Muscle damage in intensive preparation period for elite wrestlers – biochemical assessment

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ABSTRACT

PURPOSE: Preparation training of elite-class wrestlers is a highly intensive physical activity. Such activity leads to muscle tearing and the raise of concentration of certain biomarkers in blood. Some of these biomarkers indicate heart muscle or liver damage, so what we are interested in is whether biochemical tests can reveal if a highly intensive activity such as wrestling preparations at the elite level is harmful to the heart muscle and liver. METHODS: Eleven elite Croatian wrestlers have undergone seven-days preparation and 24 hours after the preparation the subjects had their blood sampled (CK, CK-MB, ALT, AST and GGT). The differences between the level of analysed biomarkers and the upper reference limits have been tested by Wilcoxon Matched Pairs test. Pearson coefficient correlation has been calculated in order to determine the connection between CK and CK-MB in addition to the CK-MB percentage in the total value of CK. RESULTS: The research revealed that AST
enzyme was significantly increased (Z=2.31; p=0.02), but since ALT and GGT enzymes are not, we may conclude there were no liver damages. There is a high correlation between CK and CK-MB (r=0.75), while the percentage of CK-MB isoenzyme within the total CK percentage is 2.23%, revealing there were no heart muscle damages. CONCLUSION: Based on the conducted research, we may draw a conclusion there is no health risk referring to liver or heart muscle damage in elite wrestlers during the intensive preparation period.

Key words: Greco-Roman wrestling, blood biomarkers, muscle damage, creatin kinase.

Introduction
In previous studies wrestling has been described as an intensive physical activity dominated by the upper and lower body power with a dominant percentage of anaerobic energy resources (Garcia-Pallares, Lopez-Gullon, Muriel, Diaz & Izquierdo, 2011; Karnincic, Tocilj, Uljevic & Erceg, 2009). Aerobic energy resources also contribute in a wrestling fight, but, according to studies, they are not among the key factors for efficiency in wrestling (Horswill, 1992; Yoon, 2002). Wrestling fights cause extreme physiological changes, and wrestlers’ adjustment to such states is a certain training phenomenon (Kraemer, Vescovi & Dixon, 2004). Exhaustive trainings with submaximum and maximum loads and frequent tournament fights lead to a significant raise of biomarkers indicating muscle tissue damage in wrestlers (Barbas et al. 2011; Kaya, 2017). Intensive physical activity leads to the damage of striated muscle fibres. Due to greater outer force affecting the muscle, eccentric activities cause the most substantial damages which results in higher permeability of the myocyte cell membrane indicated by the leak of inner cell metabolites into intercell spaces. Creatin kinase (CK), alanine aminotransferase (ALT) and aspartate aminotransferase (AST) are the most frequent “leaking” products used as striated muscle fibres damage markers (Nie et al. 2011). CK is an enzyme found in highest concentrations in heart and skeletal muscles and in slightly lower concentrations in brain as well. It comes in four forms, and we focused on CK-MM – muscle enzyme and CK-MB – heart enzyme. Raised values of CK-MB isoenzyme are one of the main cardiac arrest markers. The total CK value measured in blood serum is a combination CK – MM (95%) and CK – MB (5%). ALT and AST are enzymes in charge of amino acids metabolism and can be found in liver in large quantities and in skeletal muscles in slightly smaller quantities. There is no significant difference in the value of these enzymes between the athletes and non-athletes (Banfi, Colombini, Lombardi & Lubkowska, 2012). In standard biochemical analyses, in addition to ALT and AST as liver damage markers, gama glutamil transferasis (GGT) can also be used, an enzyme not found in striated muscles. As the intensive physical activity causes a stronger liver and heart muscle activity, the question is how sure we are that raised values of CK, ALT and AST in blood serum exclusively indicate the skeletal muscle damage. Thus, the purpose of this research is to determine whether the routine biochemical tests in assessing possible liver and heart muscle damages caused by intensive physical activity such as Greco-Roman style wrestling on the elite level is possible.

