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MUSCULAR ASYMMETRY IN JUNIOR HANDBALL ATHLETES IN THE ABSENCE OF SPECIFIC CORRECTIVE INTERVENTION – CASE STUDIES

PhD Student Gabriela Iuliana Cazac[1], ***Luminița Georgescu***[2]
University of Pitesti[1]
gabriela.cazac@usm.ro[1]
University of Pitesti[2]
kinetopit@yahoo.com[2]

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Abstract

Muscular asymmetry is a prevalent issue among athletes, particularly in sports that involve repetitive and unilateral movements, such as handball. For junior athletes, these imbalances can significantly impact their physical development, performance, and risk of injury. This article explores the progression of muscular asymmetry in junior handball athletes who do not receive specific corrective interventions, through a series of case studies. Additionaly, it examines the use of the Tanita MC-780 MA body composition analyzer as a tool for assessing and monitoring these asymmetries. The Tanita MC-780 MA provided detailed insights into muscle mass distribution, confirming significant discrepancies between the dominant and non-dominant sides. The progression of muscular imbalance without intervention suggests the need for regular monitoring and targeted training to prevent the exacerbation of asymmetries and associated injuries. The use of the Tanita MC-780 MA proved valuable in precisely quantifying muscle mass differences and tracking changes over time.

Introduction

Handball is a dynamic sport requiring high levels of strength, agility, and coordination. It involves frequent and forceful unilateral movements, such as throwing, jumping, and quick changes in direction, which can lead to the development of muscular imbalances [1]. If left untreated, these imbalances can have significant consequences on performance and injury risk.

Asymmetry appears to be part of nature and an integral part of human biology and behavior. Despite an apparent external symmetry, human anatomy abounds in bilateral asymmetries, of internal organs [2], the human face [3] vascular networks, the lymphatic drainage system, or neuronal or nerve pathways that travel distinct

paths on the right side and left side of the body [4, 5] or even their lower and upper [6, 7, 8].

The dominance of one cerebral hemisphere over the other helps the human brain acquire laterality (which is defined as the ability to perform most daily tasks more efficiently with one limb of our body than the other) [9] and it is suggested that sports with unilateral actions may, in fact, tend to accentuate certain asymmetries [10]. Due to the specific and differentiated demands of sports (e.g. handball, volleyball, basketball, tennis, badminton) limb asymmetries can be stimulated [11] an adaptation of the body following the movements that an athlete performs in regularly and unfortunately this can cause muscle imbalances that could affect performance or predispose the athlete to injury [12].

Muscular asymmetry is a common phenomen in sports, especially those requiring repetitive and unilateral movemets. It refers to the imbalance in muscle size, strength, or function between the left and right sides of the body.

Many sports involve repetitive use of one side of the body, leading to asymmetrical muscle development. For example, tennis players often develop stronger abdominal muscles and stronger muscles on their dominant arm due to repeated action of serving and hiting [13]. Athletes may unintentionally favor their dominant side during training, reinforcing existing asymmetries.

In handball, one significant contributing factor to back pain is muscle imbalances. In the context of back pain, these imbalances often involve the muscle supporting the spine and pelvis, such as: erector spinae (this muscle run along the spine and are responsable for extending and stabilizing the back), abdominal muscle (these includes the rectus abdominis, oblique, and transverse abdominis, which support the trunck and control movements), hip flexors (like iliopsoas and rectus femoris, which can become tight), gluteal muscles (the gluteus maximus, medius, and minimus, which stabilize the pelvis and contribute to hip movement) and hamstrings and quadriceps (the muscle support the pelvis and lower back). When these muscle groups are imbalanced, they can disrupt the natural curvature and alignment of the spine, leading to back pain. The typical distribution of muscular shortening (especially of the hamstrings and the iliopsoas) and muscular weakness (abdominal and gluteal muscles, erector spinae lumbalis) can adversely affect the statics of the pelvic region. The resulting hyperlordosis is increased by certain training techniques, i.e., throwing medicine balls, which can lead to a segmental instability of the lumbar spine, thus contributing to chronic back pain [14].

