PECULIARITIES OF DETERTRAINING OF 17–18 YEARS OLD HANDBALL PLAYERS AFTER 7 WEEKS OF LOW INTENSITY AND 10 WEEKS OF PASSIVE REST

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SUMMARY

The purpose of this study was to determine peculiarities of detraining of 17–18 years old handball players after different activities during 17 weeks. One alternative experiment was applied. Subjects: 15 handball players of 17–18 years old from Olympic Sport Centre of Lithuania were observed (height 188.1±6.5; weight 84.6±17.8; BMI 23.3±1.2). Sport performance level of subjects was tested before experiment – after the main competitive season (on April), after 7 weeks low intensity trainings – before the transition period (on June), and after 10 weeks of passive rest – at the end of transition period (on August). After the finishing of the main competitive period, handball players had trainings for 7 weeks. There were 3–4 trainings per week. The training consisted of low intensity of endurance training, and the other sports games. They played several friendly handball matches. During the transition period players passively rested for 10 weeks (at the same time as student’s holiday). Physical and technical fitness was tested. During the last 7 weeks of competitive period were determined the significant decrease of aerobic endurance, speed-strength and strength-speed (p<0.05), but the technical indices remained the same or some of them slightly increased. An activity of specific training programme was the reason of unchanged technical fitness. During 10 weeks of transition period athletic and technical fitness decreased. 10 weeks of passive rest during transition period had the greatest influence on the changes on technical fitness of handball players aged 17-18 years while changes in physical fitness were of contradictory nature. Passive rest of 10 weeks had greater influence on decreasing of specific fitness of handball players. 7 weeks of competitive period with training programme of lower intensity helped to maintain technical fitness but not athletic of 17–18 years old handball players. The passive rest of 10 weeks had negative influence to detraining of 17–18 years old handball players and especially to technical and athletic fitness. Interaction between indices of technical and physical fitness before experiment after 7 weeks of low intensity of physical loads and after 10 weeks of passive rest were different. These findings allow to make statement that detraining of different indices of 17–18 aged handball athletes is dynamically individual. The changing of indices of some clusters not have any regularity and uniformity of changing indices of further clusters (Drinkwater, Horvath, 1972; Skarbalius, 2003; Skarbalius, Austrauskas, 2001; Svedenhag, 1992).

Keywords: detraining, handball, sport performance.

Influence of body buoyancy on the results achieved by children training swimming

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Summary

Research of buoyancy, or the body's ability to stay afloat by use of buoyant force, has been the subject of numerous theoretical and practical studies (Bartkowiak, Bogajewski and Czabanski). The researchers have pointed to the importance of buoyancy at sport swimmers. They have all agreed that, in the same conditions, swimmers with better buoyancy learn better and faster swimming techniques enabling them to swim faster and with a smaller energy loss, technique which is more effective and more efficient. A swimmer does not need to waste energy to overcome gravity and therefore is able to use energy to develop propulsion force. Moreover, a higher position of the body effectively reduces the front drag. Both these dependencies have a direct effect on increasing swimming velocity, thus enabling swimmers to perform better.

Buoyancy depends on body density, which in turn is determined by such factors as vital lung capacity, limbs positioning, and the sum of particular human body components.

This paper aims at addressing the question, whether a high level of buoyancy enables four graders to perform better at sport swimming. It seems that with 11-year-old children this factor has a significant impact on the results achieved as children may compensate the lack of such skills as speed, strength and stamina, which are necessary to achieve those results, with...
better buoyancy level. The authors have also focused on changes that swimmers undergo in the first three years of training. The following hypotheses have been put forward:

1. Better buoyancy in swimmers of 11 years of age enables them to achieve better sports performance.

2. The body density in children of 11, 12 and 13 years of age who train swimming does not change despite exercises performed during trainings which may reduce the volume of fat tissue, and which could therefore increase the body density.

The research was carried out in December 2001 and in November 2004 in Wroclaw. 13 girls and 24 boys were the subject of the test, all of whom were 11-years of age, 9 girls and 9 boys who were 12 years old, and 13 girls and 15 boys who were 13 years old at the time. All of them attend one of the primary schools in Wroclaw. The children train 6 times a week in the fourth grade, eight times a week in the fifth grade, and nine times a week in the sixth grade.

