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European Journal of Sports and Exercise Science, 2015, 4 (1):1-9  
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# Effect of training on various anthropometric and physiological profiles of Indian national women soccer players

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## ABSTRACT

The present study was aimed to investigate the effect of formal training on different physical and physiological profile of the Indian National women soccer players. The study was conducted on 45 senior women soccer players who were divided into three groups according to their respective playing position i. e. - defender (21) midfielder (13), and forward (11) to evaluate the body height, body weight, fat percentage, fat free mass, body mass index, muscle mass, glycogen mass, potassium, calcium content, static strength, trunk flexibility in two different phases, i. e. at the beginning and end of the training camp. The result revealed that almost all the parameters were found to be changed insignificantly except the extra cellular water (ECW) and Intra cellular water (ICW) which was found to be statistically significant when compare before and after training. The defenders were found to be the youngest in age (21.9 yrs  $\pm$ 3.22) and midfielders were found to be the oldest (22.8 yrs  $\pm$ 4.37) when compared as per their field position. Again defenders were also found to be tallest (159.8 cm  $\pm$ 2.71) and heaviest (54.8 kg  $\pm$ 5.31) among the footballers whereas forwards were found to be shortest (156.8 cm,  $\pm$ 5.18) in height but not lighter in weight (51.28 kg  $\pm$ 4.63) in fact midfielder were found to be the lighter in weight (48.3 kg  $\pm$ 4.85) though their height (158.2cm  $\pm$ 3.55) was found to be more than the forwards. A significant difference ( $p < 0.05$ ) was observed in body weight, body mass index (BMI), body fat percentage, fat free mass and relative back strength when Analysis of variance was applied among these groups. However, the significant difference was observed due to the difference between midfielders and defenders, when scheffie's test was applied. Present study further showed that a shift of body fluids, with a significant reduction ( $p < 0.05$ ) in extracellular compartment whereas a significant increase in intracellular compartment. Therefore, this fact supports the possible role in monitoring the physical conditions with the capability to identify the players who is at an increase risk of dehydration. So, it may be conclude that it is essential to consider the positional requirement because acquaintance of observed differences could improve the training process as well as the selection at the early age.

**Keywords:** Women soccer players, Anthropometric & physiological profile, Training effect, bioelectrical impedance.

## INTRODUCTION

Morphological characteristics of athletes determine the success in particular sports events in various ways. The knowledge of these characteristics is necessary to establish their importance for the success in competitive sport [1]. The research on the influence of these characteristics in team games (soccer, handball, basketball, volleyball) is of particular complexity, because the success in the game depends, among other factors, on how the individual

characteristics of some players fit into the whole, thus creating a coherent team. So, playing position is of extreme importance in interpretation of morphological data because the demand is different for a specific play. Soccer belongs to an aerobic-anaerobic (intermittent) type of sport with alternate phases of high load as sprints, fast zigzag running, jumps, sudden stops, etc. Practically in all activities a player carries his body mass, moves it against the force of gravity so frequent changes of direction that each excess of body fat represents an overload which additionally burdens the energy mechanisms and makes the execution of a whole series of activities, especially the jumps and sprints, more difficult [2]. Anthropometric profiles and physiological fitness level required for match play depend on work rate demands of the game which vary with level of competition. This may vary according to their physical training regiments employed, the frequency of competition, the stage of competitive season, and so on. It can help also in identifying strength and weakness of individual players within the team [3].

Soccer is probably the most popular game worldwide but there is still limited scientific information available concerning the morpho- physiological characteristics particularly the Indian National women soccer players. The demand in women participation in competitive sports has reflected the growing popularity of women soccer [4, 5, 6]. Limited studies were conducted so far on Indian national women soccer players regarding morphological & physiological profiles [3, 7]. As per literature no such study was undertaken so far to see the effect of systematic training program particularly on Indian national women soccer players. Therefore, the present investigation on Indian National women soccer players were undertaken to study i) the morphological and physiological parameters according to their specific playing position ii) The effects of systematic training programmes on different Anthropometric & Physiological parameters, body fluid & mineral content of the women soccer players.

