

CHANGES IN RELATIVE AND ABSOLUTE FORCE MEASURED DURING POWERLIFTING AFTER A 4-WEEK TRAINING USING THE WEIGHTLIFTING METHOD AND STICK ISOMETRIC (MIXED) METHOD*

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Abstract

Introduction: The effectiveness of applied methods is, first of all, determined by the potential of muscular strength increase, reflected by sports results, obtained during powerlifting exercises. The results depend to a large extent on the volume and intensity of training load. When training loads are identical, the evaluation of method effectiveness is based on the improvement of sports results. In case of different training load components however, we should consider them in method effectiveness evaluation as they may significantly affect the increase in muscular power. Some authors claim that the greater the training volume the better results are obtained. Others claim that excessive training volume is only a burden for the participants. Training intensity is also an important factor affecting its usefulness and it should be considered in evaluation of its effectiveness.

Aim of the study: The aim of this paper is an attempt to evaluate the effect of training using the weightlifting method and the stick isometric method on sports results during the following test exercises: deadlift, squat with a barbell on the shoulders and bench press.

Methods: The studies were conducted in two groups of young men who trained using the weightlifting method (n=31) and the stick isometric method (n=28). No participant had done any strength sports before.

Results: After a 4-week training using both methods, a significant increase in the obtained values was observed during the test exercises. The ANOVA variance analysis revealed that there were no significant differences in the obtained values, although during the mesocycle**, the "weightlifting" group worked much less compared to the "stick isometric group".

Conclusions: The obtained results were probably influenced by the power value obtained in a training unit (thrice as high during weightlifting trainings compared to the group using the "stick isometric" method).

Key words: absolute strength, relative strength, powerlifting, weightlifting method, stick isometric method

Introduction

Sports trainers use different methods of muscle strength development. Depending on the participants' needs and the specifics of a given discipline, they select the most useful one (1-10). The effectiveness of applied methods is, first of all, determined by the potential of muscular strength increase, reflected by sports results, obtained during powerlifting exercises (2,11-16). The results depend to a large extent on the volume and intensity of training load. When training loads are identical, the evaluation of method effectiveness is based on the improvement of sports results. In case of different training load components however, we should consider them in method effectiveness evaluation as they may significantly affect the increase in muscular power. Some authors claim that the greater the training

volume the better results are obtained (2,6,8,10). Others claim that excessive training volume is only a burden for the participants. Training intensity is also an important factor affecting its usefulness and it should be considered in evaluation of its effectiveness (5,15,17-20). Evaluation of the weightlifting method and the stick isometric methods, depending on the load is questionable in case strength training and requires further studies (6,11,21-23). Therefore it seems justifiable to carry out an experimental study, examining the effect of a 4-week training, using the above mentioned methods, on the changes in absolute (possible to be developed by a contestant during selected movements) and relative strength (the quotient of absolute muscular power and the contestant's body mass) of young men who had never done any strength sports.

*stick isometrics - also training of "mixed method", which is also called "the method of insertions, stops or isometrical halts". Its point is to use during the work with dynamic character (in concentric and eccentric movements) some insertions of isometrical character.

** mesocycle - is a practical term used universally in Polish, Russian, German and generally - European theory of sport, and also in planning force training. It means an average training cycle and in dependence of a training period, as well as a kind of discipline, it can last from 3 to 8 weeks, in which time some periodical tasks in build process are realized. In force sports are used 4 - weeks' mesocycles, and mostly - their classic form so-called "bps" - the mesocycles of direct entry preparation, which help to select the right weights in a 4 - weeks period before main contests. Lasting for several months - the periods of makrocycle - preparatory, main and transitory, consist of mesocycles which are built of mikrocykles (usually a week), and these ones contain precise units which are planned exactly in a way of training weights and physical exercises.

Material and Methods

2 groups of young males participated in the study. One group (n= 31) was trained using the weightlifting method, while the other one was trained using the stick isometric method (n=28). The examined groups did not differ significantly in body height, age and body mass (tab.1). None of the participants had done any strength sports before.

Table 1. *Characteristics of the examined groups*

Group	Age (years)	Body mass (kg)	Body height (cm)
Stick isometric	22 ± 2.6	79.69 ± 10.80	181.79 ± 5.90
Weightlifting	22 ± 0.9	74.19 ± 5.96	179.25 ± 3.86

Experiment

The “weightlifting” group trained thrice a week, while the group using the stick isometric method, underwent training 5 times a week. Prior to the study, the participants signed declarations that they would not use any adjuvant drugs during the experiment. Their diet was made uniform and contained at least 2 grams of protein per 1 kg of body mass during a 24 hour period. Prior to the training, both groups were tested while performing the following tasks: “deadlift”, squat, and bench press. The exercises selected for the study were easy to perform and did not require any complex technical skills. Therefore, a potential effect of the applied techniques on the improvement of sports results was excluded, and it was assumed that the resulting changes were due to the applied training methods – the weightlifting and mixed (stick isometric) method. After 4 weeks, the second test was conducted, including measurements of the same parameters as those used during the first study.