The main assumption behind choosing swimmers at the age of 11 was the fact that the children, after having trained for three years, do not yet have a well developed fat tissue and sufficient (achieved in the course of training) level of such features as strength and stamina which affect sports performance. These children may compensate the lack of these features with somatic predispositions, in particular the volume of fat tissue in their organisms, which allows them to position their bodies higher in the water. As it has already been mentioned, this reduces the front drag and allows young swimmers to use more economically energy needed to overcome gravity and to stay afloat, together with generating the propulsion force. 12 and 13-year-old children were not tested for the correlation between buoyancy and performance as it was concluded that the swimmers of this age have already achieved the high level of skills such as speed, strength and stamina which determine the final sport result. Children of 12 and 13 years of age were tested to measure their body density. This age group was selected as we wanted to check changes in the body density of swimmers that take place during the course of two years of sport swimming.

Spectrophometry method was used to measure the body using the Futrex-6100 analyser, and vital lung capacity was measured by K4® produced by Cosmed. The data was used to calculate body density. To estimate buoyancy the following dependency was used: the lower the body density the better its buoyancy. The results achieved at 50 meters covered by swimmers using different strokes reflected the sports level of the swimmers. These results were then calculated into points according to Swimmers Tables.

As a result of calculations of the correlations between the sport performance of 11-year-old children swimmers and their body density and buoyancy, a small but significant correlation was found amounting to 0.29959. This means that the body composition and its density can translate into buoyancy and can have an influence on sport performance. In modern swimming this has a tremendous impact as only a fraction of a second may be of utmost importance.

In the case of 11, 12 and 13 year-old girls who train swimming, the body density remained stable in the course of the first year of the swimming training cycle. On the other hand, in the case of boys of the same age group the level of the body density changed; first it decreased and then, after the second year of the swimming training cycle, it increased.

Keywords: swimming, buoyancy, sport result.

Introduction

Research of buoyancy, or the body’s ability to stay afloat by use of buoyancy force, has been the subject of numerous theoretical and practical studies [Bartkowiak, Bogajewski and Czabański, Filon, Lowenstein]. The researchers have pointed at the importance of sport swimmers’ buoyancy. They have all agreed that, in the same conditions, swimmers with better buoyancy learn better and faster swimming techniques enabling them to swim faster and with a smaller energy loss, using technique which is more effective and more efficient. This way a swimmer does not need to waste energy to overcome gravity and therefore is able to use the energy to develop propulsion force. Moreover, a higher position of the body effectively reduces front drag (Bartkowiak, 1999). Both these dependencies have a direct effect on increasing swimming velocity, thus enable swimmers to perform better.

Human body may sink, resurface or resume the state of balance when the liquid’s surface cuts through the body. Body is floating on the surface when the body’s density (δ), or the ratio between the body weight and its volume, will be lower than the density of water (δw).

\[ \delta \text{ body density} < \delta \text{ water density} \]

The bigger the difference in this ratio, the better the buoyancy (Czabański, Filon, 1994).

As it has already been mentioned, body’s buoyancy depends on density which will change with the development of skeleton, muscle tissue and fat tissue. Human body is made of components of unequal density: muscle density is 1.04-1.05g/cm³, bone density – 1.7-1.9g/cm³ and fat density – 0.92-0.94g/cm³.

The average density of the human body will thus be the sum of its components:

\[ \delta_{\text{human body}} = \frac{m_{\text{bone}} \delta_{\text{bone}} + m_{\text{muscle}} \delta_{\text{muscle}} + m_{\text{fat}} \delta_{\text{fat}} + m_{\text{lungcap}} \delta_{\text{lungcap}}}{M} \]

The average body density is increased by bones and muscles; it is decreased by fat tissue. Witkowski states that the body’s density oscillates between 0.97 and 1.06g/cm³ (Witkowski, 1977).

Vital lung capacity has a significant influence on body’s density, our breath intake and exhalation.
During the breath intake the breast surface increases along with the amount of air in our lungs, therefore the average body density decreases so that the body may stay afloat. When we exhale, breast volume decreases together with the decrease in body density (Czabański, 1974). Therefore it is desirable to coordinate the breathing cycle so that the average air volume would be as big as possible (Bogajewski et al., 1975).

Swimmers’ average body density may change depending on positioning of their arms. It increases when the arms are above the surface of water, it decreases when they are in water. Density changes also as a result of variation in the ratio of particular body components. Different body tissues have different densities. Our breast density is relatively low (together with lungs), whereas arms and legs have the highest density, particularly forearms and hands, lower thighs and feet. This is due to the high volume of muscle and bone mass; fat tissue has low density (Bogajewski et al., 1975).

