

APPLICATION OF PERFORMANCE MATRIX TESTS IN THE PREVENTION FROM MUSCULOSKELETAL INJURIES IN YOUNG CLASSICAL STYLE WRESTLERS

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ABSTRACT

Background and Study Aim. Wrestling is a contact sport with a high risk of injury occurrence caused by typical motor system dysfunctions. In wrestling training a high value is put on the development of power and muscle strength. The program aimed at improving motor control is not introduced. This paper aims with its presentation.

Material and Methods. The study involved 25 wrestlers from Sports Championship School in Radom (Poland). To identify musculoskeletal system weak links, the low threshold Performance Matrix Tests were used. An analysis of weak links occurrence in biokinematics chain was performed using ANOVA. Location and direction of weak links occurrence was identified.

Results. The low threshold tests provide the information that tested athletes (n=25) have weak links in musculoskeletal system. Players training experience has significant influence on their occurrence $Pr(>F) 0.018$. The values $p3=Pr(>F) 0.032$ and $p5=Pr(>F) 0.040$ reflect a significant correlation with occurrence of weak links number in various places in wrestlers musculoskeletal system. The results $Pr(>F)$ for training frequency, wrestlers age and sports level indicate no significant effect of these characteristics on weak links location in musculoskeletal system.

Conclusions. Obtained results lead to the following conclusions: 1. Training loads in wrestling cause weak links occurrence in musculoskeletal system among juniors. 2. Wrestlers training in junior category significantly affects weak links occurrence in chain of musculoskeletal system in different locations. 3. Wrestlers training frequency does not have a significant impact on weak links location estimated by low threshold tests.

Key words: wrestling, prevention, Performance Matrix tests, weak links, ANOVA

Introduction

Sports fight in wrestling is conducted under the rules of classical or free style. Wrestling is a contact sport which favors the formation of musculoskeletal dysfunction in athletes. Training and fighting in wrestling is characterized by significant risks of common musculoskeletal injuries [1-3]. In sports training like wrestling a high value is put on the development of muscular strength and power, however, any actions are undertaken to apply an activity focused on improving motor control. It is forgotten that an inadequate motor control is responsible for abnormal motor pattern, which in turn reduces the effectiveness of sports training [4]. It has been proved that there is a correlation among muscle strength, power and stability vitally needed for a proper motor control function [5, 6]. Prevention of musculoskeletal dysfunction disorders is a complex process, which requires a holistic treatment of a player associated with the close cooperation of coaches, physiotherapists and doctors. The positive effect of a player's holistic treatment is motor control improvement, which can give the results in lengthening the career time of a player and can reduce treatment costs. Because of the problem importance we undertook the attempt to evaluate wrestlers' musculoskeletal system using standardized Performance Matrix Tests.

Aims

Due to the importance of cognitive meaning the following targets have been taken into consideration: 1. To determine how the training loads in wrestling influence the presence of weak links in the musculoskeletal system. 2. To determine the relationship among the occurrence of weak links in the musculoskeletal system, training duration and training frequency in junior wrestlers in classical style.

The following research hypotheses were formulated: 1. Training loads in wrestles cause the presence of weak links in the musculoskeletal system. 2. The occurrence of weak links in the musculoskeletal system does not depend on varying degrees on training experience, athletes' age, sports classes and frequency of training. 3. Training experience, athletes' age, sports level and frequency of training do not affect the location of the weak links.

Methods

Participants

The study involved 25 young, highly skilled wrestlers from School of Sports Championship in Radom, Poland aged 16.7 ± 1.2 years (mean \pm standard deviation), body weight 77.7 ± 18.7 kg, body height 175.2 ± 14.1 cm. An average training duration of the players was 6.4 ± 2.4 years. There were members of the Polish Junior National Team and Polish Junior Championship medalists among the respondents. Wrestlers participated 5.4 ± 0.5 units of training weekly on average.

Testing procedures

To evaluate the presence of weak link the low threshold Performance Matrix Tests were used [7, 8]. By analyzing and identifying the motion performed by a player, the weakest links of the musculoskeletal system were found. Tests were always assessed by the same investigator. Before the testing, the players were explained and shown how to execute the test. After the test, the results were inscribed in to the sheet. Five low threshold activity tests were carried out to evaluate wrestlers' motor control: test 1 – standing control on slightly bent leg, test 2 – spine dissociation, test 3 – control of the shoulder joint in standing, test 4 – limbs control with bent knee joints while lying on back, test 5 – limbs control in lean kneeling.

