

CHANGES IN BODY COMPOSITION DURING THE TRANSITION PERIOD AND TRAINING PERIOD IN COMPETITIVE HANDBALL PLAYERS

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Abstract

Body composition analysis has gained popularity in sports, and sports coaches, physical trainers, and physical therapists have understood the need to monitor these parameters. The purpose of this study was to monitor body composition fluctuations in a Romanian handball team during the off-season. The assessments were performed using bioimpedance and included: skeletal muscle mass (SMM), fat-free mass (FFM), fat mass (FM), fat mass percentage (BF%), total mineral mass (BMC), total body water (TBW), basal metabolic rate (BMR), and body mass index (BMI). During the transition period T1-T2, the athletes recorded a decrease in SMM (-0,55 kg) and an increase in BF% (+0,79 kg) due to a lower training volume. During the preparation period T2-T3, athletes recorded increases in SMM (+0,97 kg) and decreases in BF% (-1,75 kg), as this was a period of muscle mass accumulation and getting into shape. The impact of the entire T1-T3 period analyzed was somewhat unexpected, as the athletes did not significantly improve their body composition compared to T1. These results may be the consequence of a combination of internal and external factors that can have negative long-term and short-term effects on body composition.

Introduction

The modern game of handball involves a large number of intense, short-duration technical actions that place different demands on each player, depending on the playing position, requiring different anthropometric characteristics and individualized training regimens [1]. The body composition in handball is different

depending on the playing position in which the athletes are performing, and many studies have evaluated these differences [2,3,4,5].

Muscle development and assessment of body composition has gained momentum in sports practice, contributing to the development of performance, and has been of increasing interest to both researchers and coaches [6,7]. Higher levels of muscle mass improves speed and agility in handball, whereas obesity is closely related to slower linear and multidirectional movements [8]. Moreover, the higher the body mass index, body fat mass and total body water, the lower the psychomotor performance [9].

The determination of BMI is important because it determines an individual's normal weight [10]. However, this assessment has significant limitations, which directs attention to other, more specific, measurements that can determine the distribution of body composition by compartments and different markers [11,12]. In competitive sports, specialized medical teams use objective tests to constantly monitor body composition, such as BIA (Bioelectrical Impedance Analysis) using low intensity currents, but also DEXA (Dual-Energy X-ray Absorptiometry) [13,14]. BIA has gained popularity in sports practices through specific regression equations, but the assessment conditions must be taken into account to reduce errors [15].

The transition period has negative effects proportional to the duration of rest period and includes negative changes in body composition, physiological performance and motor skills in athletes [16,17]. The training period is characterized by a higher training accumulation and produces positive changes in body composition, strength and physiological parameters [18,19,20].

From our research, we have found that few studies have evaluated changes in body composition during the transition period and the training period in handball. Some studies have analyzed the effects of a single macro-cycle or a limited period of time. This study aims to longitudinally highlight the changes in body composition during two macrocycles spanning the transition period and the training period in a Romanian handball team.

The study is based on the following hypotheses:

- The transition period will generate a decrease in skeletal muscle mass followed by an increase in fat mass percentage;
- The transition period will result in an increase in skeletal muscle mass followed by a decrease in the percentage of fat mass;
- Body composition will be improved at the end of the training period compared to the beginning of the transition period.

Material-method

Study design

This paper is an observational, longitudinal, and prospective study, in which we analyzed the changes in body composition during the transition period and pre-competitive training in competitive handball players.

All participants were informed about the aim and objectives of the assessments performed, participated voluntarily, and had the right to withdraw from the study at any time they wished, at no cost. They initially signed the consent form and were in-formed about the research team's respect for the privacy of their personal data.

The study is in accordance with the Declaration of Helsinki, approved by the sports club no. 463/10.04.2025, fully respecting the ethical and moral principles of the subjects.