Children and adolescents generally have good buoyancy which decreases together with ontogenetic development. Better buoyancy in children is probably the factor which helps them learn to swim better than it is in the case of adults. Women generally feature lower body density due to better developed fat tissue, therefore they find it easy to stay afloat. On the other hand men who have a well developed muscle mass as a significant percentage of the body mass may find this difficult (Czabański, 1974).

This paper aims at addressing the question, whether a high level of buoyancy enables four graders to perform better at sport swimming. It seems that with 11-year-old children this factor has a significant impact on the results achieved as children may compensate the lack of such skills as speed, strength and stamina, which are necessary to achieve those results, with better buoyancy level. The authors have also focused on changes that swimmers undergo in the first three years of training. The following hypotheses have been put forward:

1. Better buoyancy in swimmers of 11 years of age enables them to achieve better sports performance.
2. The body density in children of 11, 12 and 13 years of age who train swimming does not change despite exercises performed during trainings which may reduce the volume of fat tissue, and which could therefore increase the body density.

**Materials and the method of the study**

The research was carried out in December 2001 and in November 2004 in Wroclaw. 13 girls and 24 boys were the subject of the test, all of whom were 11-years of age, 9 girls and 9 boys who were 12 years old, and 13 girls and 15 boys who were 13 years old at the time. All of them frequent one of the primary schools in Wroclaw. The children train 6 times a week in the fourth grade, eight times a week in the fifth grade, and nine times a week in the sixth grade.

The main assumption behind choosing swimmers at the age of 11 was the fact that the children, after having trained for three years, do not yet have a well developed fat tissue and sufficient (achieved in the course of training) level of such features as strength and stamina which affect sports performance. These children may compensate the lack of these features with somatic predispositions, in particular the volume of fat tissue in their organisms, which allows them to position their bodies higher in the water. As it has already been mentioned, this reduces the front drag and allows young swimmers to use more economically energy needed to overcome gravity and to stay afloat, together with generating the propulsion force, 12 and 13-year-old children were not tested for the correlation between buoyancy and performance as it was concluded that the swimmers of this age have already achieved the high level of skills such as speed, strength and stamina which determine the final sport result.

Performance achieved in swimming butterfly, backstroke, breaststroke and freestyle on a 50 metres pool was the result of the sport achievement of the 11-year-old children. These were the results achieved during the competition organized in line with the rules of the Polish Swimming Association (PZP, 1998). In order to achieve the swimming results that would be measurable according to one consistent pattern, the results achieved on particular distances were then calculated against the Swimmers Points Table (LEN, 2001-2004). This is an objective assessment of the level that the swimmer represents, which compares the abilities of men and women for all styles and distances.

Children of 12 and 13 years of age were tested to measure their body density. This age group was selected as we wanted to check changes in the body density of swimmers that take place during the course of two years of sport swimming. The authors were considering whether the training in the water environment, with its specific chemical and physical characteristics, will affect the change in the body density.
composition, and therefore its density. The water temperature was accounted for, as well as higher thermal conductivity which, being 28 times more intensive than air thermal conductivity, causes much faster body temperature loss. The thickness of the fat tissue is of the utmost significance for keeping the stable temperature of the body submerged in the water. It was assumed then that, in order to avoid hypothermia at long training cycles in the water, the volume of fat will not change or will change insignificantly in the course of the training.

The following research used the modern methods of assessing the body composition. The research was done with the use of spectrophotometry with the Futrex – 6100 analyser. The testing was carried out with the subjects in the sitting position. At this stage the optical gauge was placed to the biceps. The device was equipped with the cover protecting from the external radiation. All the children from all age groups were subjected to this test.

The vital lung capacity measurement was carried out with the use of K4b² device made by Cosmed. The children were asked to stand with their arms down alongside the body and to breath steadily, after which a deep breath was taken. Using this data 26% of maximum vital lung capacity was calculated and the amount of remaining air in the lungs. This is the capacity which remains in the lungs even after the deepest exhalation. „One can say that the air remaining in lungs is the air which can not be replaced even in the phase of the biggest breathing cycle”. (Lewiński, 1996).