Statistical analysis

In the statistical study of the results ANOVA was applied for multiple and simple factor experiments. The location of weak links was marked as: A - cervical spine, B - thoracic spine, C - brachiocephalic shoulder joint, D - shoulder joint, E - lumbar spine, F - knee joint. The results obtained were statistically analyzed using the statistical package R [9].

Results

Weak links in the musculoskeletal system were found in all 25 athletes. Their presence was noted at six levels: cervical, thoracic and lumbar spine, in brachiocephalic shoulder joint, the shoulder joint and knee joint. There were no weak links observed at the hip level. Among all respondents in the cervical spine weak links were observed in the direction of bending in two players, in the thoracic spine weak link appeared in three players in the direction of bending, and in the direction of rotation in nine wrestlers. However, in the lumbar spine weak links have been observed in the direction of rotation in up to 24 respondents, among ten wrestlers in the direction of flexion and lateral flexion. In two wrestlers lack of scapula control in brachiocephalic shoulder joint was observed. In the shoulder joint weak links appeared in the direction of front slip in 19 respondents and in 10 competitors in the direction of rotation. At the level of knee the weak links occurred in the direction of rotation in five respondents. The dependence between training experience, age of players, level of sport and the number of training in week micro cycle and the occurrence of weak links in the low threshold tests using ANOVA for multifactor experiments were verified (Table I). It must be mentioned that analysis of the P-value has not shown a significant effect of wrestlers' age, their level of sport and the number of training units on the presence of weak links in low threshold activity tests. While the wrestlers training experience has a significant influence on the occurrence of weak links in the musculoskeletal system ($P=0.018$).

Another ANOVA variation analysis was conducted to test hypothesis about the impact of training experience on the location of weak links (Table II). The P-values obtained for the location of C spine, brachiocephalic shoulder joint ($P=0.032$) and E, lumbar spine ($P=0.040$) entitle to conclusion concerning their significant influence on the occurrence of weak links in various places of

Table I. ANOVA effect of training experience, age of players, level of sport and the number of week micro cycle training on the presence of weak links in low threshold tests.

Locations	MeanSq	F-value	P-value
Training experience	0.263	6.629	0.018
Age	0.102	2.581	0.124
Sports level	0.026	0.664	0.425
Number of training sessions	2.5E-05	0.001	0.980
Residuals	0.040		

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

musculoskeletal system in wrestlers. It was also found that, the P-value A location (cervical spine), B (thoracic spine), D (shoulder joint) and F (knee joint) do not significantly influence the presence of weak links.

Table II. ANOVA effect of wrestlers training experience on the location of weak links in low threshold tests.

Locations	MeanSq	F-value	P-value
A	0.043	0.011	0.919
B	5.692	1.424	0.248
C	21.559	5.393	0.032
D	12.046	3.012	0.010
E	19.499	4.877	0.040
F	4.964	1.248	0.280
Residuals	3.998		

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

The next step of statistical analysis was to check significance of wrestling training on the location of weak links in low threshold tests (Table III). The P-values indicate no significant training frequency effect on location of the players' weak links.

Table III. ANOVA effect of wrestling training frequency on the location of weak links in low threshold tests.

Locations	MeanSq	F-value	P-value
A	0.288	1.216	0.285
B	0.145	0.626	0.439
C	0.331	1.430	0.247
D	0.636	2.745	0.115
E	0.001	0.004	0.952
F	0.195	0.843	0.370
Residuals	0.232		

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Another ANOVA was conducted to verify the significance of the dependence between the age of athletes and the location of weak links occurrence (Table IV). The calculated P-values indicate no significant effect of wrestlers' age on weak links' location. However, the P-values for the level of A (P= 0.098) and for level B (P=0.082) were close to the limit what proves the existence of a significant effect of players' age on weak links occurrence.

Table IV. ANOVA effect of wrestlers' age on the location of weak links in low threshold tests.

Locations	MeanSq	F-value	P-value
A	4.021	3.039	0.098
B	4.491	3.394	0.082
C	2.039	1.541	0.230
D	0.457	0.346	0.564
E	0.011	0.008	0.929
F	0.926	0.699	0.414
Residuals	1.323		

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Subsequently, ANOVA was conducted to assess the impact of sports level on weak links location (Table V). The obtained results of P-value show no significant impact of sports level of athletes on the location of weak links in musculoskeletal system.

Table V. ANOVA effect of wrestlers' sports level on location of weak links in low threshold tests.

