



Changes in muscle strength moments and weightlifting performance gains during two-year training cycle of young weightlifters

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Abstract

Objective of the study of the research was to evaluate changes in muscle strength moments as well as to compare these changes with the performance gains in weightlifting results during a 2-year training cycle of young weightlifters.

Methods and structure of the study. The study was conducted in a group of 20 athletes training weightlifting with at least one year of training experience and 2nd sport class. Peak torque values of the muscles of the upper and lower limbs and the trunk were measured under isometric conditions. The measurements were carried out on properly prepared LR2-P test stands (JBA Zb. Staniak, Poland).

Results and conclusions. The results achieved in individual weightlifting exercises were recalculated according to Sinclair's scores in order to eliminate the influence of the competitors' body mass change on the achieved results. Among the studied group of athletes, statistically significant ($p < 0.05$) gains in the value of moments of the analysed muscle groups were confirmed. The greatest gains among the analysed muscle groups occurred in the case of trunk extensors. The literature provides evidence that strength training of the trunk extensors in sport is important in the prevention of low back pain (LBP). Furthermore, it translates into the high performance in many sports. Therefore, these muscle unit strength gain confirmed in this study may translate into a lack of pain and the ability to continue specialised training for two years among young athletes. Gains in trunk extensors correlate significantly with gains in snatch performance, which may directly translate into performance in weightlifting, as this is an exercise performed during competitions.

Keywords: *weightlifting, long-term research, young athletes, strength.*

Introduction. Scientific research conducted in sport allows optimisation of training loads by providing coaches with information about the adaptation of the body to a given training [6]. Research concerns different time intervals, often measurements are performed at intervals of 6-8 weeks [1, 3, 8] covering the preparatory period [2], less often observations of changes in various parameters are conducted over longer periods [4]. In weightlifting, the improvement of sports performance is influenced by appropriate technical and fitness preparation [10]. Many authors researched the influence of weightlifting training on various parameters. The available literature confirms the significant effect of Olympic Weightlifting exercises on the height of the vertical jump [3] as well as the results of barbell squats [8]. You can also find stud-

ies on the strength preparation of weightlifters [9] as well as those comparing their muscle strength with athletes of other sports. In weightlifting training, the primary focus is on the trunk strength [7], as well as the knee and ankle extensors, which is associated with the so-called triple extension [1] which is important in the context of exercise technique. The development of the sport of weightlifting requires athletes to start their sport career early which becomes a big challenge for coaches in the context of optimizing training loads as well as forecasting the development path of young athletes [6]. The assessment of the level of strength preparation and the correlation with the achieved results in weightlifting can be a hint for coaches on what to focus when working with young weightlifters. Therefore, the aim of the research was



to evaluate changes in muscle strength moments as well as to compare these changes with the performance gains in weightlifting results during a 2-year training cycle of young weightlifters.

Methods and structure. The study was conducted in a group of 20 athletes training weightlifting (Table 1) with at least one year of training experience and 2nd sport class.

Table 1. Age and body mass of subjects

	Age [years]	Body mass I [kg] 2019	Body mass II [kg] 2021
mean	18.1	74.55	78.55
SD	3.93	17.05	17.02

The study was conducted in a two-year training cycle, the first measurement was conducted in January 2019 and the second one in January 2021. During the analysed period the athletes were following specialized weightlifting training 6 times a week, they were preparing for competitions of the National Championship rank, where 10 of the subjects won medals in their age groups and 5 of them were preparing for international competitions. Peak torque values of the muscles of the upper and lower limbs and the trunk were measured under isometric conditions [9]. The measurements were carried out on properly prepared LR2-P test stands (JBA Zb. Staniak, Poland) [9]. The results achieved in individual weightlifting exercises were recalculated according to Sinclair's scores in order to eliminate the influence of the competitors' body mass change on the achieved results.

Results and discussion RESULTS OF STUDIES

The differences in relative muscle strength moments under static conditions of weightlifters training in a 2-year cycle are shown in Table 2.

Among the studied group of athletes, statistically significant ($p < 0.05$) gains in the value of moments of the analysed muscle groups were confirmed. The greatest gains among the analysed muscle groups occurred in the case of trunk extensors. The average increase in a two-year training cycle was $3.54 \text{ N} \cdot \text{m}/\text{kg}$.

Table 2. Changes in relative moments of muscle strength under static conditions of weightlifters during a 2-year training cycle

	Knee joint		Trunk		Elbow joint		Shoulder joint	
	F	E	F	E	F	E	F	E
Mean [Nm/kg]	0.62	0.56	0.92	3.54	0.57	0.33	0.24	0.39
SD	0.39	0.65	0.59	1.79	0.30	0.18	0.15	0.18

F- flexors E- extensors

Gains in the value of muscle strength moments were compared with the results achieved in individual exercises used in weightlifting training after conversion into Sinclair points. The strongest correlations for the results achieved in the weightlifting exercises and the increase of muscle strength moments were confirmed between the performance gains in the squat clean and gains in the moments of strength in the extensor muscles of the knee joint ($R^2 = 0.7849$, $p < 0.001$) (Figure 1).

Statistically significant correlations were also confirmed for gains in maximal muscle strength moments under static conditions for the trunk extensor muscles and gains in barbell snatch ($R^2 = 0.656$, $p < 0.01$), power snatch from knee ($R^2 = 0.755$, $p < 0.001$) and squat clean from knee ($R^2 = 0.697$, $p < 0.001$). Statistically significant correlations were also confirmed for gains in knee joint flexor and extensor strength moments and performance gains in the front squat (Flexors $R^2 = 0.713$, $p < 0.001$, Extensors $R^2 = 0.677$, $p < 0.001$) and back squat (Flexors $R^2 = 0.746$, $p < 0.001$ and Extensors $R^2 = 0.703$, $p < 0.001$).

