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Effect of intensive karate kyokushinkay exercise on body water content

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ABSTRACT

An intensive combat sports practice affects body water content. Changes in total body water (TBW), extracellular body water (ECW) and intracellular body water (ICW) affect power output and forearm maximum strength. Unfortunately, the effect of intensive karate kyokushinkay training with full contact fighting on body composition has not been documented. The purpose of the study was to analyze the effect of intensive karate kyokushinkay training with full contact fighting on body water distribution in healthy volunteers.

PARTICIPANTS AND METHODS

Thirty healthy volunteers train karate kyokushinkay minimum three times per week were examined. All of them trained karate regularly for minimum 10 years. Fluid volume excess, TBW, ECW, and ICW were measured by whole-body BIA using the Body Composition Monitor just before and after training.

RESULTS

Twenty-seven male and 3 female (aged 22 – 45, mean 29 ± 11) were studied. TBW and ECW decreased just after training completion, whereas ICW and volume excess were practically unchanged. Changes in TBW correlated with age of participants.

CONCLUSION

Intensive karate training with full contact fighting reduces body water, especially from extracellular space.

KEY WORDS: karate kyokushinkay, bioimpedance, total body water, extracellular body water, intracellular body water.

Changes in body fluid content have been extensively studied for the last years in the sportsmen [1-3]. Some studies have documented significant changes in body water content whereas others have been not confirmed such disturbances [3-6]. Significant reduction in intracellular water content (ICW) was presented in elite judo athletes after maximal forearm strength [3]. Contrarily, swimming effort does not affect the body composition parameters [1].

Total body water (TBW) is distributed into two body spaces: extracellular and intracellular. Bioimpedance measures whole body water by analysis of body impedance, resistance, reactance, and capacitance using an electrical transmission with different frequencies [7,8]. Total body water is a sum of two compartments: the extracellular water (ECW) and intracellular water (ICW). However, whole bioimpedance analyses the bioelectrical properties between the ankle and the wrist on the same side of the body under the assumption of steady water distribution. This measurement summarizes an analysis of water content in three electrical independent segments with different lengths and areas such as the leg, the trunk, and the arm. All these segments contribute in overall whole-body bioimpedance and any disorders in one of these segments may affect final result [9]. This fact may have important implication in clinical practice, however, it has negligible in healthy volunteers.

Significant disorders in body water content may affect metabolic function in sportsmen. Recent studies have documented a significant decline of muscle power and strength following reduction of ICW [4,5]. Noteworthy, a lot of sportsmen prefer to use different dehydration medicaments instead of intensive training before competition to achieve a target body weight [10-12]. It has been documented, that an intensive judo training reduces ICW [2,4,5]. The judo fighting is connected with lower risk for injury than karate kyokushinkay or boxing, which are full contact sport. A lot of blows and hacks create a risk for bruises and can affect whole body composition.

The aim of this study was to analyze the effect of intensive karate kyokushinkay training with full contact fighting on body water distribution in healthy volunteers.

PARTICIPANTS AND METHODS:

This study was conducted in accordance with the Declaration of Helsinki; the protocol was approved by the Institutional Review Board and the Bioethics Committee of Medical University at Lublin, Poland (KE-0254/58/2010). Informed consent was obtained from all volunteers. Thirty healthy volunteers train karate kyokushinkay minimum three times per week were examined. All of them trained karate regularly for minimum 10 years.

Bioimpedance measurement

Fluid volume excess, TBW, ECW, and ICW were measured by whole-body BIA using the Body Composition Monitor (BCM, Fresenius Medical Care, Bad Homburg, Germany). Prior to examinations, patients` weight and body mass were measured. Electrode pairs were placed on the wrist (proximally to the metacarpophalangeal joint) and the ankle (proximally to the transverse metatarsal arch on the superior side of the foot) for current injection and voltage measurement. Bioimpedance was measured at 50 frequencies ranging from 5 kHz to 1 MHz in supine body position. All participants were weighted just before and just after karate training. Volume excess, TBW, ECW, and ICW were measured before and after training. None of the participants drank during training.

Training protocol

Training was divided into three part. Firstly, intensive warming-up exercises such as 50 press-ups, 50 sit-ups, and fast run were performed for 30 min. Next, participants exercised different karate techniques for 40 min and sparring match was exercising during the last 20 min of training. All volunteers had sweaty kimono after training.