The scheme of the weightlifting group training

Monday – 1. bench pressing. 2. squats 3. Clean lift 4. Trunk bending in a supine backward position. *Wednesday* – 1. Pressing in a standing position. 2. Leg press on an adjustable incline bench. 3. Bending on a Roman Chair or snatch lift. 4. Hip lifts when leaning on forearms.

Thursday – 1. Pressing in a seated position. 2. Squats with a barbell placed on the thorax.

3. Bends with a barbell when standing on flexed knees. 4. Stretching abdominal muscles tight (knees pulled up to the chin during a balanced sitting on the edge of the chair).

Load dosing - obtaining a maximal weight (MW) according to the weightlifting method (1,12, 21) (from 40 % with 2 – 3 repetitions x 2 series with a 10% progression) + 80 % with 3 repetitions during exercises 1, 2, 3 + 100 per cent with one repetition x 3 series during exercises 1, 2, 3.

$$\frac{CM}{1} \times 3; \quad \frac{80\%CM}{3} \times 3$$

where in the numerator % of the maximal weight; in the denominator – the number of repetitions, the number of series next to the fraction, during exercises No 4 – all series (3) “for refusal”. All trainings were preceded by a warm up with no external load.

Variants of the stick isometric training

Each training session included 3 exercises: Lifting and holding a barbell in the middle of bench pressing + slow lowering; reaching a semi - squat and holding the bar (the angle between the thigh and the shank, approximately 120°) + return to the baseline position, lifting and holding the bar in the middle of deadlift (the bar held on the knee level) + slow lowering.

Two training options were performed: the first one – on Monday and Tuesday, the second one – on Wednesday, Thursday and Friday.

Option I. After the warm up, the participants reached their maximal power potential, according to the weightlifting method guidelines. Next, they performed 3 series of repetitions with maximal weight during each of the above mentioned tasks. The repetition with an isometric stopping lasted 8 seconds, while the interval between each repetition also lasted 8 s., and after each series – 60 s.

Option II. After the initial warm up, the participants performed 3 series including 4 repetitions with 80% MW. The repetition with isometric stopping lasted 15s, the interval between each repetition – 60s, and the interval between each series – 180s. The value of useful work, calculated as alteration of potential bar energy while performing different exercises, constituted measurement base. The lifting height corresponded to the participant’s height, according to Saksonow’s method (18), modified by Kruszewski (5). The exercise volume is the ratio of the weight mass (kg) and lifting height (m). The weightlifting height is different for each training task and depends on the athlete’s body height (tab. 2).

Table 2. *Weightlifting height (in % values of body height) during exercises*

KIND OF EXERCISE	LIFTING HEIGHT (%)
1. deadlift	48.4 % (of body height)
2. squat	36.9 % (of body height)
3. bench pressing (narrow grip)	26.8 % (of body height)
4. pressing while standing	30.3 % (of body height)
5. Bowing with weight on the shoulders	36.0 % (of body height)

Evaluation of maximal power potential was made using the weightlifting method. The participants' potential was examined during three exercises: squat with a bar on the shoulders, bench pressing and deadlift. The method modified for the study can be expressed by the following formula:

$$\frac{40-45\%CM}{2-3} \times 2-3; \frac{50-55\%CM}{2-3} \times 2-3; \frac{60-65\%CM}{2-3} \times 2-3;$$

$$\frac{70-75\%CM}{2-3} \times 2-3; \frac{80\%CM}{1-3} \times 1-2; \frac{90\%CM}{1-2} \times 1-2; \frac{100\%CM}{1} \times 1$$

where: in the numerator – the load value in % of maximal weight (MW), in the denominator – the number of repetitions within the series, next to the dash – the number of series.

ANOVA variance analysis was used for repeated measurements; standard deviations (SDs) were calculated and significance level (SL) was accepted as 0.05. The significance of differences in mean values of the examined variables between the groups were determined using the Newman - Keul test as well as the significance of changes in each repetition (the differences in the mean values for both groups during measurements 1 and 2). The significance of result improvement was also verified depending on the examined group (the interaction between the group and repetition). The study was conducted twice. For the final analysis, the mean values from 2 measurements were used.

