POSTURAL DISORDERS IN YOUNG ATHLETES

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ABSTRACT

Research background and hypothesis. Athletes across all sports face sports injuries stemming from the overuse of specific muscle groups for that particular sport. It was hypothesised that athletes from each sport would show similar muscular-skeletal changes allowing a postural stereotype for each sport to be allocated.

The aim of this study was to determine the peculiarities of postural changes of young athletes in accordance with postural tone and phasic contraction muscles.

Research methods. The participants of this study were 92 young Latvian athletes aged 14–17 and having different preparation level, i. e. 20 swimmers, 20 ice-hockey players and 19 basketball players, 17 handball players and 16 cyclists. Tests were completed using methods of visual diagnostics (Васильева, 1996) and muscular functional testing (Kendall, M. O., Kendall, F. P., 1982).

Research results. The lower cross syndrome is a common feature for athletes of sports requiring complicated coordination at high rates of workloads on lower extremities. Individual decline from a neutral posture in the sagittal plane is a characteristic feature for individuals of various kinds of sport due to overload of some muscle groups.

Discussion and conclusions. The presence of a postural stereotype indicates that these muscular-skeletal changes are beneficial to athletes. How much benefit the athletes gain from these postural changes before injury occurs, is open to debate. It is purposeful to distinguish muscles according to their tone to postural and contracting muscles. The postural muscles that form posture have rather high tone, but if these muscles are overloaded, the tone pathologically increases and the muscle cannot contract nor relax effectively enough to allow the antagonist to work.

Keywords: sport event specifics, postural stereotypes, functional postural changes.

INTRODUCTION

Athletes across all sports face sports injuries stemming from the overuse of specific muscle groups for that particular sport. The overuse of specific muscle groups causes functional muscle imbalance leading to postural changes. These postural changes can provide benefits and advantages to athletes making them better adapted to their sport, therefore these changes are functional for athletes. Just as species have evolved through a series of adaptations over time, sports exercises, drills, and strengthening programs drive to adapt and evolve the athletes that participate in them. Despite the fact that in certain studies and literature we may find results that speak of changes in the spinal cord in athletes of different sports that involve large rotations, such as gymnastics, ballet, swimming, wrestling, javelin throwing, etc., it has not yet been determined that these activities lead to a direct acceleration or worsening of postural disorders (Tanchev et al., 2000; Wood, 2002; Slawinska, et al., 2006).

The problem that the professional/elite athletes face today is finding balance between sports advantage and injury: functionality versus detrimental change. This study is the first step in solving the problem of ensuring balance of functional muscular-skeletal changes and its advantages. It is hotly debated between coaches,

athletes and support staff about how and where that balance point is to be found and applied.

It was hypothesised that athletes from each sport would show similar muscular-skeletal changes allowing a postural stereotype for each sport to be allocated. The aim of this study was to determine the peculiarities of postural changes of young athletes in accordance with postural tone and phasic contraction muscles.

RESEARCH METHODS

The participants of this study were 92 young Latvian athletes aged 14–17 and having different preparation level, i. e. 20 swimmers, 20 ice-hockey players and 19 basketball players, 17 handball players and 16 cyclists. Tests were completed using methods of visual diagnostics (Васильева, 1996) and muscular functional testing (Kendall, H. O., Kendall, F. P., 1982; Janda, 1994). On the basis of these methods the program of assessment was developed (Solovjova, Upitis, 2008). The program integrated measurements of declines in 8 sagittal points from the vertical plane along with functional testing of 11 muscle groups.

Express-diagnostics of posture statics. The following points were marked on the athlete: the external ear opening, acromion, radial point, outer points of the palm, the highest point of the iliac crest, the trochanter, the upper end of the fibula bone and outer ankle. The subject stood at a vertical wall. The distance from the marked point to the vertical wall on the right and left side was measured.

Muscle functional tests. To state the postural tone and phasic contraction muscle functional condition, the major body and leg muscles that are involved in posture forming were tested according to H. O. Kendall and F. P. Kendall (1982). To indicate muscle shortening and weakening, muscles were tested at rest condition. Ten muscle groups were examined all together: the phasic muscles such as the blade fixators, m. rectus abdominis, m. m. medius, and the postural muscles such as m. m. erector cervicis, m. pectoralis major, m. iliopsoas, m. quadriceps femoris, hamstring muscles and m. triceps surae. The functional condition of the postural muscles was assessed in a 3 point system: 1 point was considered to be the norm, 2 and 3 points were considered to be changes.

