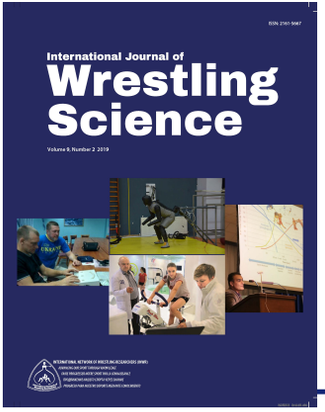


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# MODELING THE FORCE CHARACTERISTICS OF LIFTING ACTIONS BASED ON ELECTROMYOGRAPHIC RESEARCH IN HIGHLY QUALIFIED WRESTLERS

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**ABSTRACT**
It is known that fast fibers occupy the bulk of the muscular system of highly qualified power athletes. This allows them to achieve high results, especially in speed-strength sports. This is also indicated by physiological studies of individual muscle fibers of representatives of strength sports athletes, who have shown a higher level of contractility and power of work for several years in relation to untrained persons of the same age. The purpose of the study was to substantiate the efficiency of the transfer of the weight-lifting training method in stimulating an increase in the level of strength preparedness of wrestlers based on the study of the bioelectric activity of muscles. The pedagogical experiment lasted three months and was carried out at the Children's Sport School “Victoria” of the city of Tarko-Sale in the Yamalo-Nenets Autonomous District. The experiment involved two groups of wrestlers: experimental group (12 people) and control group (12 people).

The experimental group used the model motor action (MMA) in its strength training, which consisted in the fact that the traditional for the heavy weightlifters technique for performing the bar from the platform was modified to take into account the elements of the motor action of the wrestler in the parterre position and in the standing throw over the chest, namely: during the first second the bar was lifted to the knees, for 2-6 seconds the athlete held the weight of the bar in a static position, at the level of the knees, and then, at the 7th second, the bar was lifted until the legs and torso were fully straightened. The wrestlers of the control group trained in the preparatory period according to the traditional strength training program, namely, without the use of barbell traction with intensive loads. Control testing was carried out three months later and only in the barbell pull from the platform.

While performing MMA with the help of a myomonitor, the bioelectrical activity of the direct bundle of the quadriceps muscle of the left and right legs, the right and left side of the latissimus muscle of the wrestler's back was carried out continuously. It was found out that the use of intensive power loads (ranging from 60 to 100% of the maximum) when performing bar pull from the platform led after three months to the development of more economical functioning of the neuromuscular system of wrestlers of the experimental group along with a background of significantly higher final results of force testing in comparison with the wrestlers of the control group.
**Keywords:** modeling of elements of competitive motor action, barbell pull from the platform, bioelectric muscle activity, wrestlers.

**BACKROUND**
Recently much attention has been paid to research in the field of physiology of the neuromuscular system during motor activity in general and, in particular, in sports of speed-strength nature (Aagaard, 2010; Babault, 2001; Fry, 2004). These studies made it possible to identify not only regularities, but also the mechanisms of the influence of various loads on the speed of processing information from external stimuli to the results of their power (speed-power) manifestation under the conditions of specific (competitive) motor actions of athletes (Bashkin, 2009; Verkhoshansky, 2005). At the same time there is no convincing evidence that the speed-strength nature of motor actions (or its qualitative manifestations such as dexterity, endurance, etc.) changes significantly the ratio of two types of muscle fibers (fast and slow) (Fry, 2004). However, strength (speed-strength) muscle contractions during a long-term training can lead to a change in the ratio of two types of fast muscle fibers, for example, on the one hand, increase the magnitude of the effect of fast glycolytic fibers, and on the other hand, reduce the number of fast oxidation-glycolytic fibers (Hakkinen, 1987).

It was also found that as a result of training with intense weight the degree of increase in fast muscle fibers is significantly accelerated in comparison with slow oxidizing fibers (Hortobagyi, 2000). Therefore, the above facts confirm the existence of a dependence of the degree of increase (decrease) in the magnitude of muscle fibers on the specific effects on the neuromuscular system of one or another type of athletic motor activity (Kozlov, 1999). This is indicated by the facts - fast fibers occupy the bulk in the muscular system of highly qualified wrestlers and weightlifters, which allows them to achieve high results in high-speed power sports (Dvorkin, 2011). This is also indicated by physiological studies of individual muscle fibers of highly qualified athletes from

power sports, who have shown a higher level of constructive ability and work power in relation to untrained people of the same age and sports qualification (Fry, 2004). This points to conclusion that the physiological characteristics of the contractile properties of fast muscle fibers allow one to use the possibility of transferring strength training (speed-strength qualities) with the help of intensive weights of a weight-lifting sport to another power sport - wrestling (Aagaard, 1994).

