PHYSIOLOGICAL EFFECTS OF OVERTRAINING IN ATHLETES

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Abstract: *Proper sports training enhances metabolism, strengthens the cardiovascular system, and improves endurance, while excessive load and insufficient recovery lead to overtraining. This study compares morpho-functional disorders and BMI changes in 50 non-athletes, 50 weightlifters, and 57 canoe rowers. Athletes' anthropometric and physiological indicators were monitored every three months. Results showed that 28% of competing athletes were overtrained, with significant BMI increases: 24 weightlifters and 5 canoeists exceeded normal BMI levels. Among weightlifters, 48% had grade 2–3 overweight; among canoeists, 8.77% had grade 2 overweight. Atherosclerosis was found in 48% of athletes, and latent type 2 diabetes in two cases. Excessive loads without proper recovery pose serious health risks, highlighting the need for medical supervision and individualized training programs.*

Keywords: *adaptation, endurance, overtraining, thermoregulation, hypoxia, stress.*

ФИЗИОЛОГИЧЕСКИЕ ЭФФЕКТЫ ПЕРЕТРЕНИРОВАННОСТИ У СПОРТСМЕНОВ

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Аннотация: *правильная спортивная тренировка улучшает обмен веществ, укрепляет сердечно-сосудистую систему и повышает выносливость, тогда как чрезмерная нагрузка и недостаточное восстановление приводят к перетренированности. В данном исследовании сравниваются морфофункциональные нарушения и изменения ИМТ у 50 неспортсменов, 50 тяжелоатлетов и 57 гребцов на каноэ. Антропометрические и физиологические показатели спортсменов контролировались каждые три месяца. Результаты показали, что 28% участвующих в соревнованиях спортсменов находились в состоянии перетренированности, сопровождавшейся значительным увеличением ИМТ: 24 тяжелоатлета и 5 гребцов превышали нормальные значения. Среди тяжелоатлетов 48% имели избыточный вес 2-3 степени; среди гребцов - 8,77% имели избыточный вес 2 степени. Атеросклероз был обнаружен у 48% спортсменов, а скрытый сахарный диабет 2 типа - у двух человек. Чрезмерные нагрузки без должного восстановления представляют серьёзный риск для здоровья, подчёркивая необходимость медицинского контроля и индивидуализированных тренировочных программ.*

Ключевые слова: *адаптация, выносливость, перетренировка, терморегуляция, гипоксия, стресс.*

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Introduction.

Overtraining without sufficient recovery during training sessions can lead to overtraining syndrome. Continued training without adequate recovery after specific exercises can harm an athlete's health and negatively impact performance outcomes. Training risks can arise in two scenarios: improper exercise technique or the presence of contraindications. Even if athletes do not face these issues, they must undergo medical evaluations before starting training. Among weightlifting injuries, muscle and tendon damage are the most common [1, 2]. A study by Calhoon and Fry [3] found that acute injuries account for 59.6%, chronic injuries 30.4%, and other types of injuries 10% among weightlifters. According to Raske and Norlin, 20% of injuries are muscle-related, and 25% involve tendons. In the Olympics, five athletes suffered tendon ruptures [2]. Slesarenko's data indicates that weightlifters experience injuries as follows: 10% wrist, 0.7% head, 5.4% neck, 17.7% shoulder, 2.5% elbow, 4.8% back, 23.3% lower back, 3.2% thigh, 2.3% knee tendons, and 19.1% knee injuries. Keogh et al. [4] identified the shoulder, lower back, and elbow as the most commonly injured areas. Braun and Kimball's study [5] showed that approximately 50% of injuries occur in the lower back, knee, and chest. A study by Siewe et al. [6] on elite German weightlifters found that 50% experienced shoulder issues, and over 40% had lower back and knee injuries throughout their careers. Various contusions and fractures occur when athletes lose control of the barbell, often due to improper weight selection relative to body weight, failure to follow sports adaptation principles, or incorrect technical and tactical execution of lifts [7]. Kulund's research found spondylosis in 30% of weightlifters [8]. In former weightlifters over 50 years old, 62% showed reduced intervertebral space in the lower spine [9, 10]. Koryachenkov observed changes in the diaphyseal diameter of tubular bones, the thin perivascular layer of bone (connective tissue surrounding blood