Study participants

The participants in this study are high performance athletes from the Romanian National Handball League. The analyzed group is male, with only professional players aged between 19 and 41 years old, with a mean of $25,4 \pm 6,79$, a weight of $97,39 \pm 16,07$ and a height of $191,5 \pm 5,83$, as shown in Table 1. Following the inclusion/exclusion cri-teria, 10 athletes who fully met the required standards remained eligible for the study.

Table 1-Characteristics of the Athletes

| Data | Average | Standard Deviation | Minimum | Maximum |
|----------------|----------------|---------------------------|----------------|----------------|
| Age (years) | 25,4 | 6,79 | 19 | 41 |
| Height (cm) | 191,5 | 5,83 | 185 | 205 |
| Weight T1 (kg) | 97,39 | 16,07 | 73,5 | 117,2 |

Materials used

The materials used during the study were as follows:

-Height was assessed using a stadiometer and all athletes were monitored under the same conditions [21].

-Body composition was assessed by electrical bioimpedance performed with the Tanita MC-780 SMA device which contains the following specifications: 3 measurement frequencies, 8 electrodes and 2 measurement modes (normal and athletic) [22].

Working methods

In order to identify changes in body composition during the transition period, we performed an initial measurement on 22-05-2025 which we denoted T1 and an inter-mediate assessment denoted T2 on 04-07-2025. The T2 assessment coincides with the end of the transition period which lasted 6 weeks, but it is also the beginning of the preparation period which lasted a total of 8 weeks. The preparation period was completed with a last assessment that we noted T3 being conducted on 29-08-2025.

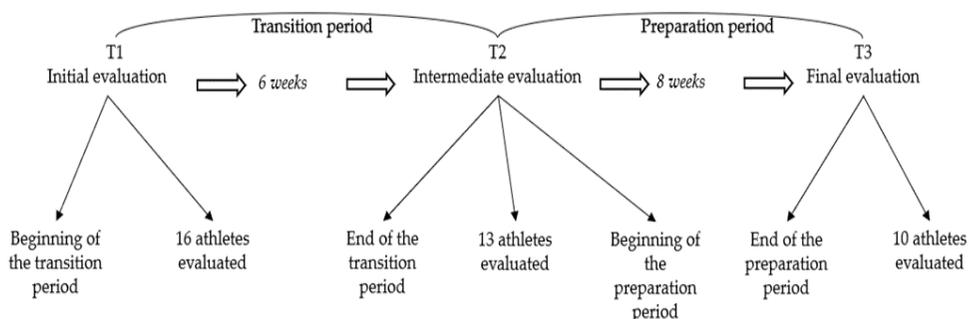


Figure 1-Study Design

The T1 assessment marks the beginning of the transition period and was carried out on 16 eligible athletes. At the end of the transition period, 3 athletes had transferred/ or were no longer part of the team and measurements were carried out on 13 of them. At the end of the training period, for objective reasons, a total of 10 athletes completed the 3 measurements and fully completed the transition and training period thus becoming eligible for our study.

The exclusion criteria were as follows:

- athletes who did not complete the transition period because they moved to the national team squad;
- athletes who did not perform all 3 planned measurements on the scheduled dates;
- athletes who were injured during this period or did not complete the training period because they were transferred.

Parameters monitored during this period were: SMM, FFM, FM, BF%, BMC, TBW, BMR, BMI.

The athletes were examined during the first part of the day, without eating anything beforehand, all of them being dressed only in short shorts, which were quantified to 0.5 kg weight on the TANITA machine. Height was identified with a stadiometer, and subjects were unhooked and positioned to avoid errors during the process. Demo-graphic data such as gender and date of birth were submitted by each participant individually.

All body composition assessments were performed in the same room, with the same devices used initially, and the athletes did not perform any physical activity on the day until the measurements were taken.

Tools for data analysis

The following tools were used to analyze the data:

- Descriptive statistics which included mean, standard deviation, minimum and maximum, facilitating comparison of initial, intermediate and final parameters;
- Microsoft Excel, to process and and organize the data into tables;
- T-test, to determine statistical significance and differences were considered significant if $p < 0.05$.