During the testing also other selected features of the body were measured, such as height and body mass. All the data were used in the equation and the body density was calculated.

\[ \delta_{\text{human body}} = \frac{m_\text{bone} + m_\text{muscle} + m_\text{fat} + m_\text{lungcap}}{M} \]

As the data received during the tests resulted in the calculation of the lean body mass, which includes the bone mass, muscle mass and internal organs mass whose density given by Wieliński is around 1,1 g/cm³, the equation was transformed to correspond to those results. It is as follows:

\[ \delta_{\text{human body}} = \frac{m_\text{Leanbodymass} + m_\text{fat} + m_\text{lungcap}}{M} \]

The following correlation was used to calculate the buoyancy level: the lower the body density the better its buoyancy.

Results

On the basis of the data mean arithmetical body density was calculated in children of 11, 12 and 13 years of age, all of whom train sport swimming.

![Body density](image)

1 – 11 year of age  
2 – 12 years of age  
3 – 13 years of age

Fig 1. Change in body density in girls of 11, 12, 13 years of age who train swimming

As it can be seen on the above diagram, the body density of girls in the course of the first year of training is slightly lower than later. In the course of the two following years the body density increases and remains at the stable level, despite using intensive exercises in the training cycle.

The situation is slightly different with boys. As can be seen on diagram 2, boys in the course of the first year of training have the body density slightly decreased, whereas in the course of the second year of training it is substantially bigger. Such an outcome may result from the fact that the insufficient number of boys of this age were tested, or the fact that such particular boys were in the class. It is surprising, however, that boys of 12 years of age have the body density lower than girls of the same age. This hypothesis requires further verification.

![Body density](image)

1 – 11 year of age  
2 – 12 years of age  
3 – 13 years of age

Fig 2. Change in body density in boys of 11, 12, 13 years of age who train swimming
As a result of calculations of the correlations among the sport performance of 11-year-old children swimmers and their body density and buoyancy, a small but significant correlation was found amounting to 0.29959. Significant correlation is at the level of 0.05. This means that the body composition and its density can translate into buoyancy and can have an influence on sport performance. In modern swimming this has a tremendous impact as only a fraction of a second may be of utmost importance.

Similar correlations in 12 and 13-year-old swimmers do not show significant dependencies, however to verify this hypothesis further research will be done.

Discussion

On the basis of the results analysis of the research on buoyancy one can assume that buoyancy has an influence on swimming performance. As it has been already shown this correlation is not big, it has however an influence on performance achieved. In modern swimming, highly competitive and measured in fractions of a second, each factor potentially contributing to the final success should be considered, tested and used in the training stage.

Authors who have dealt with the problem in the past based their calculations on measuring the correlation between sport performance and the body mass (Drozdowski, 1960). Drozdowski calculated the average correlation between these two factors. Comparing the above research results would not be reliable as the author based his assumptions on measuring the body density, assuming that the higher the body density the lower the buoyancy (Czabański, Filon, 1994). The authors of this paper do not aim at proving that buoyancy is the only determinant influencing performance, but rather that it has a significant influence on the performance. By positioning the body high in the water the front drag is decreased and the swimmer’s energy can be used to propel the body forward and to gain speed, and to a lesser extent to keep the body afloat.

It is clear that better buoyancy level allows learning swimming techniques faster and more effectively. Buoyancy should be taken into account as one of the factors at selecting the training methods, especially in the first years of the process. Better buoyancy facilitates learning swimming techniques and breathing conditions.

In a series of experiments Moritz Salder proved that swimming training decreases the body density. Therefore through systematic training in water body buoyancy increases which enables swimmers to position the body higher in the water and to waste less energy on movements aiming at keeping the body afloat (Bogajewski et al., 1975). Other authors have presented the results achieved by Onoprijeno and Bartoszczuk who stated that the swimmer’s body density depends on the sports level. According to those authors, swimmers representing master class in sports possessed the average value of the body density which was decreasing steadily as the swimmers achieved next master class (Witkowski, 1977). In the course of the research the body density in girls increased at first and then remained stable. In the case of boys, the final body density level decreased.

Conclusions

1. Small but statistically significant correlation was established between buoyancy and sports performance in 11-year-old swimmers.
2. In the case of 11, 12 and 13 year-old girls who train swimming, the body density remained stable in the course of the first year of the swimming training cycle. On the other hand, in the case of boys of the same age group the level of the body density changed; first it decreased and then, after the second year of the swimming training cycle, it increased.