RESEARCH RESULTS

Results obtained during this study indicate that all athletes have some functional muscular-skeletal changes at various skeletal points. Asymmetry of the point distance from the vertical line between the left and right sides was observed in two swimmers, one ice-hockey player and one basketball player. These measurements were averaged for ease of profiling.

The following peculiarities of posture statics can be marked in the athletes' individual posture profile: the body deviation forward, so-called "body falling" forward was observed in athletes of all groups; the distance from the vertical line between the outer ankle and the auricle of the ear in group A was 9.1 cm, in group B – 5.5 cm, in group C – 10.7 cm; the hip rotation forward was observed in all athletes. It can be concluded that the difference between the highest point of the iliac crest (point 5 in Figure 1) and the trochanter, (point 6 on Figure 1) – in the ice-hockey players is 5.5 cm, swimmers – 2.0 cm and basketball players – 3.5 cm. The greatest distance from the vertical line in the swimmers is in the shoulder girdle (11 cm), ice-hockey players – the highest point of the iliac crest (8 cm), basketball players – the auricle of the ear point (10.7 cm), see Table 1, Figure 1.

In general the following peculiarities of posture statics can be marked in the athletes' individual posture profile. All sports profiles were found to fall forward, cyclists being the most pronounced. Swimmers have a round back and a slight forward rotation of the pelvis. Ice-hockey and handball players along with cyclists have explicit forward rotation of the pelvis.

Muscle testing results indicate that the greatest changes were found in the postural muscles – m. rectus femoris – in all 20 ice-hockey players and cyclists (100%), handball players (91,2%), basketball players (84.2%) and swimmers (41%).

Changes in the hamstring muscles were recorded in hockey players (64%) and handball players (64.7%), swimmers (60%), basketball players (57.9%) and cyclists (55.6%). The greatest changes of m. triceps surae were in the swimmers group (41%) and handball players (35.3%). Both ice-hockey players and cyclists recorded 22.3% change and basketball players – 21.1%.

Athletes in all groups have short pelvic muscles (A – 77.2%, B – 84%, C – 73%, D – 82.4%,
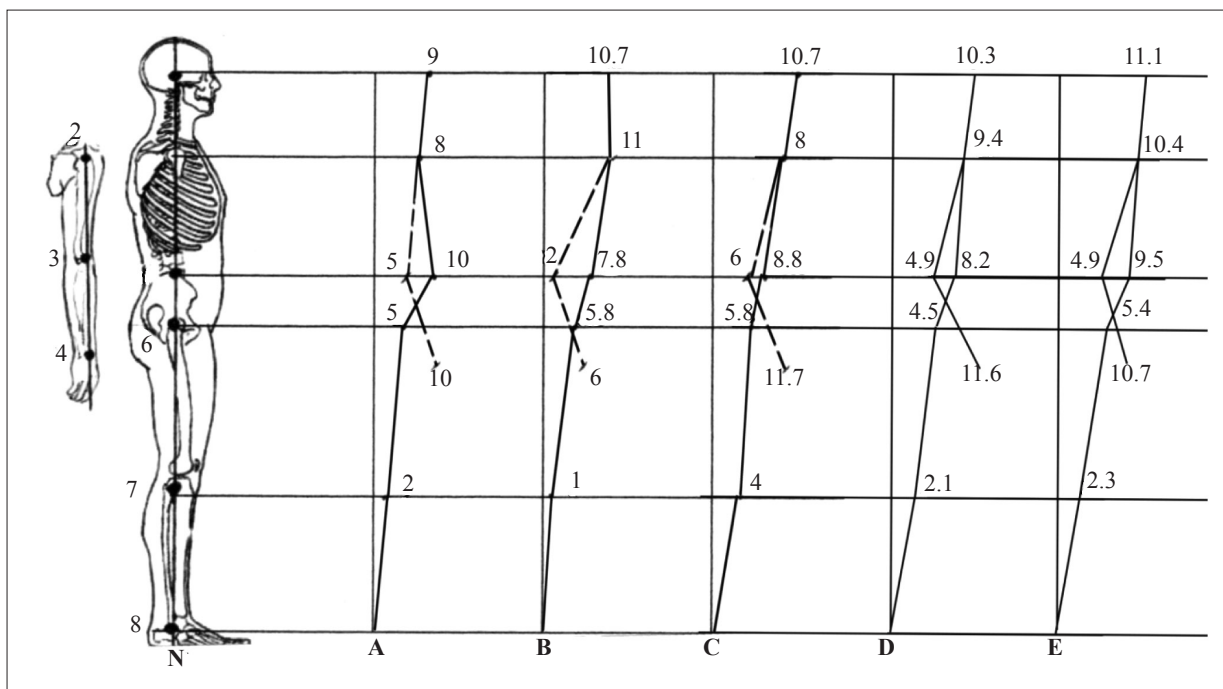
Note. N – optimal position; A – ice-hockey players (n = 20), B – swimmers (n = 20), C – basketball players (n = 19), D – handball players (n = 17) and E – cyclists (n = 16) average data, cm.