Results

The results are presented in table form and are divided according to the analyzed periods.

Table 2 – Transition period T1–T2

| Parameters | Deviation T1 | Deviation T2 | Median | Median | Min | Max | Min | Max | T-Test |
|-----------------------------|--------------------|--------------------|--------|---------|-------|------|------|------|--------|
| | | | T1 | T2 | T1 | T1 | T2 | T2 | T1-T2 |
| SMM (kg) | 44,31 ± 4,49 | 43,76 ± 4,51 | 43,9 | 43,75 | 37,1 | 50,5 | 36,4 | 49,6 | 0,003 |
| FFM (kg) | 78,07 ± 7,99 | 77,57 ± 7,86 | 76,8 | 76,30 | 66,5 | 91,6 | 66,7 | 88,7 | 0,260 |
| FM (kg) | 15,3 ± 8,31 | 15,89 ± 8,11 | 15,35 | 15,20 | 3,5/2 | 26,9 | 4,6 | 27,7 | 0,134 |
| BF (%) | 14,82 ± 6,35 | 15,61 ± 5,89 | 15,45 | 16,10 | 4,8 | 23,9 | 6,1 | 24,6 | 0,031 |
| BMI (kg/m ²) | 26,11 ± 3,56 | 26,12 ± 3,45 | 26,25 | 26,05 | 21,5 | 30,9 | 21,9 | 30,9 | 0,928 |
| BMR (kcal) | 2453,9 ± 302,31 | 2422,2 ± 269,39 | 2385 | 2358,50 | 2026 | 2961 | 2036 | 2841 | 0,312 |
| TBW (kg) | 52,99 ± 5,26 | 52,67 ± 5,32 | 51,95 | 52,05 | 44,6 | 59,6 | 44,3 | 60,4 | 0,121 |
| BMC (kg) | 4,02 ± 0,39 | 4 ± 0,36 | 4 | 3,95 | 3,5 | 4,7 | 3,5 | 4,5 | 0,509 |

The results are expressed as mean ± standard deviation

Table 2 shows the impact of the transition period on body composition. During this period the SMM had a decreasing trend according to $p=0,003$, however 2 athletes showed increases or SMM remained unchanged. FM increased in 5 athletes, the rest showed decreases in FM; however, total fat percentage showed an increase in BF%, which was statistically significant. The other parameters monitored did not undergo

statistically significant changes, meaning that the transition period did not have a major impact on BMC, BMI, and the other parameters. This decrease in SMM and increase in BF% may be an adaptation due to a lower training volume, and the lifestyle that athletes have during the vacation period.

Table 3-Training period T2-T3

| Parameters | Deviation | Deviation | Median | Median | Min | Max | Min | Max | Test |
|--------------------------|--------------------|--------------------|--------|--------|------|------|------|------|---------|
| | T2 | T3 | T2 | T3 | T2 | T2 | T3 | T3 | T T2-T3 |
| SMM (kg) | 43,76 ± 4,51 | 44,73 ± 4,18 | 43,75 | 44,35 | 36,4 | 49,6 | 38,3 | 50,1 | 0,009 |
| FFM (kg) | 77,57 ± 7,86 | 78,45 ± 7,77 | 76,3 | 76,6 | 66,7 | 88,7 | 69 | 90 | 0,064 |
| FM (kg) | 15,89 ± 8,11 | 14,04 ± 7,19 | 15,2 | 14,35 | 4,6 | 27,7 | 2,2 | 23,4 | 0,004 |
| BF (%) | 15,61 ± 5,89 | 13,86 ± 5,77 | 16,1 | 14,95 | 6,1 | 24,6 | 3 | 21,2 | 0,002 |
| BMI (kg/m ²) | 26,12 ± 3,45 | 25,9 ± 3,13 | 26,05 | 25,75 | 21,9 | 30,9 | 21,9 | 30,2 | 0,137 |
| BMR (kcal) | 2422,2 ± 269,39 | 2459,7 ± 291,01 | 2358,5 | 2353,5 | 2036 | 2841 | 2096 | 2895 | 0,137 |
| TBW (kg) | 52,67 ± 5,32 | 53,25 ± 4,99 | 52,05 | 52,1 | 44,3 | 60,4 | 45,8 | 60,8 | 0,048 |
| BMC (kg) | 4 ± 0,36 | 4,03 ± 0,37 | 3,95 | 3,95 | 3,5 | 4,5 | 3,5 | 4,6 | 0,279 |