REFERENCES

KŪNO PLÛDRUMO ĮTAKA VAIKŲ, KULTIVUOJANČIŲ PLAUKIMĄ, REZULTATAMS

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SANTRAUKA


Plûdrumas priklauso nuo kûno tankio, kurá savo ruoþtu nulemia tokie veiksniai kaip gyvybinë plauèiø talpa, galûniø padëtis ir tam tikrø þmogaus kûno kom- ponentø suma.

Darbo tikslas – atsakyti á klausimà, ar didelis plûd- rumas susijæs su geresniais ketvirtos klasës mokiniø plaukimo rezultatais. Atrodo, kad 11-meèiams vaikams šis gebëjimas turi reikšmingà poveiká rezultatams, kadangi vaikai geresniu plûdrumu gali kompensuoti greièio, jëgos ir ištvermës trûkumà. Autoriai taip pat skyrë dëmesio pokyèiams, kuriuos plaukikai patiria per pirmus trejus treniravimosi metus. Buvo iškeltos tokios hipotezës:

1. Geresnis 11-meèiø plaukikø plûdrumas  leidþia jiems pasiekti geresniø sportiniø rezultatø.
2. 11, 12 ir 13 metø amþiaus vaikø, kultivuojanèiø plaukimà, kûno tankis nekinta, nepaisant per pratybas atliekamø pratimø, kurie gali sumaþinti riebalinio au- dinio apimtà ir taip padidinti kûno tanká.

T yrëmai atlikti 2001 m. gruodþio mën. ir 2004 m. lapkrièio mën. Vroclave. T yrime dalyvavo 13 mergaièiø ir 24 berniukai (11 metø amþiaus), 9 mergaitës ir 9 berniukai (12 metø) bei 13 mergaièiø ir 15 berniukø, kurie tuo metu buvo 13 metø amþiaus. Visi jie lankë vienà iš Vroclavo pradiniø mokyklø. V aikai treniravosi 6 kartus per savaitæ ketvirtoje klasëje, 8 kartus per savaitæ penktoje klasëje ir 9 kartus per savaitæ šeštoje klasëje.

Pagrindinë prieþastis, dël kurios buvo pasirinkti

vienuolikmeèiai plaukikai, buvo ta, kad vaikai, treni- raveþi trejus metus, dar neturëjo gerai susiformavusio riebalinio audinio ir pakankamai išugdytø tokii ypa- tybiø kaip jëga ir ištvermë, kurios veikia sportinius rezultatus. Šie vaikai minëtøjø ypatybiø trûkumà gali kompensuoti somatinëmis organizmo savybëmis, konkretiai – riebalinio audinio kiekiu, kas leidþia jì kûnams aukûciau laikytis vendenyje. Kaip jau buvo minëtò, taì sumaþina vandens pasipriešinimà ir leidþia jauniems plaukikams ekonomiškiau naudoti energijà, reikalingà áveikiant sunkio jëgà. 12 ir 13 metø amþiaus vaikø koreliacija tarp plûdrumo ir rezultatø nebuvo tirta, nes buvo nuspræsta, jog tokio amþiaus plaukikai jau bûna gerai išsugë tokias ypatybes kaip greitis, jëga ir ištvermë, nulemiančias sportinius rezultatus. 12- meèiø ir 13-meèiø buvo tiriama tik kûno tankis. Ši amþiaus grupë buvo pasirinkta nutarus stebëti plaukikų kûno tankio pokyèius, vykstanèius per dvejus plaukimo treniruoðtiø metus.


Nustatyta, kad tarp 11-meèiø plaukikø plauki- mo rezultatø ir jës kûno plûdrumo yra nedidelë, bet reikëminga koreliacija (0,2959). Tai rodo, kad kûno struktûra ir jo tankis gali turëti átakos sportiniams rezultatams. Šiuolaikiniaiû plaukime, kai svarbi kiekviena þimto sekundës dalis, tai turi didþiulæ reikšmæ.

11, 12 ir 13 metø amþiaus meèiø plaukikø kûno tankis per pirmuosius treniravimosi metus liko stabulis. Kita vertus, tos paèios amþiaus grupës berniuko kûno tankis kito: pirmiausia sumaþëjo, o paskui, po antrøjø treniravimosi metø, padidëjo.

Raktaþodþiai: plaukimas, plûdrumas, sportiniai rezultatai.