±0.2 years, height: 1.45±0.6 m, body mass: 40±0.6 kg). Participants were randomly selected and randomly grouped assigned to the experimental group (weight training) and the control group (dynamic exercise). Upon signing the consent form, participants indicated their willingness to participate in the study and were advised that they might withdraw at any point of the testing. The results will be kept as confidential. All participants were free from any health problems and illneses.

The experimental group underwent four weight training sessions each week for six weeks, interspersed with two days of active rest. This regimen called for four training sessions of sixty minutes each session. The control group continued their regular training regimen at the same level of intensity for the whole six weeks of the intervention procedure. The goal of their prescription was to maximise gains in strength.

Procedure of Weight Training Program

Training sessions were supervised by certified strength and conditioning coach. Before every training session, a standardised warm-up consisting of dynamic stretching exercises was completed. The training sessions was concluded with a five min of dynamic stretching exercises for the cool-down. The implementation 6 weeks weight training program was aimed at strength and power development. It incorporated 60% of the intensity and 3 sets each session. Each training session comprised 6 different exercises, 3 min of rest between sets. All exercises were compound exercise involving multiple muscle groups to provide sufficient stimuli. Volume and intensity were based on the needs of handball players. The training program consisted of 6 types of exercise for every two weeks. For the first 2 weeks, 3 sets of jumping jacks, push ups, sit ups, wide arm push ups, chest stretch, and cobra stretch were performed. Then followed by jumping jack, russian twist, abdominal crunches, mountain climbers, leg raises, and plank for week 3 and 4. The final week 5 and 6, the participants performed jumping jack, sit ups, squat, military press, dumbbell curl and dumbbell bend over row. Each exercise was performed for 30 second. Table 1 outlines the 6 weeks weight training program implemented by the experimental group, 4 times a week, followed by 2 days of active rest.

Table 1 Weight Training Program

Week	Activity	Repetition	Set
1-2	Jumping jack	30 s	
	Push-ups	30 s	
	Sit-ups	30 s	3
	Wide arm push-ups	30 s	
	Chest stretch	30 s	
	Cobra stretch		
3-4	Jumping jack	30 s	
	Russian twist	30 s	
	Abdominal crunches	30 s	
	Mountain climber	30 s	3
	Leg raises	30 s	
	Plank	30 s	
5-6	Jumping jack	30 s	
	Sit ups	30 s	
	squat	30 s	
	Military press (5kg)	30 s	3
	Dumbbell curl (5kg)	30 s	
	Dumbbell bent over row (5kg)	30 s	

Test protocol

One minute push up test

Muscle strength was determined by one min push up test. The pushing and pulling movement during push up involved muscles such as triceps, pectoralis, deltoids, lower back, abdominal and core muscles that were specific for handball players. The full push up test was performed by pressing arms fully extended, abs and lower back were tucked in, until chest was three inches from the floor (not touching the floor). The scores were by repeating the push up in one min as many as the participants can.

Vertical Jump test

Explosive power was performed by using Vertec. The vertical jump was performed by bending of the knees prior to jump, feet land back on with legs nearly fully extended. The scores were recorded by measuring the highest distance.

Statistical analysis

All statistical data were analysed using the IBM Statistical Package for Social Sciences version 23.0 (SPSS Inc, Chicago, IL, USA); descriptive statistics are presented as mean ± standard deviation unless otherwise stated. Independent T-tests were performed on the data to test for interaction and condition differences. Statistical significance was set at $p \leq 0.05$. Where appropriate, post-hoc com-parisons using Bonferroni adjustments were conducted.

Results

The muscle strength of the experimental group was significantly improved (p=0.0001) as compared to the control group (p=0.2922) after undergoing a 6-week fitness intervention program (Table 2).

Table 2 Muscle Strength of Handball Players before and after short-term weight training (n=24)

Group	Test	Mean	Standard Deviation	P value
Control	Pre	10.83	2.041	0.2922
	Post	12.33	2.582	
Experiment	Pre	15.67	1.751	*0.0001
	Post	26.17	3.971	

*significant p<0.005

The explosive power of the experimental group was significantly improved (p=0.0001) as compared to the control group (p=0.25) after undergoing a 6-week fitness intervention program (Table 3).