Summary and conclusions. The aim of this study was to determine the relationship between gains in strength moments under static conditions and changes in performance in weightlifting exercises. In weightlifting training, the main focus is on trunk strength, which is important because all movements originate in or are assisted by the trunk [7].

The two-year training in weightlifting resulted in a significant increase in the relative values of strength moments for all analysed muscle groups. The greatest gains in strength, as well as the strongest correlations with performance gains in weightlifting exercises, were confirmed for the muscle groups of knee extensors and trunk extensors. This is in accordance with the data presented by many authors suggesting that in the weightlifting technique an important role is played by the muscles of extensors of the ankle and knee joints and trunk extensors responsible for the so-called triple extension [1].

In many sports, the structure of an athlete's movement during a movement activity is related to the tri-

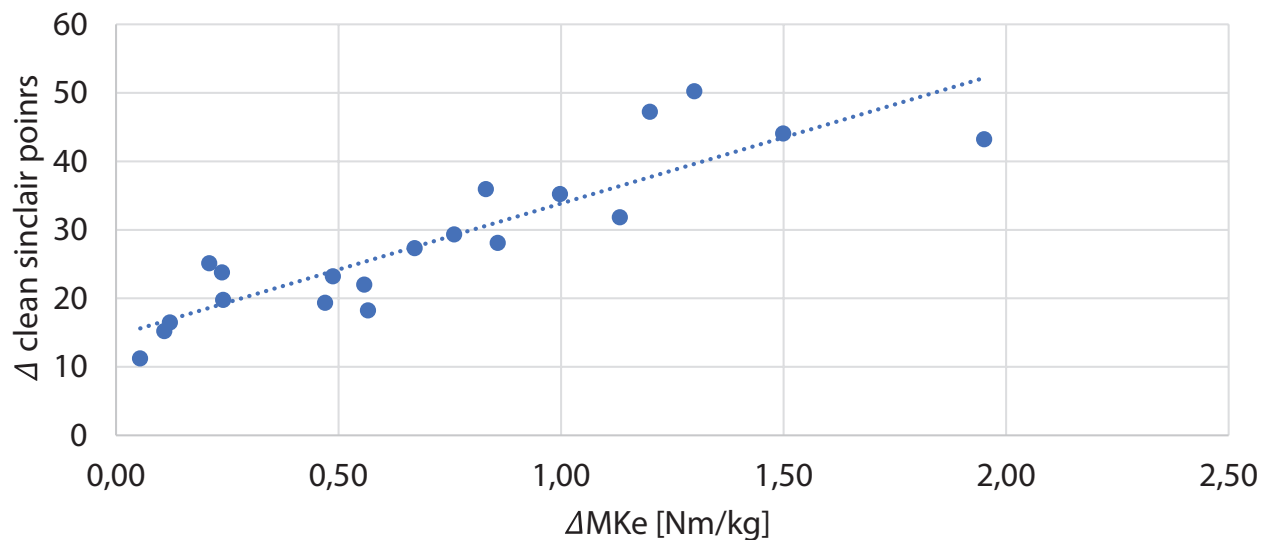


Figure 1. Relationship between the Sinclair scores in the clean and gains in knee extensor strength moments of weightlifters

ple extension, so it seems reasonable to use weightlifting exercises in other sports to improve strength parameters affecting this triple extension [1]. These sports often use power snatch from knee, because the movement technique in this exercise is easier to master [4, 10]. As confirmed by the conducted analyses, the gains in this variant of the exercise correlate with gains in maximal moments of trunk extensor muscles.

The literature provides evidence that strength training of the trunk extensors in sport is important in the prevention of low back pain (LBP). Furthermore, it translates into the high performance in many sports [5]. Therefore, these muscle unit strength gain confirmed in this study may translate into a lack of pain and the ability to continue specialised training for two years among young athletes. Gains in trunk extensors correlate significantly with gains in snatch performance, which may directly translate into performance in weightlifting, as this is an exercise performed during competitions.

SUMMARY

The aim of the research was to evaluate changes in muscle strength moments as well as to compare these changes with the performance gains in weightlifting results during a 2-year training cycle of young weightlifters. The study was conducted in a group of 20 athletes training weightlifting with at least one year of training experience and 2nd sport class. Peak torque values of the muscles of the upper and lower limbs and the trunk were measured under isometric conditions. The measure-

ments were carried out on properly prepared LR2-P test stands (JBA Zb. Staniak, Poland). The results achieved in individual weightlifting exercises were recalculated according to Sinclair's scores in order to eliminate the influence of the competitors' body mass change on the achieved results. Among the studied group of athletes, statistically significant ($p < 0.05$) gains in the value of moments of the analysed muscle groups were confirmed. The greatest gains among the analysed muscle groups occurred in the case of trunk extensors. The literature provides evidence that strength training of the trunk extensors in sport is important in the prevention of low back pain (LBP). Furthermore, it translates into the high performance in many sports. Therefore, these muscle unit strength gain confirmed in this study may translate into a lack of pain and the ability to continue specialised training for two years among young athletes. Gains in trunk extensors correlate significantly with gains in snatch performance, which may directly translate into performance in weightlifting, as this is an exercise performed during competitions.

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