Statistics

Means and standard deviations (SD) were calculated for all variables. Student's unpaired t-test was used, and analysis was performed using Statistica 13.1. The power of the statistical tests was assessed by the G*Power test. A $p < 0.05$ was considered significant.

RESULTS

Twenty-seven male and 3 female (aged 22 – 45, mean 29 ± 11) were studied. The mean body weight before training was 78.57 ± 13,33 kg and decreased to 77.55 ± 13.11 kg after physical activity. Physical activity did not affect VE and ICW, which median values were 0.41 ± 0.89 L and 26.79 ± 0.86 L, and 24.28 ± 2.66 L and 24.29 ± 3.01 L, before and after the karate training, respectively. An intensive karate training significantly decreased TBW and ECW (figure 1 and 2, respectively). A decrease in TBW correlated with age ($r = 0.4$, $p < 0.01$).

DISCUSSION

Changes in body water content have been not documented in sportsmen, who have trained karate kyokushinkay regularly for minimum 10 years. This study has documented that intensive training decreased TBW and ECW, whereas VE and ICW were practically unchangeable following physical activity.

The whole body bioimpedance is a sensitive method to assess body water composition in healthy subjects, athletes, obese or overweight people and patients with kidney injury treated with hemodialysis [7-9,13-15]. The problem with the whole-body bioimpedance measurement is the bioelectrical properties between the wrist and ankle under the assumption of steady fluid distribution throughout the whole body [16,17]. The credibility of bioimpedance findings depends on body position and daytime. During orthostatic position, extracellular fluid shifts from the upper to the lower limbs and its transposition is dependent on orthostatic duration and physical activity [18,19]. The rapid translocation of the blood volume to the vessels in the lower increases intravascular pressure in the lower limb vessels leading to higher water shift than in the upper limbs. Additionally, the increase in blood venous pressure in the lower limb causes a change in the Starling equilibrium increasing capillary pressure and the hydrostatic gradient for fluid filtration. The daily variability in bioimpedance in healthy participants ranges of 0.3% to 0.7% and is approximately twice as large as daily water balance variability [20]. Type of physical activity also affects bioimpedance findings. Static sports, such as weightlifting, increase muscle mass leading to higher muscle water content than dynamic sports [21,22]. Reversely, karate kyokushinkay is very dynamic sports and the changes in body water content seem to be similar to others type of combat sports.

Changes in body water composition have been described in highly trained volleyball, basketball, handball and simmers [3]. Swimming does not affect body water composition, whereas judo or [4-6, 23-25]. Interestingly, it has been documented that air temperature plays a crucial role in water loss during exercise reducing the credibility of whole bioimpedance [24]. In the present study, all participants trained in room temperature, and we can assume that this temperature did not affect bioimpedance findings.

Our finding is in contrast with Silva and co-workers study [5]. In our study, kyokushinkay training caused a decrease in TBW and ECW whereas Silva and co-workers presented a reduction in TBW and ICW in elite judo athletes. They also reported a clear relationship between changes in ICW and power output and forearm maximum strength. Athletes, who lost ≥ 2% of forearm maximum strength showed a reduction of 2.7% in TBW, 4.5% of ICW and 0.3% of ECW. However, they studied body composition before competition in volunteers, who had practiced judo ≤ 5 years, whereas we studied adult participants practiced kyokyshinkay longer than 10 years. Hence, we can speculate, that reduction in ECW may be prior to a decrease in ICW. Additionally, long experience in intensive karate practice may stabilize rapid changes in ICW, however, this hypothesis required further study.

Our study had one important limitation. We did not study power output after reduction of TBW and ECW. We also did not study the further effect of body water reduction. Judelson and co-workers indicated a relationship between reduction in TBW and decreased muscular performance [26]. They documented, that 3-4% reduction in body water content led to 2% reduction in muscular power [27].

In conclusion, intensive karate kyokushinkay training with full contact fighting reduces body water content, particularly from extracellular space in healthy athletes with longer than 10 years practice.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

INFORMED CONSENT

Written informed consent was obtained from all participants.