vessels within the bone), and apophyses in weightlifters after 3–5 years of intensive strength training. Bone density in weightlifters was found to be higher than in other sports [11]. Canoeing is a cyclic sport requiring strength and endurance. Energy expenditure in canoeists is high, primarily supplied through carbohydrate oxidation. Glycogen stores in the body are depleted during each training session, and their rapid replenishment is critical for successful canoeing performance [12]. Injuries in canoeing are primarily linked to overuse, most commonly affecting the knee, lumbar spine, and ribs. The severity of injuries is directly related to training volume and technique. Injuries in canoeing are primarily caused by excessive strain [13]. A review of canoeing programs at Harvard and Rutgers Universities identified 180 injuries among rowers over three years, with most occurring during intense training periods in the fall and winter before the racing season. Knee pain was the most common, followed by back and chest pain. Excessive strain on the knee joint is prevalent in canoeing. Activities like stair running and jumping significantly increase knee pressure. Surveys on canoeing injuries indicate the knee as the most affected area, with diagnoses including patellar cartilage wear and friction syndrome in the knee joint caused by the femur and tibia heads. Knee cap injuries manifest as anterior knee pain during exercises. Low back pain is a common complaint among canoeists. Howell's research on lightweight female canoeists showed that 82.2% reported low back pain, consistent across age and gender [13]. Chest pain is also frequent, primarily due to rib stress fractures. Studies of collegiate canoeing programs and the Canadian national team found that rib stress fractures account for approximately 10% of injuries, mainly affecting the fifth and ninth ribs.

Purpose and Objectives.

The purpose of this study is to compare morphological-functional disorders and body mass index (BMI) caused by overtraining across three groups with different levels of physical activity.

Methods and Organization.

To assess anatomical and physiological indicators, body weight and anthropometric measurements were taken from athletes and non-athletes. Normal growth and development are crucial for the body. Fatigue and metabolic deficiencies can arise from deviations in normal growth and development. The study involved 50 non-athletes, 50 weightlifters, and 57 canoeists. Physiological and morphological changes were monitored every three months. BMI was calculated using the formula: BMI = kg/m². Results were interpreted as follows:

- Below 18.5: Underweight
- 18.5–24.9: Normal weight
- 25–29.9: Grade I obesity
- 30.0–34.9: Grade II obesity
- 35.0–39.9: Grade III obesity
- Above 40: Grade IV obesity (potentially due to hormonal disorders, requiring thyroid examination, treatment, and diet).

Results and Discussion.

Overtraining without sufficient recovery can lead to overtraining syndrome. Continued training without adequate recovery after specific exercises can harm athletes' health and negatively affect performance outcomes. Overtraining can reduce an athlete's physical condition, negatively impact results, and lead to injuries. In weightlifting, it may also contribute to cardiovascular diseases. Therefore, athletes must monitor their training limits and fatigue levels. The study found that 28% of 50 competitive athletes (participating in national and international competitions) experienced overtraining. Overtraining was shown to cause changes in BMI, with contrasting effects observed in weightlifters and canoeists.

Elevated BMI above normal ranges was observed in 24 overtrained weightlifters and 5 canoeists. Due to high BMI, athletes were found to suffer from several physiological disorders. Among weightlifters, overtraining and lifting in inappropriate weight categories led to 48% experiencing atherosclerosis, while two athletes were diagnosed with latent type 2 diabetes. Conservative medical treatment was recommended for them. In the early stages of sports participation, excessive physical exercise significantly increases the likelihood of overtraining compared to adults well-adapted to high training volumes. Early overtraining considerably weakens the body's protective mechanisms, increasing the risk of diseases caused by overtraining in the future. The study revealed that due to overtraining, 48% of weightlifters had grade II and III obesity, 8.77% of canoeists had grade II obesity, and 34% of weightlifters and 24.56% of canoeists had grade I obesity based on body mass index (BMI). This contributed to 48% of athletes developing atherosclerosis, 1% developing type 2 diabetes, 57.3% experiencing hypertension, 28% suffering from osteoarthritis, 58.5% showing mental fatigue, and 49.2% exhibiting physical fatigue.

Conclusion. Excessive physical exercise in the early stages of sports participation significantly increases the risk of overtraining compared to adults well-adapted to high training volumes. Early overtraining weakens the body's protective mechanisms, elevating the risk of future diseases caused by overtraining. The disruption of physiological adaptation principles, particularly in weightlifting, leads to a high prevalence of related diseases, resulting in a regressive decline in participation in this sport. However, abandoning sports is not the solution, especially given the continuous expansion of youth and adolescent competition schedules. Proper organization of training loads, prevention of the aforementioned issues, and regular physiological assessments are recommended.

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