Locations	MeanSq	F-value	P-value
A	0.383	0.579	0.456
B	0.019	0.029	0.866
C	0.458	0.693	0.416
D	1.039	1.570	0.226
E	0.001	0.001	0.972
F	0.025	0.038	0.847
Residuals	0.662		

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Discussion

The study has confirmed the first research hypothesis that the training loads in wrestling cause the occurrence of weak links (determined with low threshold test) in the musculoskeletal systems. Particularly important in the players' evaluation is the ability to indicate the place in musculoskeletal system, in which a weak link can occur. The knowl-

edge helps to improve prevention from a player's injury. Such detailed and comprehensive analysis of wrestlers' musculoskeletal systems also allows applying a precise treatment program, which is an important complement to sports training. Research hypotheses have been verified which suggest that the presence of weak links in the musculoskeletal systems do not depend on wrestlers' age, their performance level and frequency of participation in training. However, it has been found that training experience significantly affects the occurrence of weak links $P=0.018$ (Table I).

It was also examined whether the training experience, wrestlers' age, sports level and frequency of workouts do not have a significant effect on the weak links location. On the basis of the values obtained P-value presented in Table II it can be stated, that for the location A (cervical spine), B (thoracic spine), D (shoulder) and F (knee) training duration has no significant effect on the occurrence of weak links in musculoskeletal systems. However, for location C (brachiocephalic shoulder joint) and E (lumbar spine) has a significant impact because for C is $P=0.032$ and for E is $P=0.040$ (Table II). Taking our own research, conducted on canoeists and Canadian canoeists as an example, it was proved, that the longer is the training experience of competitors apart from the presence of weak links in the lumbar spine, there was also a limitation of movements in the lumbar spine in all directions [10]. The frequency of training determined on the base of a number of training units in the micro cycle, shows no significant effect on the location of the weak links in musculoskeletal systems (Table III). Also the values P-value for age and sports level do not significantly influence the location of the weak links (Table IV, Table V).

Martial arts are characterized by a high risk of injury occurrence [1, 3]. The most frequently mentioned locations of injuries in musculoskeletal systems in wrestlers are knee joints, shoulder joints, head and face, lumbar spine, ankles, cervical spine and muscle strains [11 – 16]. More frequent injuries of elbow and knee joints, head, face and nose are among the competitors practicing the classical wrestling style [17]. The same injuries were noted among the World Cup ski and snowboard contestants during the season of 2006-2007 and 2007-2008 [18]. Comparing the frequency of the occurrence of injuries in young footballers and wrestlers, it was found out, that their number was identical for these disciplines [19]. More often than

in wrestling, head and neck injuries are present in baseball, softball, basketball and soccer [20]. More frequent injury occurrence of lower limbs was found in acrobatic gymnasts [21, 22]. In another experiment, among 95 subjects who were highly advanced wrestlers, in over 80% of them, during their sports career, soft tissues injuries of the musculoskeletal systems were found [2]. Muscle rupture or strain is also a cause of a substantial percentage of injuries among players in different sports disciplines [21, 22]. Our study has provided the information that places in musculoskeletal system with a weaker motor control in tested players is brachiocephalic shoulder joint and lumbar spine. The results obtained from the research conducted on the group of athletes representing different sports disciplines like: fencing, canoeing, rowing, hockey players have also given information that the lumbar spine is deprived of motor control, what – as the result, predisposes to feeling pain, dysfunctions and injuries in this segment [4, 10, 23, 24]. Injuries within the lumbar spine section are often found in competitors training tennis, bowlers, cricketers and yachting crew [25–27]. The obtained results are a valuable source of information pointing at the necessity of introducing a preventive action for wrestlers with training experience 6.36 ± 2.38 years which would prevent them from the occurrence of weak links in the musculoskeletal systems among the respondents. For preventive actions a stabilization training involving lumbo-pelvo-hip complex, that is LPHC [28, 29] should be included. The training introduced for local and global LPHC complex helps reduce the weak links in the lumbar spine [24]. The exercise set applied, the "11", among young female competitors training football did not have any preventive influence on the occurrence of injuries in their group [30]. The common problem of athletes, mainly among footballers, is feeling the pain in the groin. The intervention program was applied among a numerous group of footballers and it reduced the number of pain feelings in the groin but only in 31% of subjects taking part in the program [31]. It should be mentioned that not enough of sufficient attention is paid to the prevention from injuries among wrestlers. Most coaches working with players focus their attention on the development and improving sports technique [32]. Certainly, greater coaches' awareness on the use of injury prevention and the introduction of these activities in training practice would contribute to reducing the occurrence of injuries in wrestlers [33].

Conclusions

1. Training loads in the classic wrestling style cause the occurrence of weak links in musculoskeletal chain among juniors.
2. Wrestlers training duration in the junior category significantly affects the occurrence of weak links in the musculoskeletal chain in different locations.
3. Wrestlers' training frequency does not have a significant impact on the location of the weak links in musculoskeletal system evaluated by using low threshold tests.

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