Previous injuries can lead to compensatory movements that favor one side of the body, causing asymmetrical muscle development [15]. Rehabilitation may not always restore perfect symmetry, leading to long-term imbalances. Muscular imbalances can affect an athletes biomechanics, leading to inefficiencies in

movement. Asymmetries can increase the risk of overuse injuries, as the stronger side compensates for the weaker side and the athletes with significant asymmetries may experience quicker fatigue on the weaker side, leading to overcompensation by the stronger side. This can further exacerbate the imbalance and increase injury risk [16].

Junior handball players are in a critical phase of physical development, and their involvement in a sport that demands repetitive, high-intensity, and unilateral movements predisposes them to muscular asymmetries. During adolescence, players undergo rapid growth spurts which can temporarily disrupt coordination and muscle imbalance. Uneven groth rates between bones and muscles can lead to imbalances [17]. Developing coordination and motor skills during the junior years can result in uneven muscle use and development, as young athletes are still learning optimal movements patterns. Training programs that do not emphasize balanced strength and conditioning can exacerbate existing asymmetries. Junior players might focus more on sport-specific skills rather than overall muscle balance [18]. Some junior programs may lack comprehensive strength training, which is essential for balancing muscle development. Emphasis might be placed more on skills development than on balanced physical conditioning. Without adequate rest and recovery, the muscles on the dominant side can become overused and fatigued, leading to imbalances [19]. Minor injuries that are not properly addresses can lead to compensatory movements, where players rely more on their non-injured side, further exacerbating asymmetries [18]. Natural right or left handedness means that players will inherently use one side of their body more than the other. This predisposition cand lead to uneven muscle development unless specifically addressed [19, 20, 21]

The Tanita MC-780 MA is a highly accurate device (Verney, et al., 2015) that uses non-invasive 8-electrode electrical bioimpedance (Leuciuc, et al., 2021) and allows the analysis of body composition in both adults and and in adolescents (Brener, et al., 2021; Salton, et al., 2021; Azoulay, et al., 2021; Rusek, et al., 2021; Verney, et al., 2015). Evaluating muscle mass asymmetry is crucial in sports for several reasons, which relate to performance optimization, injury prevention, and overall athletic development. Muscle imbalances can significantly affect an athletes performance. Asymmetrical muscle development can lead to inefficient movement pattern, decreased power output, and reduced agility. By identifying and addressing these imbalances, coaches and trainers can help athletes achieve more symmetrical strenght, leading to enhanced performance and efficiency in their respective sports [18, 19].

One of the primary reasons for evaluating muscle asymmetry is to prevent injuries. Imbalances can place excessive stress on joints, tendons, and ligaments, increasing the risk of overuse injuries. For example, an imbalance between the

quadriceps and hamstrings can lead to knee injuries. By identifying asymmetries early, corrective exercises can be implemented to prevent injuries before they occur [22]. Ensuring balanced muscle development is critical for the long-term development of junior athletes. As young athletes grow, muscle imbalances can become more pronounced and lead to chronic issues if not addressed. Evaluating and correcting these imbalances during the development stages can set a foundation for healthier athletic careers [22, 19].

Material-method

The aim of this research was to investigate the progression of muscular asymmetry in junior handball athletes who do not receive specific corrective interventions. The Tanita MC-780 MA body composition analyzer was used to measure and track muscle mass distribution. Additionally, the study aimed to evaluate the effectiveness of the Tanita MC-780 MA body composition analyzer in assessing and monitoring these asymmetries over time.

The study involved a group of 5 junior handball athletes aged between 14 to 16 years. Athletes underwent an initial body composition analysis using the Tanita MC-780 MA. Measurements focused on muscle mass distribution in the upper and lower limbs on both sides of the body. The final assessment was conducted after a period of 8 months. These assessments aimed to monitor changes in muscle mass distribution and the progression of muscular asymmetry.

Results

Case study: Athlete B.S.

Position: Inter left

Injury: Athlete B.S. suffered a grade II dislocation of the left ankle.