The results are expressed as mean ± standard deviation

The results obtained during the training period are shown in Table 3. During this period, i.e. between T2 and T3 which lasted 8 weeks, SMM increased in 8 out of 10 athletes, with an average of +0,72 kg skeletal muscle mass, being statistically significant according to p=0,009. In terms of fat mass, some athletes showed increases in FM, while others showed decreases in FM, and the average between T2-T3 showed a decrease in FM of -0,85 kg, which may indicate inadequate nutrient intake. FM decreased during this period being statistically significant p<0,05, signaling an improvement in body composition post training period. The other parameters analyzed did not show significant changes during this period, but small oscillations that cannot be compared individually. The results obtained over the entire training period show an expected increase in SMM and a decrease in FM induced by the significantly higher training volume and intensity during this period.

Table 4-Statistical results over the analyzed period T1-T3

| Parameters | Deviation | Deviation | Median | Median | Min | Max | Min | Max | Test T |
|-----------------------------|--------------------|--------------------|--------|--------|------|------|------|------|--------|
| | T1 | T3 | T1 | T3 | T1 | T1 | T3 | T3 | T1-T3 |
| SMM (kg) | 44,31 ± 4,49 | 44,73 ± 4,18 | 43,9 | 44,35 | 37,1 | 50,5 | 38,3 | 50,1 | 0,116 |
| FFM (kg) | 78,07 ± 7,99 | 78,45 ± 7,77 | 76,8 | 76,6 | 66,5 | 91,6 | 69 | 90 | 0,566 |
| FM (kg) | 15,3 ± 8,31 | 14,04 ± 7,19 | 15,35 | 14,35 | 3,5 | 26,9 | 2,2 | 23,4 | 0,059 |
| BF (%) | 14,82 ± 6,35 | 13,86 ± 5,77 | 15,45 | 14,95 | 4,8 | 23,9 | 3 | 21,2 | 0,102 |
| BMI (kg/m ²) | 26,11 ± 3,56 | 25,9 ± 3,13 | 16,25 | 25,75 | 21,5 | 30,9 | 21,9 | 30,2 | 0,357 |
| BMR (kcal) | 2453,9 ± 302,31 | 2459,7 ± 291,01 | 2385 | 2353,5 | 2026 | 2961 | 2096 | 2895 | 0,789 |
| TBW (kg) | 52,99 ± 5,26 | 53,25 ± 4,99 | 51,95 | 52,1 | 44,6 | 59,6 | 45,8 | 60,8 | 0,401 |
| BMC (kg) | 4,02 ± 0,39 | 4,03 ± 0,37 | 4 | 3,95 | 3,5 | 4,7 | 3,5 | 4,6 | 0,811 |

The results are expressed as mean ± standard deviation

The impact of the whole analyzed period, i.e. from T1 to T3, which includes both the transition period and the training period, is different compared to our expectations, because the body composition did not undergo significant changes, but on the contrary some athletes did not reach the shape they had at the end of the previous competitive year. According to the statistical data applied on the period T1-T3 we show a difference between the SMM averages of +0,42 and a loss of -1,26 kg of FM, with a insignificant t-test in both cases in agreement with Table 4. Analyzing the data individually we observed an improvement in FM in 8 athletes and an increase in SMM in 6 athletes. The statistical tests applied in T1-T3 were not statistically significant, meaning that, the athletes did not improve their body composition or only some of them showed a better shape than the initial one. Most of the athletes who improved their SMM during the above mentioned period showed increases in BMI, an improvement in BMC, an increase in BMR and an improvement in TBW, respectively. Athletes who did not improve their initial SMM showed decreases in BMC, BMR, BMI and TBW.