Figure 1. **Deviations of the body vertical line from the side, vertical line parameters in cm**

Table 1. **Distance of the body points from the vertical line**

Groups	1	2	3	4	5	6	7	8
Group A, ice-hockey players, n = 20	9.1 ± 0.5	8.3 ± 0.5	5.1 ± 0.6	10 ± 0.7	10.4 ± 0.7	5.2 ± 0.5	2.1 ± 0.6	0
Group B, swimmers, n = 20	5.5 ± 0.4	10.6 ± 0.4	2.4 ± 0.6	6.9 ± 0.9	7.8 ± 0.5	5.8 ± 0.3	1.7 ± 0.2	0
Group C, basketball players, n = 19	10.7 ± 0.6	8.0 ± 0.6	5.7 ± 0.7	11.7 ± 1.1	8.8 ± 0.6	5.8 ± 0.5	4.2 ± 0.4	0
Group D, handball players, n = 17	10.3 ± 0.5	9.4 ± 0.5	4.9 ± 0.6	11.6 ± 0.9	8.2 ± 0.4	4.5 ± 0.4	2.1 ± 0.4	0
Group E, bike riders, n = 16	11.1 ± 0.7	10.4 ± 0.8	4.9 ± 0.5	10.7 ± 1.1	9.5 ± 0.7	5.4 ± 0.4	2.3 ± 0.3	0

Note. 1 – Lower points of the auricle of the ear, 2 – major tubercle, 3 – elbow, 4 – outer points of the palm, 5 – highest point of the iliac crest, 6 – major trochanter, 7 – middle points of the knee joint side surface, 8 – outer ankle; average data of the groups, cm, X ± SD.

E – 83.4%) and hamstring muscles. The changes of the shoulder girdle muscle tone were as follows: m. pectoralis major 21% in 4 swimmers, 5% in 2 basketball players; ice-hockey players, handball players and cyclists do not have any changes (Figure 2). Handball players have the greatest number of changes in m. pectoralis major – 70.6%, swimmers have the smallest – 49%, but cyclists, basketball players and hockey players have changes respectively 66.7, 63.2 and 54.4%. See Figures 2 and 3.

Having the results of muscle testing we can see the changes in the phasic muscles when their effectiveness decreases, that is, they extend and are not able to contract effectively: m. rectus abdominis – 47% of swimmers and 77% of ice-hockey players, 47% of basketball players, 70.6% of handball players and 44.5% of cyclists. Swimmers have the lowest tone of the shoulder blade fixators – 70%, basketball players – 42%, cyclists – 61.2%, hockey riders – 54.4% and handball players – 41.2%. See Figure 4.