Rest Period: The athlete had a rest period of 1.5 months for recovery.

Assessment Outcome: The use of the Tanita professional analyzer revealed an asymmetry of muscle mass in the lower limbs, with a discrepancy of 1500g (1.5 kg) between the left and right legs after the recovery period. (fig. 1). Rehabilitation for these injuries often required extended periods away from training and competition, further exacerbating muscular imbalances due to reduced physical activity.

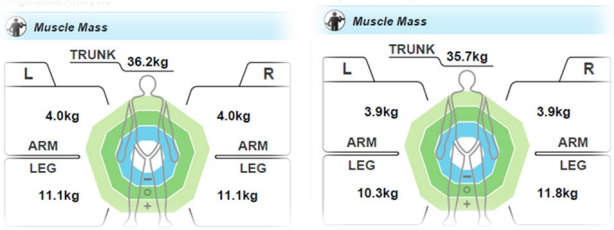

Fig. 1. The selection of the changes that occurred in the plane of symmetry/asymmetry of the initial and final lateral muscle mass – subject B.S

Case study: Athlete C.L.
Position: Inter right
Initial Assessment:
- Upper Limbs: Initial muscle mass asymmetry of 100g.
- Lower Limbs: Initial muscle mass asymmetry of 400g.

Progression Over Time:
- Upper Limbs**:** Muscle mass asymmetry increased to 300g.
- Lower Limbs: Muscle mass asymmetry adjusted to 300g.

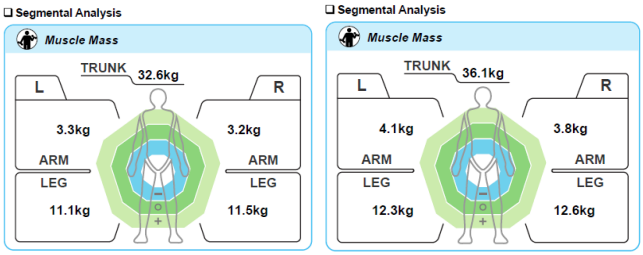

Fig. 2. The selection of the changes that occurred in the plane of symmetry/asymmetry of the initial and final lateral muscle mass – subject C.L.

Case study: Athlete C.I.A.
Position: Center
Initial Assessment:
- Upper Limbs: Symmetrical muscle mass.
- **Lower Limbs**: Muscle mass asymmetry of 400g.

Final Assessment (after 8 months):
- **Upper Limbs**: Developed a muscle mass asymmetry of 100g.
- **Lower Limbs**: Muscle mass asymmetry reduced to 300g

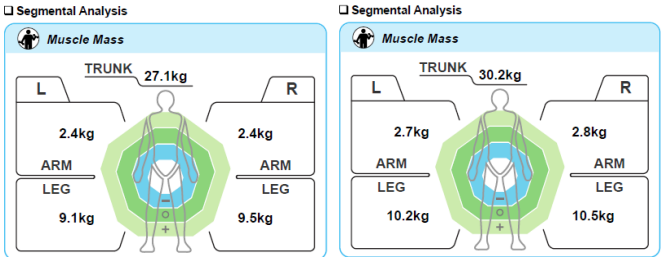

Fig. 3. The selection of the changes that occurred in the plane of symmetry/asymmetry of the initial and final lateral muscle mass – subject C.I.A

Initially, athlete C.I.A. had symmetrical muscle mass in the upper limbs. Over time, a muscle mass asymmetry of 100g developed in the upper limbs. This suggests that the dominant upper limb may have received more training or usage, leading to greater muscle development compared to the non-dominant side. Initially, there was a significant muscle mass asymmetry of 400g in the lower limbs. By the final assessment, this asymmetry reduced to 300g, indicating some improvement in balancing the muscle mass between the lower limbs. This reduction could result from targeted training or natural compensation mechanisms during the training period.