Methods
Eleven elite Croatian Greco-Roman wrestlers (aged 22.2±3.5 (yrs); body height 180.3±8.3 (cm); body mass 84.1±10.9 (kg); body mass index 25.8±2.0 (m/kg²); the latest ranking on the state championship 2.8±1.6; experience 8.5±3.6 (yrs)) were selected for this study. The ranking on the last state championship in addition to the wrestlers’ experience suggest these are elite wrestlers in addition to the fact they are the members of an extended national team. All the subjects were previously informed about the research and they provided us with their written consent, and the study protocol was approved by the ethical committee of the Faculty of Kinesiology in Split. The sample of variables involves the following biomarkers sampled from the wrestlers’ blood: creatin kinase (CK), creatin kinase
heart isoenzyme (CK-MB), alanine aminotransferase (ALT), aspartate aminotransferase (AST) and gamma glutamyl transference (GGT). All data have been processed by statistica 13.3 programme (Staatistika.Ink), due to the small sample (n=11), nonparametric statistics were applied. We calculated descriptive statistical parameters, the differences between the levels of analysed biomarkers and the upper reference limits have been tested by Wilcoxon Matched Pairs test. Pearson correlation coefficient has been calculated in order to determine the connection between CK and CK-MB as well as the percentage of CK-MB in the total value of CK. The level of significance has been set at p<0.05.

Procedure description and measuring instruments
Seven-day preparation training was done according to the plan in table 1. Twenty-four hours after the preparation cycle had finished, the subjects were taken vein blood samples from cephalic vein. By centrifuging blood samples at 3000 RPM over a fifteen-minute period, we obtained blood serum from which we determined enzyme activities using ABBOTT ARCHITECT ci16200 biochemical auto-analyzer by applying Abbot reagents.

<table>
<thead>
<tr>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morning</td>
<td>Training 1</td>
<td>Training 3</td>
<td>Running</td>
<td>Training 5</td>
<td>Training 7</td>
</tr>
<tr>
<td>Afternoon</td>
<td>Training 2</td>
<td>Training 4*</td>
<td>Training 6</td>
<td>Training 6</td>
<td>Training 8*</td>
</tr>
</tbody>
</table>

*highest intensity training – high-impact training

Table 1. Seven-day preparation training plan

<table>
<thead>
<tr>
<th>Biochemical markers (reference values)</th>
<th>AS±SD</th>
<th>MIN/MAX</th>
<th>Upper reference limit</th>
<th>Wilcoxon Matched Pairs Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>AST (11-38 U/L)</td>
<td>50.27±12.39</td>
<td>32.00/66.00</td>
<td>38</td>
<td>2.31</td>
</tr>
<tr>
<td>ALT (12-48 U/L)</td>
<td>36.27±10.71</td>
<td>24.00/54.00</td>
<td>48</td>
<td>2.5</td>
</tr>
<tr>
<td>GGT (11.55 U/L)</td>
<td>19.26±3.44</td>
<td>13.20/3.44</td>
<td>55</td>
<td>2.93</td>
</tr>
<tr>
<td>CK (0-177 U/L)</td>
<td>1276.55±629.96</td>
<td>457.00/2372.00</td>
<td>177</td>
<td>2.93</td>
</tr>
<tr>
<td>CK MB 7-25 U/L</td>
<td>28.42±7.77</td>
<td>17.00/7.77</td>
<td>25</td>
<td>1.48</td>
</tr>
</tbody>
</table>

Table 2. Descriptive statistical parameters (arithmetic means and standard deviation AS±SD, minimum and maximum value MIN/MAX) and the differences between biochemical markers and their upper reference limits (Wilcoxon Matched Pairs test).

CK - creatin kinase; CK MB – creatin kinase heart isoenzyme. ALT - alanine aminotransferase; AST - aspartate aminotransferase; GGT - gama-glutamyl transference; U/L - units per litre.

Table 2 evidently reveals that the following enzyme values have been significantly raised: aspartate aminotransferase (AST) and total creatin kinase (CK), compared to the upper reference limits. The value of CK-MB isoenzyme is slightly higher than reference values, but without any statistical significance.