Figure 2. **Results of swimmer, ice-hockey, bike rider, handball player and basketball player postural muscle length**
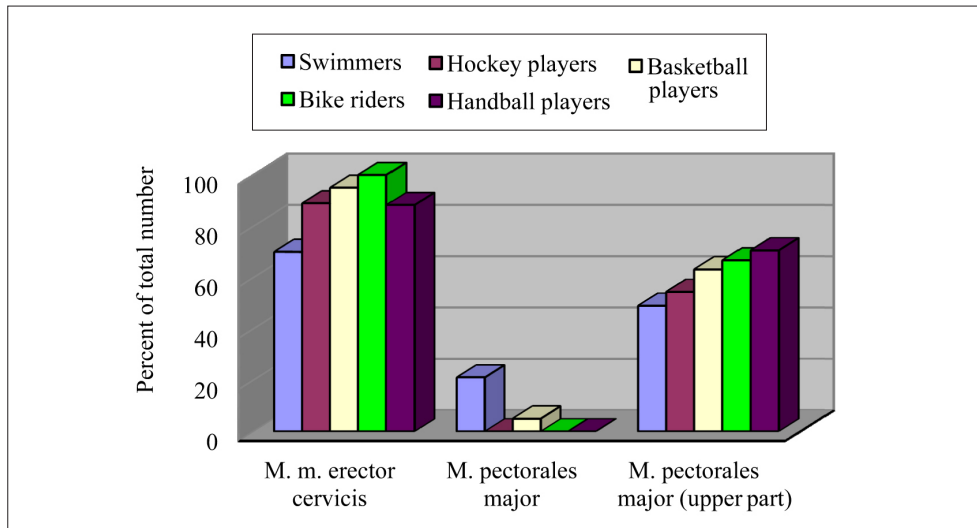

Figure 3. **Results of swimmer, ice-hockey, bike rider, handball player and basketball player postural muscle length**
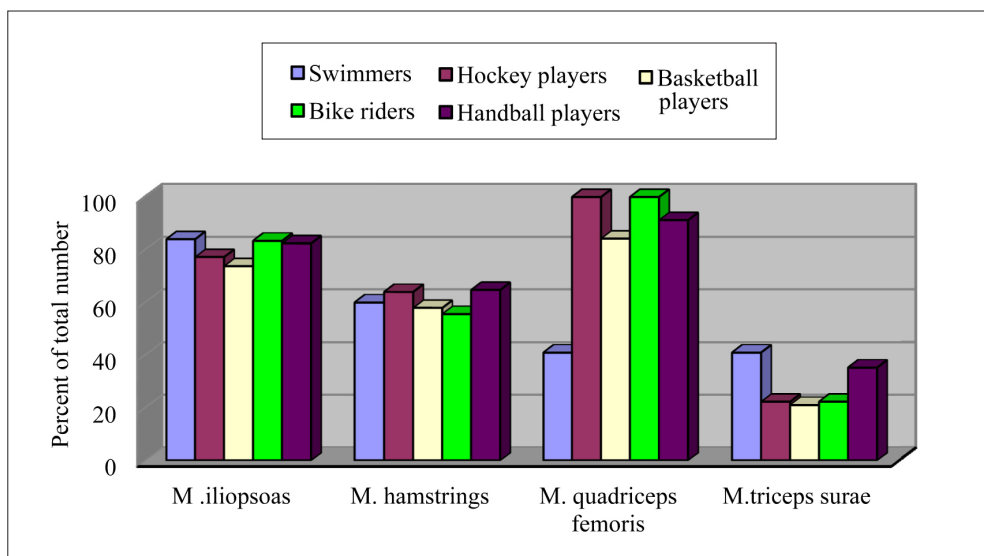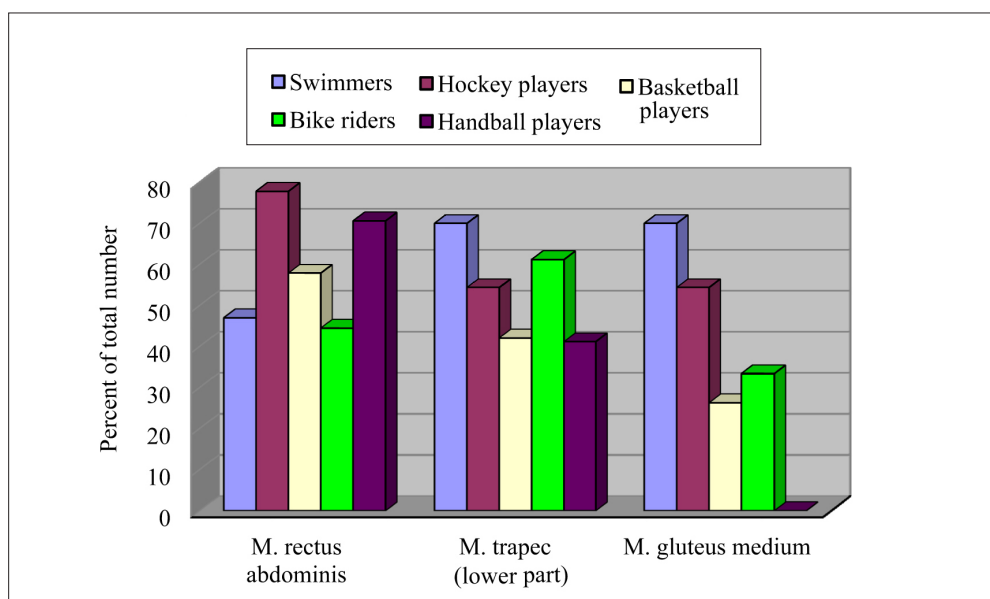