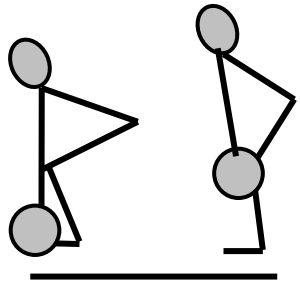
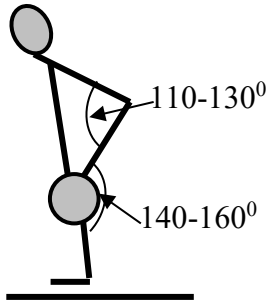
**The purpose of the study** is to substantiate the effectiveness of the transfer of weightlifting training on the basis of electromyographic research methods to increase the level of development of speed-strength preparedness of highly qualified wrestlers.

**METHODS**

This pedagogical experiment lasted three months and took place at the Children's and Youth Sports School "Victoria" in the city of Tarko-Sale of the Yamalo-Nenets Autonomous Okrug. Two groups of wrestlers took part in the experiment: experimental group (12 people) and control group (12 people). The gist of the pedagogical experiment was that with the help of a myomonitor, the bioelectric activity of the direct bundle of the quadriceps femoris of the left and right legs, the right and left parts of the latissimus dorsi muscle was recorded. For the experimental group of wrestlers a model motor action (MMA) was developed which consisted in the fact that changes were made in the traditional technique for weightlifters pulling the bar from the platform, taking into account the elements of the motor action of the wrestler in the parterre position and in the standing throw over the chest, namely the beginning muscle bioelectric activity was recorded at the 1st second during the bar pull from the platform to the knees (first phase), then (in the second phase) for 5 seconds the athlete kept the bar at the knee level (legs bent you are in the knee joint at an angle of 140-160°, the body is tilted forward at an angle in the hip joint within 110-130°) and at the 7th second (in the third phase) he completed the MMA by pulling the bar up until the body and legs in the knee are fully straightened and hip joints (Figure 1).

The special planning of the training load when performing bar pull from the platform for wrestlers of the experimental group was of great importance. Due to this fact, it was planned to the perform bar lift from the platform once a week in the preparatory period in the training process of highly qualified wrestlers. The wrestlers of the experimental group performed this strength exercise with three load options, alternating sequentially, using the conjugate-sequential method of pulling the bar from the platform 60-80% of the maximum weight, 5 in one session and 3-4 number of bar lifts in one set (option 1), respectively, of a variational-progressive methodology - 80-100% of the maximum, 5 sets in one lesson and 1-2 reps in one set (option 2) and an integral technique - a combination of the first two methods equally (option 3).

Wrestlers of the control group trained in the preparatory period according to the traditional strength training program, namely, without the use of bar traction with intensive weights. A control test was carried out only in the bar lifted from the platform at the beginning of the experiment and after three months.

<table>
<tr><td colspan="3">Weight is 70% of maximum</td></tr>
<tr>
<td>  <br>The first phase (1 s)</td>
<td> 

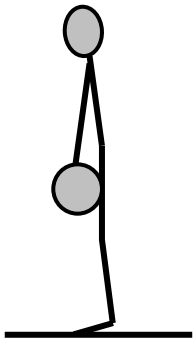
<br>The second phase (2-6 s)</td>
<td>  <br>The third phase (7 s)</td>
</tr>
<tr>
<td>Lift of the bar from the platform to the knees (dynamic mode)</td>
<td>Hold the bar at the knees in isometric mode for 5 s</td>
<td>Pulling the bar until the body and legs are fully straightened (explosive forces)</td>
</tr>
</table>

Figure 1 - A diagram of the bar pull from the platform simulating the elements of the motor action of the wrestler and weightlifter during which the bioelectric activity of the muscles was recorded.

**RESULTS**

Table 1 represents the results of the control test in the bar pull from the platform. It can be seen that the body weight of the wrestlers of the two compared groups did not significantly differ (at $P>0.05$), and there were also no significant differences between the two groups of wrestlers in the first test when performing bar pull from the platform ($P>0.05$). Therefore, according to these initial parameters, all participants in the experiment were homogeneous. During the three months of the preparatory period all the participants in the experiment improved their initial results in the pull of the bar from the platform. In the experimental group the maximum indices in this exercise for three months increased on average by 25.2 kg ($P<0.001$), then in the control group, which did not use intensive weights in strength training, - by 6.0 kg ($P<0.05$). In general, the wrestlers of the experimental group at the end of the study significantly exceeded the wrestlers from the control group when performing bar pulls from the platform in the final result (at $P<0.01$).