Discussions

The transition period and the preparation period have a significant impact on the body composition of competitive handball players. The transition period lasted ap-proximately 6 weeks, during which the athletes followed an active rest program,

re-sulting in a decrease in SMM and an increase in BF%, which was statistically significant according to $p < 0,05$. The training period lasted approximately 8 weeks, during which the athletes followed a rigorous training program, resulting in an increase in SMM and a decrease in BF%, which were statistically significant. The body composition recorded at the beginning of the transition period T1 did not improve by the end of the training period T3, although SMM increased considerably and FM decreased during the training period. The losses recorded during the transition period had a high impact on the parameters evaluated and did not significantly alter the final results.

Body composition is closely related to physical performance in handball, and dynamometer and jump tests performed within a team suggest a positive relationship between muscle mass and athlete performance [23]. Furthermore, athletes with ectomorphic profiles had negative effects on certain physical parameters [24]. These findings support maintaining optimal body composition to promote performance in handball.

There are few studies in the literature conducted on competitive handball players that have monitored the impact of the transition period; however, some research highlights a trend similar to the results obtained in this study. The breaks caused by the COVID-19 pandemic led to an increase in fat mass and a decrease in sprint capacity and VO₂ max, followed by a decrease in the vertical jump test in some competitive athletes [25]. Other data obtained from different sports, such as soccer, report a decrease in SMM and an increase in FM during the transition period [26,27]. Contradictory data are highlighted in a study conducted on 24 soccer players in Brazil, where changes in muscle strength, jumping ability, and sprint speed were monitored during a 4-week break from training. They were encouraged to engage in light to moderate physical activity (walking, jogging) and were given a specially designed nutritional plan to maintain their individual body composition. After the final measurements, no significant changes in strength and speed were recorded, and surprisingly, jumping performance was substantially improved. The authors argue that a rest period of less than four weeks can have positive effects on neuromechanical capacity [28]. However, it should be noted that the group included in the analysis was much younger than in the studies mentioned above. The results obtained in our study are consistent with the studies mentioned above [25,26,27]. Although FM did not increase in all players during this period, which was a positive aspect observed in some of the athletes, SMM showed statistically significant decreases. A plausible explanation for these discrepancies could be the different lifestyles adopted by individual athletes, as well as the low volume and intensity of training during this period.

Five weeks of training with two Polish handball teams resulted in a decrease in FM and an increase in SMM, which is consistent with the results obtained in this study, although the training period was much shorter [29]. Other results reported a

decrease in FM during the training period, but the other parameters monitored remained un-changed; the increase in FM continued throughout the competitive year and was attributed to different training content, intensity, eating habits, and the effects of fatigue and stress [30]. The effects of an 8-week training period for the Danish national hand-ball team prior to an Olympic tournament suggest positive changes in body composition and performance. Following the training period, total body mass and FFM increased significantly, BF% decreased, and strength tests showed an upward trend [31]. Other studies in handball, soccer, and rugby support a decrease in FM and an increase in FFM or SMM during the training period [32,33]. These changes are due to an increase in the volume and intensity of training, which is a period of muscle mass accumulation and maximization of physiological and motor parameters. Although the athletes changed their body composition between T1 and T3, BMI did not change significantly at any stage of analysis. This suggests the limitations of this measurement and its reduced applicability in sports, as has been suggested in other studies [34,35,36].

