Abstract

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Title:

Lower limb functional state assessment using RTAA in Czech TeamGym

Objectives:

The aim of this study was to assess the functional condition of a deliberately selected group of representative gymnasts, focusing on the lower limbs. The goal was to determine whether all tested athletes could complete all the tests in the Return to Activity Algorithm (RTAA) within the given range. Another objective was to identify any asymmetries in the group of participants with unilateral lower limb issues and, if applicable, to examine potential differences between the created groups. Additionally, the study sought to identify the most common injuries among TeamGym athletes, compare them with the literature, and, finally, provide possible recommendations for training preparation.

Methods:

The practical part of the thesis is designed as a non-experimental observational study. The research sample consisted of a deliberately selected group (n = 35) of representative gymnasts from TeamGym (including women n = 29 women and men n= 6) aged 14-25, as both the Senior and Junior competitive categories were included in the study. The average age of female gymnasts was 18.3 ± 1,4, and the average age of male gymnasts was 17,8 ± 2,3. All participants (or their legal guardians) signed an informed consent form approved by the Ethics Committee. Data collection took place in the gymnastics hall during training camps using The MAT® platform. The research employed a battery of functional tests according to RTAA, in the following predefined order: Level I: Balance Squat, Y-Balance Test (YBT); Level II: Front Hop Test, Front Hop Test for Distance; Level III: Side Hop, Side Hop Test; Level IV: 90° Balance Hop, Square Hop Test. Evaluation was carried out by comparing the results of DKK and calculating

the LSI for each participant. For the YBT, after normalizing for functional leg length, all three tested directions (ANT, PM, PL) were evaluated separately. A more detailed data analysis also included the calculation of a composite score. The Shapiro-Wilk test was used to verify the normality of the distribution of the measured data. A paired t-test was used to compare the data between both lower limbs. For comparing groups with and without difficulties, an analysis of variance (ANOVA) was used. The results were assessed at a statistical significance level of $\alpha = 0.05$.

Results:

Of the entire tested sample (n=35), only 26% of participants successfully completed the tests at all four levels. A tolerance for asymmetry of the lower limbs up to 10% in the LSI (limb symmetry index) of quantitative tests was used for successful test completion. Subjective health complaints were reported by 83% of the participants. Half of the tested athletes (51%) reported two or more health issues. The highest prevalence of injuries was found in the ankle area, with 68% of the participants reporting issues with at least one ankle. Statistically significant differences ($p < 0.05$) between limbs were found in the composite score of the YBT ($p = 0,029$) and in other quantitative tests: *Front Hop test for Distance* ($p = 0,027$), *Side Hop Test* ($p = 0,004$), *Square Hop Test* ($p = 0,001$) in participants with unilateral problems. A more detailed analysis of the YBT in probands with unilateral issues revealed a significant difference in the anterior direction ($p = 0.014$) and in the posteromedial direction ($p = 0.027$). The posterolateral direction did not show a statistically significant difference ($p = 0.575$). No statistically significant differences ($p > 0.05$) were found using analysis of variance among the groups with unilateral issues, bilateral issues, and the group without issues at any tested level (level I: YBT for the anterior direction ($p = 0.156$), posteromedial ($p = 0.446$), posterolateral ($p = 0.149$), level II ($p = 0.527$), level III ($p = 0.997$), level IV ($p = 0.505$)). In the group with bilateral issues, a statistically significant difference between the limbs was found in the Square Hop Test ($p = 0.016$), and in the group without issues in the posterolateral direction of the YBT ($p = 0.048$). The highest success rate was observed in the level II test (Front Hop Test for Distance), while the most asymmetries were detected in the level III test (Side Hop Test). A more detailed analysis of the YBT results focused on the calculation of the composite score and the calculation of the differences in maximum reach. The composite score values of the YBT did not differ significantly in any tested direction ($p > 0.05$) from the average composite score of the group without issues.

A significant difference ($p < 0,029$) was found only between the limbs in participants with unilateral problems. A difference greater than 4 cm, indicating an increased risk of injury, was detected in 17% of participants in the ANT direction, in 37% of participants in the PM direction, and in 23% of participants in the PL direction.

Conclusion:

The objectives of the study have been achieved. Based on the data analysis, six out of the seven hypotheses were confirmed. Significant functional insufficiency was found in some gymnasts and gymnasts from the national team, which could increase the risk of injury. Statistically significant differences were detected in the group with unilateral lower limb problems across all tests. No statistically significant difference was found between the groups with difficulties and the group without difficulties. In future studies, it would be advisable to monitor development over a longer period during preparation for upcoming competitions, increase the number of participants from different categories, and compare results based on category and gender. Based on the findings of this study, it is recommended to incorporate tests focused on dynamic postural stability into the training programs of gymnasts in order to reduce the risk of injury. Another important recommendation is the testing of athletes returning from injury to training or competition. It was found that the condition of gymnasts after a recent injury was not adequate for the demands of the sport. Education on injury prevention and safe return to sport should be an essential part of the education for both coaches and athletes.

Keywords: TeamGym; gymnastics; sport injury; return to sport; functional testing, lateral ankle sprain