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Influence of Training on Body Composition and Physical Health of Indian Young Female Canoers

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Abstract— *Canoeing is now a popular water sports. Although, males are mostly involved, very little information is there on training effect on female canoers. So, it is of great interest to explore the influence of systematic training on physical health and body composition of those athletes. The aim of the study was to explore the systematic training effect on the body composition and physical health of Indian young female canoers and to find out such a training intensity which would be suitable for the athletes to reach the zenith of their success. The experiment was carried out in the center of Jagatpur, Sports Authority of India on 7 female canoers. Body height (cm), body weight (kg) and body mass index or, BMI (kg/m2) were measured by the standard procedures. Body composition including fat mass (FM), fat free mass (FFM), total body water (TBW), extracellular water (ECW), intra cellular water (ICW), the ratio between extra and intra cellular water (ECW: ICW), body cell mass (BCM), muscle mass (MM), total body potassium (TBK), total body calcium (TBCa), glycogen and mineral were analysed using Bioelectrical Impedance Analysis or, BIA (Maltron Bioscan 920-2, UK). Total body electrical impedance attached to an alternate current (0.2mA and at frequencies of 5, 50, 100 and 200 KHz) was measured with the help of multi-frequency analyser. The training programme of our present study was divided into three phases- Pre-competitive Period (PCP), Competitive Period 1 (CP1), Completive Period 2 (CP2). Our present study was focused to analyse training influence on health and composition of body. Groups differences were determined by one-way analysis of variance (ANOVA) then Schiff`s Post hoc test was performed with Confidence level at $p<0.01$ and $p< 0.05$. It was noted that the TBW (p value = 0.005) and mineral (p value = 0.049) content of female canoers were significantly and progressively increased from Precompetitive Period (PCP) to Competitive Period 2 (CP2). ICW (p value = 0.003), ECW/ICW ratio (p value = 0.004), TBK (p value = 0.005) and glycogen content (p value = 0.049) were also improved. It may be concluded that the body composition estimations are very much crucial to monitor obesity, nutritional status, training outcomes and general health of athletes; at the same time, designing and implication of proper training is essential to maintain proper body composition.*

Keywords— *Training, Body composition, Total body water, Mineral content, Bioelectrical impedance analysis*.

I. INTRODUCTION

Every sport's discipline requires specific abilities from athletes which are essential for their victory. The physical and body composition profile of an athlete plays a pivot role on competitiveness in canoeing. Long-term training can maintain body composition of the athletes to make them fit for the specific game.[1, 2] Canoeing is an aerobic endurance kind of sports for which training, competition, aerobic energy along with anaerobic lactic acid capacity requirements are very essential. Canoeing was introduced as Olympic discipline in 1936 in Berlin and in 1938 in Sweden, where first world championship took place. Canoeing is a technical sport with special requirements of body strength. In addition with the estimation of sports characteristics, physical and body composition profiles can provide theoretical basis for selection and training of the athletes scientifically.[3] Canoers kneel down in the boat, facing forward. In this water sports, proper body composition estimation assists an athlete to reach the best possible performance level, even before development of technical and tactical understanding.[4] The differentiation of body build increased depending on the type of boat and specific events.

The main object of our current work is to analyse the influence of training on body composition and physical health of the Indian female canoers.

II. MATERIALS AND METHODS

Participants: 7 female canoers (age=13.57±1.06 years) were considered for this study. All these athletes belonged to Sports Authority of India (SAI) Jagatpur, Orissa and were well trained having experience of 4 to 5 years. They belong to the same status socio-economically with common nutritional profiles and having common training pattern at same climatic conditions. Hence, they could be called as homogenous subjects.

Training regimen: Total training of 10 to 11 sessions in each week was done and after 5 sessions, one break was allowed. Athletes used to start their training early in the morning at 5:45 am and continued till 9:30 am. In the evening training was given from 3:30 to 7:00 pm. In the morning they perform endurance training for 60 to 80 minutes and in the evening strength training for 45 to 60 minutes. Training regimen is shown in Table 1.

TABLE 1. Training regimen for Female Canoers

Training Intensity	**Training Phases**		
	PCP	**CP1**	**CP2**
Volume (minutes/week)	662	690	712
Distance covered (kilometres)	8-9	9.5-10.5	12-14

PCP = Pre-competitive period (April – June)
Basic Specific Endurance/ Paddling Technique
CP1= Competitive period 1 (July to September)
Increased Specific Endurance
CP2 = Competitive period 2 (October – November)
"Peak" for the Championships

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Intensity: Intensity is generated basically in "Heart rate" with an indicated "Target Zone", focused on percentage of "Maximum Heart rate". Maximum heart rate is achieved by subtracting 220 from athletes` age indicated Stroke rate. The "Stroke rate" is very much related to the Heart rate, having its own technical effect.

Measurement of physical parameters:

Height (in cm) – with anthropometry /stadiometer

Weight (in kg) – with weighing pan.