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Figure 1. Changes in total body water (TBW) in healthy athletes trained karate kyokushinkay longer than 10 years practice. ** p < 0.01 – differences between TBW before and after practice.

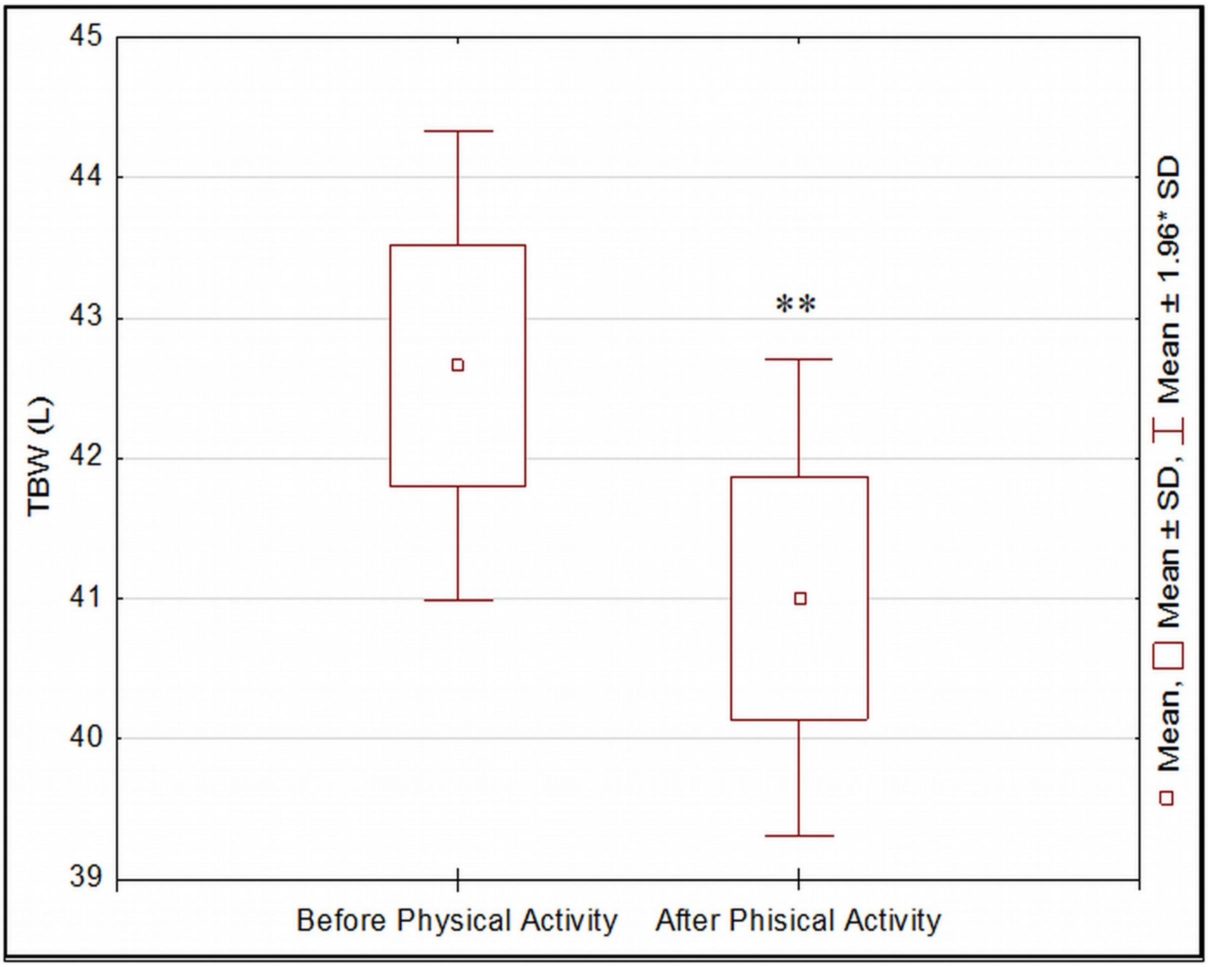

Figure 2. Changes in extracellular water content (ECW) in healthy athletes trained karate kyokushinkay longer than 10 years practice. ** $p < 0.01$ – differences between ECW before and after practice.