Table 1 - Testing results of highly qualified wrestlers in bar traction from the platform to the full straightening of the legs and torso

| Groups | n | Body Weight (kg) | Initial indicators (kg) | Final indicators in three months (kg) | $P_{M2-M1}$ |
|---|---|---|---|---|---|
| Experimental | 9 | 82.3±2.4 | 147.1±4.2 | 172.3±3.7 | P<0.001 |
| Control | 10 | 83.7±3.8 | 152.2±5.8 | 158.2±4.2 | P>0.05 |
| | | P>0.05 | P>0.05 | P<0.01 | |

The results of the above mentioned studies allowed us to continue studying the problem of the influence of the traditional form of strength training using intensive weights taking into account the peculiarities of the wrestler's motor actions on the functioning of the neuromuscular system using electromyographic studies. Muscle bioelectric activity was recorded taking into account the phase structure of MMA.

Studies have shown that in the first phase of MMA (bar pull from the platform to the knees), the bioelectrical activity of the direct bundle of the quadriceps femoris of the left leg was 0.3 mv / s in the control group fighters. and 0.08 mv / s in the experimental group; in the second phase (holding the bar in a static position at the knee level from 2 to 6 seconds). respectively - from 0.33 to 0.39 mv / s and from 0.21 to 0.24 mv / s and at the 7th second of execution MMA (the third phase - bar detonation) – 0.3 and 0.29 mv / s. The value of bioelectric activity of the quadriceps femoris of the right leg in the first phase in the control group wrestlers was 0.26 mv / s. and in the experimental – 0.1 mv / s. respectively. in the second phase - from 0.44 to 0.51 mv / s and from 0.11 to 0.49 mv / s. and in the third phase. 6.1 and 4.8 mv / s. respectively (Figures 2 and 3).

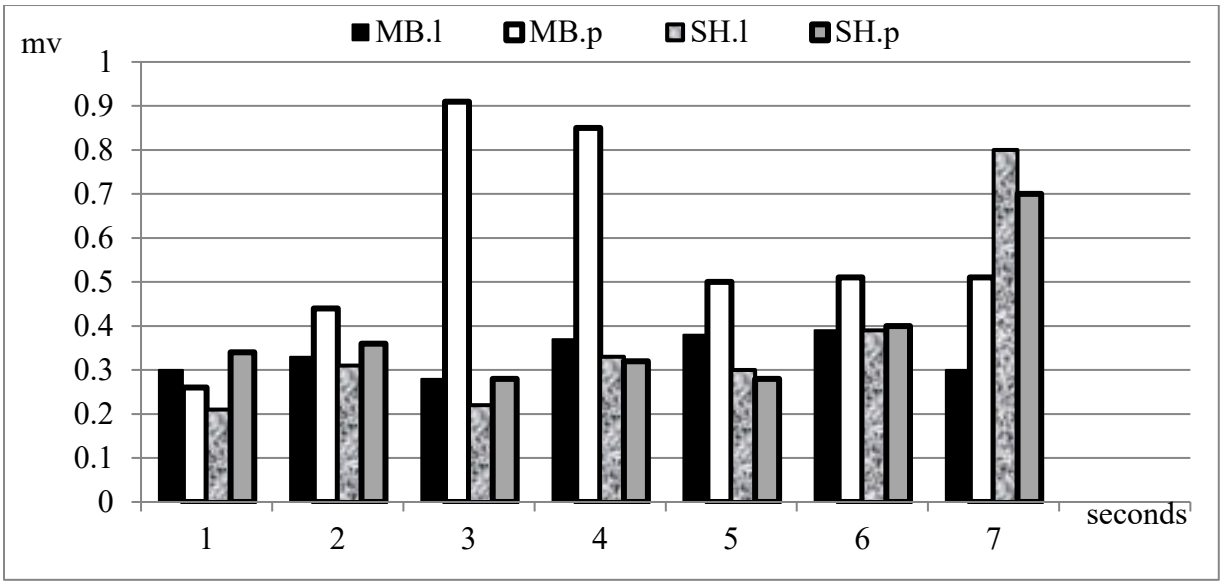



Figure 2 - Dynamics of the bioelectric activity of the muscles of the control group wrestlers when lifting the barbell at 70% of the maximum (first phase: 1 s - bar pull from the platform to the knees. second phase: 2-6 s - holding the bar in isometric voltage mode and the third phase 7 s - pulling of the bar until the trunk and legs are fully straightened.
MB.l - quadriceps femoris of the left leg and MB.p - right leg. SH.l - latissimus dorsi (left) and SH.p (right side)

In the third lead of the myomonitor simultaneously with the first two. the bioelectrical activity of the latissimus dorsi (its right and left parts) was recorded. Studies have shown that if the wrestlers of the control group in the first phase of MMA at the 1st second had bioelectric activity of the right and left parts of the latissimus dorsi muscle was 0.21 and 0.34 mv / s. in the experimental group. respectively. 0.11 and 0.11 mv / s. In the second phase. The bioelectric activity of the left side of the latissimus dorsi muscle in the control group wrestlers was in the range from 0.31 to 0.39 mv / s. and in the right - from 0.36 to 0.40 mv / s. respectively. In the experimental group - from 0.20 to 0.30 mv / s; and 0.23 to 0.33 mv / s. In the third phase. the bioelectric activity of the right side of the latissimus dorsi muscle was 0.8 in the control group wrestlers and 0.7 mv / s in the left part. respectively. In the experimental group – 0.9 and 0.85 mv / s.