Body mass index or, BMI (kg/^{m2}) – Formula: BMI = Body-weight (kg) / height (meter^2).[5]

Estimation of body composition: Several body compositions were critically analysed by BIA. Total body electrical impedance in separate current (0.2mA) with four separate bioelectrical impedance analysis frequencies at 5, 50, 100 and 200 KHz was measured with the help of multi-frequency analyser. All these were taken by placing a subject in a supine position on a non-conducting surface and were also asked to take rest for 5 minutes. Electrodes were attached on the sites cleaned with isopropyl alcohol on hands and feet (right side of the body, dorsal surface); adherence was ensured to limit the possible errors.[6]

III. Observation and Result

Statistical Program for the Social Sciences or, SPSS, version 26.0 of Chicago, Il, USA was used for statistical analysis. Groups differences by one-way (ANOVA) then Schiff`s Post hoc test were performed with Confidence level at $p<0.01$ and $p< 0.05$.

TABLE 2. Influence of training on body composition and physical health of female canoers

Profiles	Female Canoers			F Value	P Value
	Training Phases				
	PCP	CP1	CP2		
Body Height (cm)	163.16±1.89	163.47±1.96	163.77±1.96	.071	.933(ns)
Body Weight (kg)	59.27±2.70	56.0±4.33	52.93±3.09	2.535	.159(ns)
BMI (kg/m^2)	22.27±0.72	21.0±1.54	19.83±1.15	3.161	.115(ns)
Fat Free Mass (kg)	80.33±2.27	83.53±3.51	85.47±2.83	2.373	.174(ns)
Fat %	20.43±1.96	18.73±2.92	17.47±2.67	1.024	.414(ns)
Total Body Water (TBW) (liter)	53.93±0.51	57.87±2.18	60.27±2.01	10.156	.012*
Extra-cellular Water (ECW) (%)	27.77±1.66	31.63±0.91	33.83±1.42	15.214	.004(ns)
Intracellular Water (ICW) (%)	68.33±0.85	72.23±1.66	74.13±1.05	17.219	.003**
ECW/ICW (%)	0.38±0.03	0.46±0.02	0.53±0.04	15.364	.004**
Body Cell Mass (kg)	23.5±0.7	25.8±0.69	27.4±1.4	11.805	.008**
Muscle Mass (kg)	18.1±0.36	19.2±0.52	20.23±1.79	2.843	.135(ns)
Total Body Potassium (TBK) (gm)	103.13±2.82	110.4±5.07	124.73±6.51	14.293	.005**
Total Body Calcium (TBCa) (gm)	781.33±18.58	829.33±33.13	862±47.84	3.971	.080(ns)
Glycogen (gm)	364.33±6.35	390±12.49	413±12.12	15.537	.004**
Mineral (kg)	2.93±0.10	3.28±0.35	3.78±0.43	5.226	.049*

Values of different variables are shown in 'mean ± standard deviation'; (*) denotes significant at ($p<0.05$); (**) denotes significant at ($p<0.01$) from Precompetitive Phase (PCP) to Competitive Phase 2 (CP2) and (ns) denotes values are not significant.

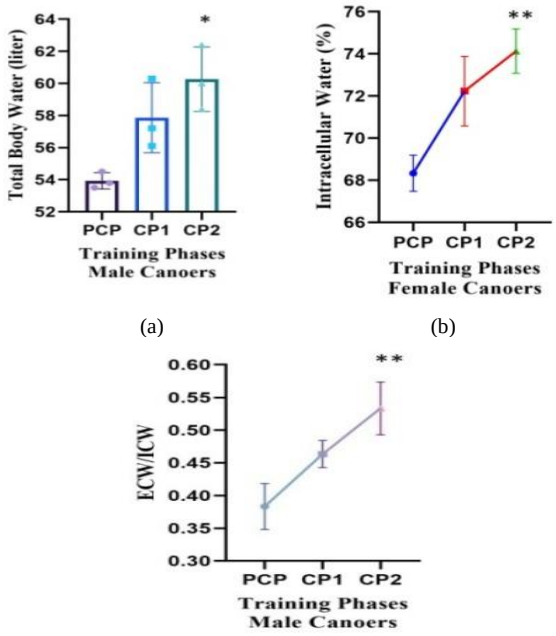
Table 2 depicts that (ICW), (ECW/ICW), (BCM), (TBK) and glycogen were significantly and progressively increased from Precompetitive Period to Competitive Period at ($p<0.01$) and (TBW), mineral content at ($p<0.05$).