The types of training applied have different impacts on body composition, so it has been observed that classic training does not offer significant changes in body composition compared to high-intensity training [18]. This suggests that the types and modes of training influence body composition.

Seasonal changes in body composition during the competitive period report a maintenance of lean mass and an increase in fat mass in the latter part of the season [37]. In contrast, in a study by Staśkiewicz W and colleagues, lean mass decreased and fat mass increased compared to the end of the training period [38]. The lean mass lost during a competitive year was not regained during the off-season, which included the transition and training periods, according to another study [39]. Other data suggest a steady decrease in fat mass during this period, but it should be noted that the group included junior football players, which may be different from senior players [40]. Changes in body composition in handball are not significant during a competitive season, according to another article. The data recorded at the end of this period suggest a redistribution of body mass, such that: muscle mass in the upper and lower limbs increases significantly and the total percentage of body fat remains unchanged. These changes are closely related to the playing position [41]. These studies describe the variability of body composition during a competitive season, where an increase in fat mass and conflicting opinions on lean mass are observed. Although we did not analyze body composition during the competitive period and cannot draw conclusions about this period, other authors have noted an inefficiency of the off-season compared to the competitive season, and this inefficiency in the off-season in terms of body composition was also observed in our study, but only for a limited period, as it was not correlated with the changes that occurred throughout the season.

Athletes who have experienced significant muscle mass loss during the transition period and those who have not sufficiently increased their SMM during the

training period require a detailed analysis of the factors involved in producing these results in order to create more effective long-term management. Lifestyle factors such as balanced nutrition, quality sleep, appropriate behavioral habits, stress levels, and others play an important role in the life of an athlete, influencing body composition. As discussed in other studies, food choices appropriate to the period in which the athlete finds themselves and high nutritional knowledge make a difference in promoting a body composition conducive to performance throughout the calendar year [42,43,44,45]. The results obtained in this study may be the consequence of an unbalanced lifestyle or poor management of transition and training periods.

The strengths of this paper are: the methodology for performing the three measurements, which emphasized compliance with the initial instructions, which stated that athletes should not eat or train on the day of the assessment, and that the start time and location of the assessments should be similar; the accuracy of the objective measurements taken using Tanita bioimpedance, which differentiates skeletal muscle mass (SMM), compared to the classic measurements taken using skinfold calipers, which calculate an average lean mass that also takes into account other irrelevant structures of total body mass; the inclusion of two distinct periods in the research, namely the transition period and the preparation period, in order to quantify the changes induced by the sports break and the impact of the preparation period, facilitating an analysis of the parameters over time;

The limitations of this study are: the small number of athletes included in the study, which makes it difficult to generalize the results obtained; the failure to identify eating habits and observe lifestyle throughout the entire period analyzed, making it impossible to accurately correlate the data with other external factors that influence body composition; the lack of an analysis of athletic performance and the impact of body composition on physical parameters such as strength, speed, and endurance.

Based on the results obtained, future studies should include larger groups of subjects and correlate both internal and external factors, such as genetics, lifestyle, balanced nutrition, and others, which may have effects on body composition. At the same time, it is important to mention the need to monitor athletes throughout an entire competitive year to observe the impact of off-seasons and competitive seasons on body composition. These assessments could provide valuable information to sports coaches, physical trainers, and team physiotherapists, contributing to better prevention and promoting long-term performance in handball.

Conclusions

The body composition of performance handball players changed during the transition and training periods, and two out of the three hypotheses we proposed were confirmed.

During the transition period, the athletes experienced a decrease in SMM and an increase in BF, representing the body's adaptation to a proportionally lower

training load. The training period led to a decrease in BF and an increase in SMM, suggesting a positive physiological response to the applied muscular stimuli, thus validating the first two hypotheses.

The impact of the entire analyzed period was favorable only for some athletes, as only a part of them improved their initial body composition. Moreover, the statistical tests applied were not significant, indicating a distorted general trend, most likely influenced by external factors.

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