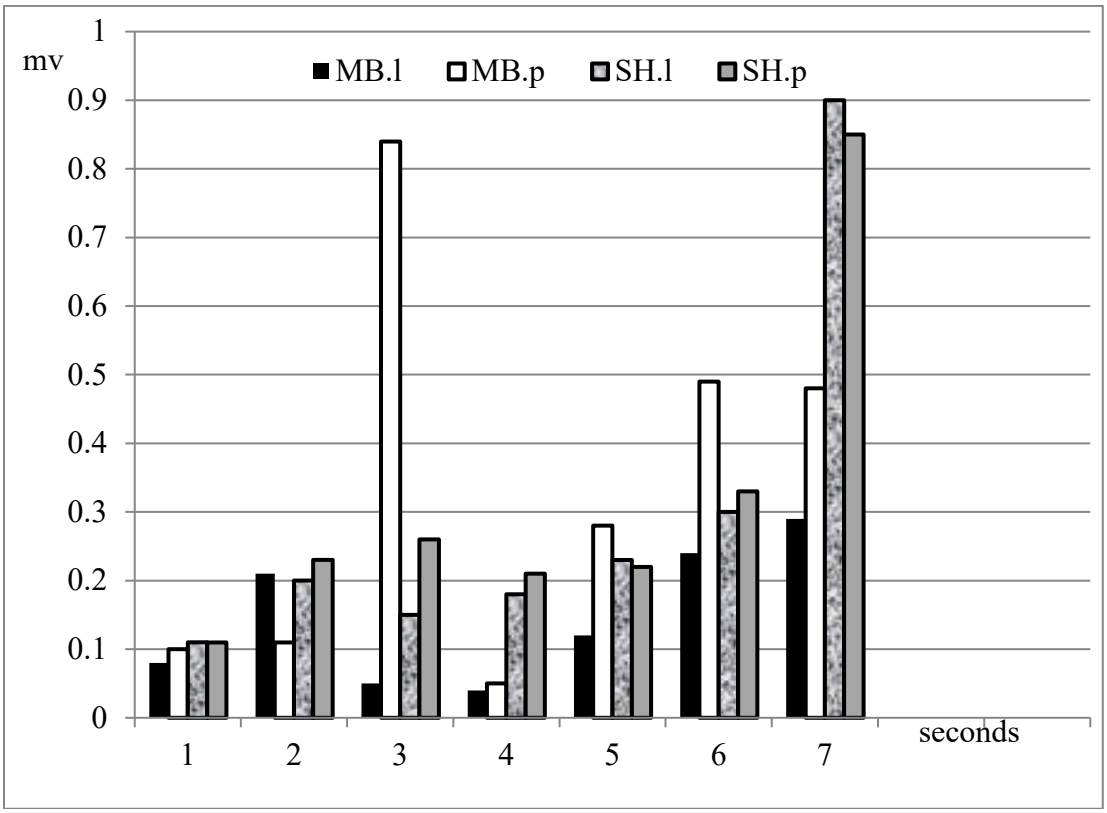



Figure 3 - Dynamics of the bioelectric activity of the muscles of the experimental group of wrestlers when lifting the barbell at 70% of the maximum (first phase: 1 s - bar traction from the platform to the knees,

second phase: 2-6 s - holding the bar in isometric voltage mode and the third phase 7 s - undermining the bar until the trunk and legs are fully straightened.
MB.l - quadriceps femoris of the left leg and MB.p - right leg. SH.l - latissimus dorsi (left) and SH.p (right side)

**CONCLUSIONS**

1. In order to increase the level of functioning of the neuromuscular system in the training process of the preparatory period of wrestlers it is proposed to use a high-intensity weightlifting exercise (bar pull from the platform) taking into account the motor action of the wrestler in the parterre position and in the standing throw over the chest.
2. The bioelectric activity of the muscles of the legs and back was recorded continuously taking into account the following structure of the bar traction from the platform: the first phase — the bar traction to the knees, the second phase — holding the bar at the knees for 5 s in the third phase (7th second) – lifting bars to the full extension of the trunk and legs in the knee and hip joints.
3. It was found that the use of intense power loads (ranging from 60 to 100% of the maximum) when performing bar lifts from the platform after three months led to the development of a more economical functioning of the neuromuscular system of the experimental group wrestlers against the background of significantly higher final results in strength testing compared to the control group of wrestlers.

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