Case study: Athlete D.I.
Position: Left wing
Initial Assessment:
- Upper Limbs**:** Muscle mass asymmetry of 100g.
- Lower Limbs: Muscle mass asymmetry of 500g (right side vs. left side).
Final Assessment (after 8 months):
- Upper Limbs: Developed a muscle mass asymmetry of 200g.
- Lower Limbs**:** Muscle mass asymmetry remained at 500g (right side vs. left side)

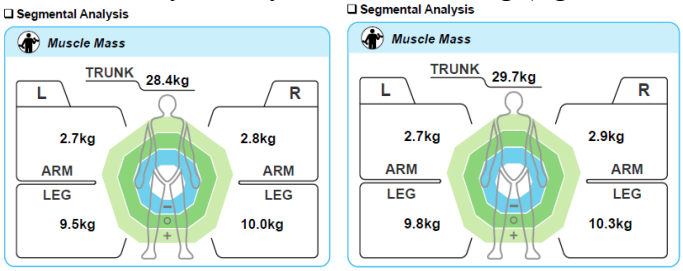

Fig. 4. The selection of the changes that occurred in the plane of symmetry/asymmetry of the initial and final lateral muscle mass – subject D.I.

Case study: Athlete P.C.
Position: Right wing
Initial Assessment:
-Upper Limbs**:** Muscle mass asymmetry of 100g.
- Lower Limbs**:** Muscle mass asymmetry of 400g (right side vs. left side).
Final Assessment (after 8 months):
-Upper Limbs: Muscle mass asymmetry of 100g (preserved).
- Lower Limbs: Muscle mass asymmetry reduced to 300g, with the right lower part better developed than the left lower part.

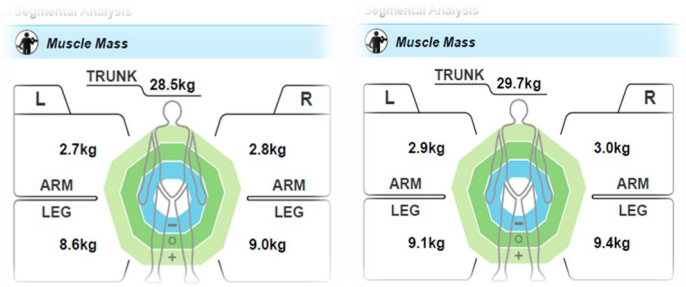

Fig. 5. The selection of the changes that occurred in the plane of symmetry/asymmetry of the initial and final lateral muscle mass – subject P.C.

Discussions

The study addresses a prevalent issue in junior handball athletes, namely muscular asymmetry, which has significant implications for performance and injury risk. By shedding light on this issue, the study provides valuable insights for coaches, trainers, and athletes to address and mitigate muscular imbalances.

The study utilizes advanced technology, such as the Tanita MC-780 MA body composition analyzer, to assess and monitor muscular asymmetry. This demonstrates a commitment to employing state-of-the-art tools and methodologies in sports science research, which can enhance the accuracy and reliability of findings.

By adopting a longitudinal approach with initial and final assessments over an 8-month period, the study captures the dynamic nature of muscular asymmetry progression. This allows for a comprehensive understanding of how asymmetries evolve over time, which is crucial for developing effective intervention strategies.

The inclusion of individual case studies, such as athletes B.S., C.L., C.I.A., P.C., and D.I., provides a nuanced understanding of how muscular asymmetry manifests differently in athletes with varying positions and injury histories. This individualized analysis offers tailored insights that can inform personalized training and rehabilitation programs.

The study's findings have direct practical implications for coaches, trainers, and sports medicine professionals working with junior handball athletes. By highlighting the importance of regular monitoring and targeted interventions, the study offers actionable recommendations to optimize athletes' physical development and minimize injury risk.

Overall, the study contributes valuable insights into the understanding of muscular asymmetry in junior handball athletes and provides a basis for further research and practical application in sports science and athlete development.

Suggestions

- **Regular monitoring**: Continue regular assessments using the Tanita MC-780 MA body composition analyzer to monitor changes in muscle mass distribution. Frequent monitoring can help identify early signs of developing asymmetries and guide necessary interventions.
- **Targeted training programs**:

Upper limbs: Develop a specific training program aimed at the non-dominant upper limb to correct the emerging asymmetry. Exercises should focus on strength and endurance to balance muscle development.