Table 3 Explosive Power of Handball Players before and after short-term weight training (n=24)

Group	Test	Mean	Standard Deviation	P value
Control	Pre	42.33	1.61	0.25
	Post	42.08	1.38	
Experiment	Pre	42.17	1.27	*0.0001
	Post	49.67	1.30	

*significant p<0.005, (t=0.3529, df=11, standard error of difference = 0.708)

Discussion

The results of the study demonstrate how well weight training works to increase handball players performance. In particular, after engaging in 6 weeks of weight training, the experimental group outperformed the control group in both muscle strength and explosive power. These results are consistent with previous study which highlights the effectiveness of weight training in improving handball players' lower limb explosiveness and shoulder muscular strength (Vinoth Kannan G. & Logeswaran A.S, 2022). Split into experimental and control groups, athletes underwent weight training and showed significant increases in muscle strength in comparison to those in the former who only performed dynamic stretching. Interestingly, the post-test mean score increase shows significant gains as a consequence of the intervention program. This emphasises how crucial it is to follow the right training guidelines and practise self-control in order to maximise performance results.

In a related study, Hammami M. et al. (2022) investigated the effectiveness of a strength and weight training program utilizing elastic bands on handball players. It was conducted over 10 weeks and was observed to significantly increase the strength of upper body muscles. These findings suggest that elastic band enhanced strength of upper body muscles, thus potentially elevating muscle strength levels among handball players. Such interventions hold promise for elevating players from lower to higher levels of muscle strength, highlighting the role of handball coaches in maximizing players' muscle strength through strategic weight training initiatives (Hammami M. et al. 2022).

This study also revealed a significant disparity in the effectiveness of weight training in explosive power among the players. Through a division into control and experimental groups, where the former engaged in dynamic stretching activities and the latter underwent six weeks of weight training, notable differences emerged. Notably, participants subjected to weight training exhibited markedly improved explosive power compared to those engaged in dynamic stretching. The post-test mean score increase from M= 42.17 to M= 49.67 (p=0.0001) underscores the efficacy of the weight training intervention program in enhancing explosive power among the players.

In future study, the inclusion of females into weight training regimens would contribute new and important information. Excessive training could also be monitored considering the indication that males had higher reported training levels after the intervention but failed to demonstrate an improved competitive performance. These conclusions are related to the subjects and the gender of the participants. Both schoolchildren and adolescents have an expanded reserve for adaptations to near maximum effort and hence improved strength (Stricker et al., 2020; Kolle et al., 2020). Early development of strength could also provide a foundation for future training regimes designed to enhance other aspects of sport performance. The most obvious application is within the context of strength training as part of the physical education program to provide an alternative training experience to running or games which do little to develop relative strength or neuromuscular function (Liu et al., 2020).

Greater strength training benefits may be obtained by the inclusion of more advanced techniques of strength training (e.g. plyometrics or Olympic lifts) in a more highly motivated group or with a longer duration of training. The power test used in the present study depended upon the strength expressed in a speed of movement of a restricted range of twisting movement and hence the additional power needs of a game of this type are not measured. (Lockie et al., 2020; Ioannides et al., 2020; Dos' et al., 2020) The value of this test was its dimension or a combination of tests to check strength increases and also to note the transformations from strength to application. The direct measurements of body composition and body weight change would also provide valuable information on the timing of increases in muscle strength or the establishment of muscle hypertrophy (Lopez et al., 2021). It would have been informative to consider the variations in performance in relation to the biological development of the subjects. This often seems confused with age but young people of the same chronological age often differ by three years in skeletal maturation. The simultaneous evaluations of muscle performance under circumstances such as the first quarter of a game could also be of considerable value.

Conclusion

This study reveals that the initial muscle strength level of handball players in both the control and experimental groups was at a commendable level, indicating a solid foundation for further improvement. Further, weight training emerged as a highly effective method for enhancing the muscle strength and explosive power. The systematic implementation of weight training programs tailored to the players' needs proved instrumental in improving their performance. In conclusion, the study underscores the importance of systematic and tailored weight training programs in enhancing the muscle strength and overall performance of handball players. Coaches play a crucial role in planning and implementing creative training programs to maximize player engagement, motivation, and performance outcomes.

Conflicts of interest

The authors have no conflict of interest to declare.

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