The measured value of CK-MB isoenzyme is in significant correlation with the value of total CK on the level r=0.75 and the percentage of CK-MB isoenzyme within the total CK value is 2.23%.
Discussion
The results of our research reveal there are significantly raised AST values and total CK values in addition to bordering raised values of CK-MB isoenzyme. CK is a marker most frequently used in striated muscle damage, which can also be found in the heart muscle. CK-MB heart isoenzyme has been measured in order to calculate its percentage in the total CK concentration, and this percentage in intensive activities should reach up to 5% if the activities do not damage heart muscle. The total CK value is significantly raised which was expected considering intensity and volume of training. The value of CK-MB isoenzyme is higher than upper reference limits, but not significant which, under certain circumstances, may indicate possible heart muscle damages. CK-MB isoenzyme higher values are frequently measured in marathon runners after the race (Smith, Garbutt, Lopes & Pedoe, 2004). Since the analysis revealed a high level of correlation between CK and CK-MB with the percentage of CK-MB in the total value of CK of 2% only, we may conclude both enzymes are “leaking” products caused by the striated muscle damage and thus we may exclude potential heart muscle damages. Higher AST values may indicate skeletal muscles damage, but can also be a liver damage marker. Higher AST and ALT values have already been measured in wrestlers, but are within reference limits (Alpay, 2013; Ozkan & Ibrahim, 2016). The differences in AST levels may occur due to differences in the intensity and volume of training during competition and preparation period (this study was conducted over a preparation period). Although ALT is frequently used as a skeletal muscles marker (Nathwani, Pais, Reynolds & Kaplowitz, 2005), ALT, in addition to GGT, is also a specific liver damage marker. According to other studies, ALT value is slightly higher after a physical activity which may indicate the existence of ALT in a skeletal muscle, but in a smaller quantity than AST (Lippi et al. 2011; Ozkan & Ibrahim, 2016). As AST, ALT and GGT are as a rule liver enzyme, a higher AST value likely indicates striated muscle damages since liver damage would most likely lead to the higher values of all three enzymes (Rosales et al. 20018).

Conclusion
The calculated biochemical parameters reveal the expected striated muscle system damages due to the intensive preparation period, while heart muscle and liver damages have not been marked. Thus, we may assume there is no health risk from the aspect of heart muscle and liver damage in elite wrestlers during an intensive preparation period.

References


consistent with user expectations in terms of knowledge as well as with the labour market
development, extraordinary competition, demanding customers, empowered and
preservation of health and healthy lifestyle, and would thus become competent players in
reasonable to assume that customers mostly tend toward achieving quick desired results, as
selling their services through rapid satisfying of customers' needs and demands. It is
solely on the perceived importance of fitness managers, it is possible that they focus on
method of observation. Furthermore, because the present model of competencies is based
model with other models for fitness managers shows considerable congruence. In the
questionnaire. Nevertheless, we believe that the identified model of broader factors of
sample of the fitness centre managers-participants who were willing to complete the

Discussion

Peng, H., 2000. Competence as derived from activity: the problem of their

References

Kaunas: University of Technology, Institute of Educational Studies.

Ozkan, I., & Ibrahim, C. H. (2016). Dehydration, skeletal muscle damage and inflammation
before the competitions among the elite wrestlers. Journal of physical therapy science,
biomarkers of cardiac and skeletal muscle damage in adolescent runners. Scandinavian
journal of medicine & science in sports, 21(5), 625-629.

Ozkan, I., & Ibrahim, C. H. (2016). Dehydration, skeletal muscle damage and inflammation
before the competitions among the elite wrestlers. Journal of physical therapy science,

Exercise (Marathon Running) on Biochemical and Haematological Markers Used in the
Investigation of Patients in the Emergency Department. British journal of sports
medicine, 38(3), 292-294.

Yoon, J. (2002). Physiological profiles of elite senior wrestlers. Sports Medicine, 32(4),
225-233. doi:10.2165/00007256-200232040-00002

Conflicts of Interest Statement
The authors certify that they have NO affiliations with or involvement in any organization
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discussed in this manuscript.