Figure 4. **Results of swimmer, ice-hockey and basketball player phasic muscle strength**

DISCUSSION

The muscles of trunk and core play a critical role in stabilizing the spine and pelvis during sports activities, protecting the cord and other body parts from injuries (Wood, 2002; Huxel Bliven, Anderson, 2013). Adding exercises to daily training routine that target to increase the strength of trunk and core is a foundation for advancing to a higher level of fitness and improved sports performance (Huxel Bliven, Anderson, 2013; Watanabe et al., 2014).

The measurements shown on the athlete profiles indicate that these changes occur at a young age during the training process as these athletes are aged between 14 and 17 years. For superior athletic performance, athlete posture profiles should be monitored throughout an athlete's development to indicate the speed that these changes occur. With the monitoring of the athletes' profiles, early intervention can be made to keep a more neutral posture and eliminate the chance of injury.

However, participation in any sport should not affect an athlete's posture to the extent that joint/muscle pain occurs due to muscle imbalance. If the correct training program is adopted (the one that incorporates strengthening of antagonistic muscles), a more neutral balanced posture should be maintained throughout the course of an athlete's career. This should allow the athlete to maintain superior athletic performances with minimal injuries due to posture changes. Yet, in order to achieve a neutral posture, athletes must spend equal time working on the antagonist muscle groups. This may not feasible due to time and physical limitations.

Spinal cord in athletes of different kind of sports that involve large rotations, such as gymnastics, ballet, swimming, wrestling, javelin throwing, etc., it has not yet been determined that these activities lead to a direct acceleration or worsening of postural disorders (Tanchev et al., 2000; Wood, 2002; Slawinska et al., 2006).

The results of this study showed that athletes of all groups had short pelvic (A − 77.2%, B − 84%, C − 73%, D − 82.4%, E − 83.4%) and hamstring muscles. If the leg and pelvic muscles are shorter, the lordosis of the lower back increases the function of the spine, amortisation decreases, as well as equal load division. If the body adaptation ability is low, it can cause pain in the lower back and knee joints. Basketball players' hamstring muscles have significantly higher tone than those of swimmers.

The shortened muscles of the shoulder girdle in group B – m. erector cervicis, m. pectoralis major and m. pectoralis minor indicate that these muscles are overloaded. The upper cross syndrome is characteristic of athletes in repetitive shoulder sports such as swimming and rowing (Коган et al., 1986; Иваничев, 1999). The loading of the sport on the shoulder girdle has shown the spine hyper-kyphosis of the chest part and the shortening of the small chest and upper trapezius muscles (Solovjova, a, b, 2004).

The lower cross syndrome is characteristic of athletes in sports requiring complicated coordination (e. g. Ice-hockey, basketball) with high loads on lower extremities: "body falling" forward, hyper-lordosis of the chest-pelvis area and the shortening of the pelvic muscles at weakened major hip muscles and m. rectus abdominis (Travell, Simons 1992).

CONCLUSIONS

1. It is purposeful to distinguish muscles according their tone to postural and contracting muscles. The postural muscles that form posture have rather high tone, but if these muscles are overloaded, the tone pathologically increases and the muscle cannot contract nor relax effectively enough to allow the antagonist to work. Contracting muscles that provide movements have lower tone than postural muscles.

2. Individual decline from a neutral posture in the sagittal plane is a characteristic feature for individuals of various kinds of sport due to the overload of some muscle groups.

3. The lower cross syndrome is a common feature for athletes of sports requiring complicated coordination at high rates of workloads on lower extremities.

4. Balanced strength of the phasic and postural muscles is one of the preconditions to form a correct posture. The adequate strength is a factor ensuring a correct stereotype variety of movements.

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