Lower limbs: Maintain and enhance the current training regimen that has been effective in reducing the asymmetry. Incorporate unilateral exercises that equally target both lower limbs to further balance muscle mass.

- **Injury prevention**: Implement preventive measures to avoid injuries that could exacerbate muscle asymmetries. This includes proper warm-ups, cool-downs, and maintaining flexibility and mobility through regular stretching and conditioning exercises.
- **Balanced workloads**: Ensure that training loads are balanced between both sides of the body. Coaches and trainers should be aware of the asymmetries and adjust training plans accordingly to prevent overuse of the dominant side.
- **Individualized attention**: Provide individualized attention to each athlete's unique muscle mass distribution. Tailoring training and recovery programs based on specific needs can help in effectively managing and correcting muscular asymmetries.

Conclusions

The progression of muscular asymmetry in junior handball athletes indicates the importance of regular monitoring and targeted interventions to manage and correct these imbalances. The Tanita MC-780 MA body composition analyzer proved to be an effective tool in accurately assessing and tracking muscle mass distribution over time. Regular assessments can help identify early signs of asymmetry, allowing for timely and targeted corrective training to prevent exacerbation and associated injuries.

Perspectives for future studies

- **Individualized training plans**: Develop individualized training plans that address the specific muscle imbalances observed in athletes like P.C., with a focus on strengthening the weaker side of the lower limbs.
- **Biomechanical analysis**: Incorporate biomechanical analysis to understand how asymmetries in muscle mass affect movement mechanics and

performance, particularly in players with positional demands like the right wing.

- **Longitudinal studies**: Conduct longitudinal studies to examine the long-term effects of asymmetries on performance, injury risk, and overall athletic development among handball athletes.
- **Injury prevention strategies**: Design injury prevention strategies that target the lower limbs, particularly focusing on reducing asymmetry and improving balance to mitigate injury risk.
- **Recovery and regeneration protocols**: Implement recovery and regeneration protocols that promote muscle symmetry and address any imbalances resulting from training and competition.

By addressing these aspects in future studies, researchers can enhance understanding of muscular asymmetry in handball athletes and develop targeted interventions to optimize performance, reduce injury risk, and promote overall well-being.

While the research provides valuable insights into the progression of muscular asymmetry in junior handball athletes and the effectiveness of the Tanita MC-780 MA body composition analyzer, **there are several limitations** that should be acknowledged:

- **Sample size and diversity**: The study may have a limited sample size and may not represent the full spectrum of junior handball athletes. Additionally, the study might lack diversity in terms of age, gender, skill level, and training background.
- **Duration of the study**: The study's duration of 8 months may not be sufficient to capture long-term trends in muscular asymmetry development and progression. Longer-term studies would provide a more comprehensive understanding of how asymmetries evolve over time.
- **Injury and recovery monitoring**: While the study tracks the impact of injuries and recovery periods on muscle asymmetry, the analysis may not fully account for all injury types, severity levels, and individual recovery trajectories, which could influence the observed asymmetries.
- **Assessment methods**: While the Tanita MC-780 MA body composition analyzer is a useful tool for assessing muscle mass distribution, it may have limitations in accurately quantifying asymmetries, especially in specific muscle groups or segments.
- **Generalizability**: The findings of the research may not be generalizable to all handball athletes or athletes in other sports. Factors such as sport-specific demands, individual physiology, and training practices could influence the manifestation and progression of muscular asymmetries differently.

- **External validity**: The research may lack external validity in terms of its applicability to real-world settings, such as training environments, competitive contexts, and clinical practice.

Addressing these limitations in future research endeavors would enhance the robustness and applicability of findings related to muscular asymmetry in junior handball athletes and contribute to the development of more effective prevention and intervention strategies.

Despite its limitations, the study lays a solid foundation for future research in this area. It identifies key areas for further investigation, such as the effectiveness of specific intervention strategies, the role of biomechanics in muscular asymmetry, and the impact of asymmetries on long-term athletic performance and injury outcomes.

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