Results

The study results were preceded by the analysis of work performed by both groups in one training unit during a week and month and of power developed during the training (fig.1,2,3,4)

Analysis of the data concerning work performed during one training session did not reveal any significant differences between the “weightlifting” group (22.65 kJ) and “stick isometric” group (21.22 kJ).

Weekly proportions of the performed work changed significantly. The mean value of work performed within

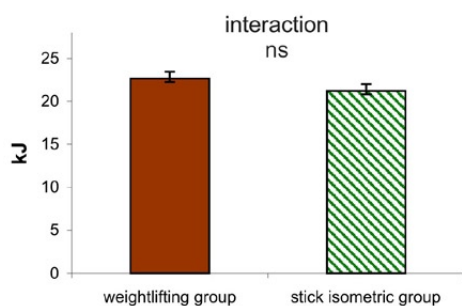


Fig. 1. Mean value of exercise performed by the participants using the stick isometric method and weightlifting method during one training session

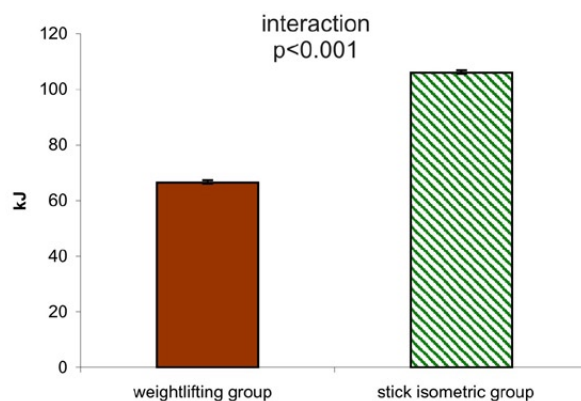


Fig. 2. The mean value of work performed by groups using the isometric method and the weightlifting method within a week

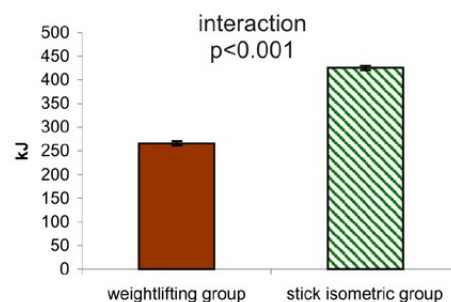


Fig. 3. The mean monthly value of work for the weightlifting and stick isometric group

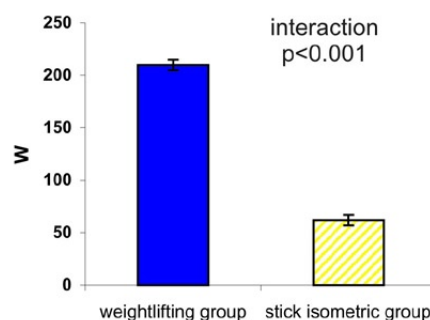


Fig. 4. The mean value of power obtained during stick isometric and weightlifting training

a week by a participant using the stick isometric method was 106.11 kJ, so it was significantly higher than the mean value of work performed by a weightlifting participant (66.50 kJ). This marked difference was due to the number of weekly training sessions. The “stick isometric group” underwent 5 trainings weekly, while the “weightlifting” group was trained only thrice a week.

The mean value of work performed during a meso-cycle by a participant using the stick isometric method (425.53 kJ) was significantly higher compared with the mean work performed by weightlifters (266.02 kJ). This is due to the above mentioned number of training sessions.

The mean value of power obtained during one training session by a participant using the weightlifting method was 209.81 W, so it was significantly higher as compared to the participant using the stick isometric method (61.97 W). This difference probably results

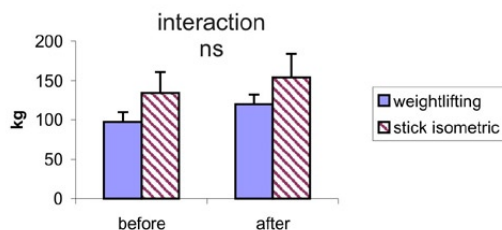


Fig. 5. Changes in results during the „deadlift”