IV. Discussion

Body composition has a great influence on human physiology; and severely for athletes involved in training of sports. It also has a pivot impact on sports ability and performance. It can also deliver theoretical basis for scientific selection of athletes, scientific training, morphological ornamentation, technical and tactical play and training level. For better analysis we compared our data with the earlier studies. In our current work no changes was seen in BF (%) and FFM (kg) of female canoers. Maintaining BMI in the proper status is very much vital to gain a maximum performance in competition.[7]

Table 2 depicts that stature (cm) (163.77±1.96), body weight (kg) (52.93±3.09) and BMI (kg/^{m2}) (19.83± 1.15) of our female canoers was less than males in previous research (176.9 ± 6.9), (75.5 ± 8.0) and (24.1± 1.2) respectively[8]. Total body water was significantly increased from (53.93±0.51) to (60.27±2.01) (p value = 0.012) as shown in table 2 and in figure 1(a). Total body water in litter (60.27±2.01) was also found to be higher than their counterparts (32.27±4.01)[8]. Human body is made of 60% of water. Overall body weight contains 45-65% of water. Body water constitutes 79% muscles, 73% brain and 31 % bones. Fluid present in the interstitial spaces performs many important process during both rest and exercise phase[9]. Body water is expelled during paddling which may leads to hypo hydration which hampers performance by reducing plasma volume of blood, destroying function of heart, muscular flow of blood and ability of temperature regulation[10]. Proper hydration is very much essential during any boat event. Intracellular fluid content of our female canoers has improved from (68.33±0.85) to (74.13±1.05) at (p value = 0.003) as shown in table 2 and figure 1 (b). Intracellular fluid content of female canoers (74.13±1.05) was found to be higher than their Polish male counterparts (14.67 ± 1.97)[8]. TBK (p value = 0.005) and mineral content (p value = 0.049) of female canoers were significantly increased from (103.13±2.82) to (124.73±6.51) and (2.93±0.10) to (3.78±0.43), respectively as shown in Table 2, in figures 2(a) and 2(c). Minerals, proteins and inorganic salts are very much vital for athletes. They are important components and regulate the physiological function

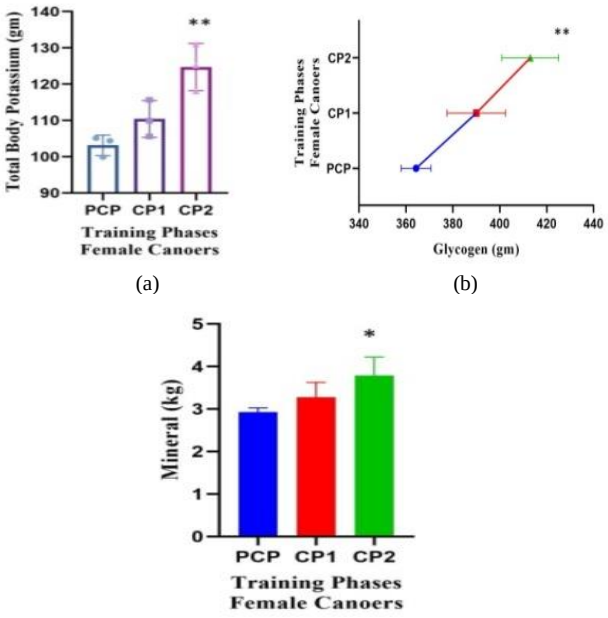
of athletes' body. Proper training increases the body composition uptake and utilization of nutrients.[3]



(a) (b)

(c)

Fig. 1(a-c) Influence of training on total body water (TBW) (liter), intracellular water (ICW) (%), intracellular and extracellular water ratio (ECW/ICW) of female canoers, (**) denotes significant at ($p<0.01$), (*) denotes significant at ($p<0.05$), (values are shown in mean ± standard deviation)



(a) (b)

(c)

Fig. 2 (a-c) Influence of training on total body potassium (TBK) (gm), glycogen content (gm), mineral content (kg) of female canoers (**) denotes significant at ($p<0.01$), (*) denotes significant at ($p<0.05$), (values are shown in mean ± standard deviation).

Dehydration is very much related to various endurance sports performance. It was observed by Slater and Tan that on water racing resulted in 1.59% of dehydration.[11] Potassium is one of the most important intracellular cations, and 98% of it is found within the body cell mass (BCM).[12] Body cell mass (BCM) (kg) (p value = 0.008) was progressively improved from (23.5±0.7) to (27.4±1.4) as shown in table 2. ECW/ICW (p value = 0.004) ratio was improved from (0.38±0.03) to (0.53±0.04) as shown in table 2 figure 1 (c). Glycogen content (p value = 0.004) of our female canoers was increased from (364.33±6.35) to (413±12.12) as shown in table 2 and figure 2 (b). Glycogen plays a vital role as both systemic and cellular energy source during whole competitive phase. Proper fluid intake is the most relevant tool to overcome dehydration and minimizing the tendency of thermal stroke in sports persons indulged in workouts during fitness programme and water event. Perfect water and electrolyte balance is very much crucial for metabolic functions, blood flow and to uplift physical performance of athletes, [13, 14] which is very much consistent with our present observations.

V. Conclusion

During water event and training sessions body maintains accurate body temperature by sweating, in this way heat is removed also. Metabolically active cell mass is the body cell mass, higher of which means faster cell signal. Proteins, nucleic acids and other biological molecules remains bathed in intracellular fluid. Total body potassium (TbK) (gm) is crucial for heart health, proper functioning of muscles and nerves. Minerals are the chemical elements that helps to regulate the body`s processes. Body composition estimations are very much crucial for canoers. Further modifications of training protocols are to be done so that our athletes can touch the zenith.

Conflict of Interest

The authors have no conflicts of interest regarding this investigation.

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