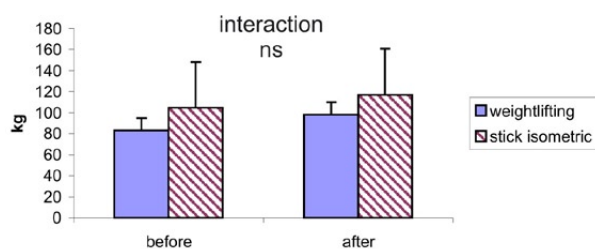


Fig. 6. Changes in results during squats

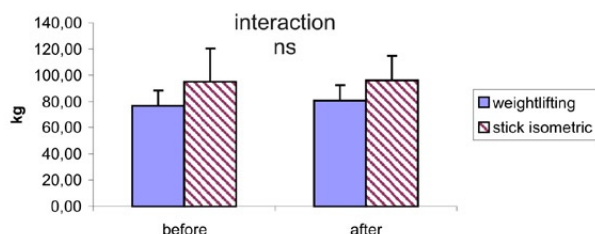


Fig. 7. Changes in results during bench pressing

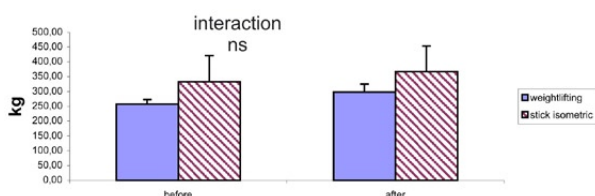


Fig. 8. Changes in the results during powerlifting

from markedly longer period of isometric tension, occurring when using the stick isometric method. Such a great difference might suggest obtaining better results by the group using the stick isometric method (13).

After a 4-week training session, comparison was made of the changes in absolute and relative strength during powerlifting exercises. Another comparison of absolute and relative strength was made following the weightlifting and stick isometric training mesocycle during the “deadlift” (fig. 5).

The increase in mean values of the “deadlift” results was significant for both groups (repetition effect $p < 0.001$). In the weightlifting group, the mean value was 22.08 kg, while in the stick isometric group it was 20 kg. The increase in values per kg of body mass was also significant – 0.3 and 0.6 kg respectively. No marked differences were observed between the groups.

The changes in absolute and relative strength during squats with a bar on the shoulders were also compared.

The changes in mean values of the results obtained during squats with a bar on the shoulders were also significant for both groups (repetition effect $p < 0.001$). In the weightlifting group the mean value was 14.79 kg, while in the stick isometric group it was 12.33 kg (Fig. 6). The increase in body mass was also significant for both groups – 0.19 and 0.16 kg respectively. No significant differences were observed between groups. The changes in absolute and relative strength during bench pressing were insignificant (Fig. 7).

The changes in results during bench pressing in a supine position were insignificant for both groups (repetition effect $p < 0.01$). The mean value for groups using the “weightlifting” and “stick isometric” method were 3.96 kg and 1.17 kg respectively. The increase in body mass was also insignificant for both groups – 0.06 kg and 0.07 kg respectively. No significant differences between groups were observed.

After a 4-week training session, comparison was made of changes in absolute and relative strength during powerlifting for both groups (Fig. 8).

The mean improvement of the results during powerlifting was significant for the weightlifting and isometric group – 40.84 kg and 33.5 kg respectively. The increase in body weight was also significant – with the values of 0.55 kg and 0.48 kg respectively. No significant differences between groups were observed.

Discussion

The increase in the result values during powerlifting were significant for both groups, thus using both training methods favourably affected their development. It should be stressed however, that the weightlifting group worked less during the mesocycle compared to the stick isometric group. This seemed to confirm the hypothesis that high level of muscular strength might have been obtained using optimal loads instead of maximal training loads (4,5,7). Training effectiveness probably had an impact, mainly on its intensity and therefore, despite a significant difference in work performed by both groups, the increase in values of the sport results was similar (5,8,9,11,16). As the training was carried out using a weightlifting method, it proved more effective. It seemed that better results might be obtained using the mixed (stick isometric) method in case of high performance weightlifting participants (1,4,9,11,13). Therefore, the effectiveness of both training methods still needs to be examined.

In both groups, significant increase in absolute and relative strength was noted during the “deadlift”, squat with a bar on the shoulders and powerlifting. Insignificant effect of both training forms on bench pressing might have been due to several factors. The load applied using both methods was close to maximal, so the number of possible repetitions was limited. The response to such stimuli was increase in strength

of large muscle parts, e.g. during squats or “deadlift” (12,15,19,23-25). During bench pressing, muscular effort was stimulated by more repetitions during a longer period (1,5,19,21,24,26) and therefore, the results did not improve significantly. In conclusion, using both methods resulted in a significant increase in absolute and relative strength, and thus, significant improvement of powerlifting results.

The increase in absolute and relative strength in the weightlifting group despite markedly lower effort, might have been due to high training intensity.

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