## MATERIALS AND METHODS

### Selection of Subject:

The present study was carried out on forty five (45) Senior Indian National women soccer players who were selected to participate in SAFF Championship for Women- 2012, held at Colombo, Sri Lanka. They were attending a national coaching camp at the Sports Authority of India, Kolkata, for the preparation of above Championship and were evaluated for various anthropometric and physiological profiles in the Human Performance Laboratory at Sports Authority of India, Kolkata. Tests were conducted twice, maintaining three weeks interval between each test. The players belonged to almost similar socio-economic status and having similar dietary habits and were having same kind of training regimen. Hence, the subjects were considered as homogeneous. At the beginning of test all the players were clinically examined by the physicians of SAI, Kolkata, who are specialized in Sports Medicine following standard procedure [8]. The players who were found to be medically fit, healthy and with no history of any hereditary and cardio respiratory diseases, were finally selected for the above test.

### Training Phase:

The formulation and implementation of systematic training program was made by the qualified Indian national coaches with the guidance of the scientific expert from Sport Science Department, SAI, Kolkata. The training regimen was used to apply 4 to 5 hours training every day except Sunday, about 30 hours in a week. There were two sessions in each day i. e. Morning session and evening session and in each session was comprises of skill training for two hours and physical training for one hour. The physical training schedule comprises of different strength and endurance training program apart from the stretching and flexibility exercises which was also included in the programme. Endurance training was applied weekly three days and strength training was two days. Besides the technical and tactical training, they underwent for warming up and cooling down session of about half an hour before commencement of the training and end of the training respectively.

### Measurement procedure:

The physical characteristics of the subjects including age (yr), height (cm), weight (kg) were measured by anthropometric rod and digital weighing machine followed by standard procedure [9]. The decimal age of the players were calculated from their date of birth recorded from original birth certificate at the time of testing. Skinfold thicknesses were measured by Herpenden skinfold caliper at the site of biceps, triceps, subscapular and suprailiac. The body fat percentage was calculated by the formula of Siri [10]. Body density was calculated using the equation of [11]. Back and hand grip strength (both right and left) were measured by back and grip dynamometer (Senoh, Japan) following the standard procedure [12]. The relative back strength was calculated in relation to the body weight of each player. Evaluation of trunk flexibility was done by 'Flexometer' made of Lafayette Instrumental co, USA. Total body water (TBW), Extra cellular water (ECW), Intra cellular water (ICW), ratio of

ECW & ICW, Total body Potassium (TBK), Total body calcium (TBCa), Total Mineral content, Glycogen mass and Muscle mass were measured by Bioscan 920- 2 (Maltron, UK). All the tests were conducted at a room temperature varying from 23 to 25 degree centigrade with relative humidity varying between 50- 60%.

### Statistical Analysis:

Data was analyzed by using the SPSS software, 17.0 version. One way Analysis of variance was applied to see the difference of the players as per their specific field position and between the (Midfielder, Forward and Defender) pre test and post test in order to find out the level of significance along with the mean and standard deviation of each parameter.

## RESULTS

Table I demonstrated the comparison and descriptive statistical analysis of all anthropometric variables of women football players between their two separate test phases and one way Analysis of variance was also applied to see the effect of training (if any). The table further reveals that the difference in all the anthropometric variables were not found to be statistically significant as the value of all the parameters were not much changed after training. Body weight was found to be slightly increased after training in these girls. Fat free mass (FFM) percentage was found to be decrease and the body fat percentage was found to be increase after training. Muscle mass, glycogen mass and flexibility were also found to be increased, whereas strength parameters were found to be remaining same after training. Table I further depicts the status of total body water (TBW), extra cellular water (ECW), Intra cellular water (ICW), total body potassium (TBK), Total body calcium (TBCa), and mineral mass estimated by BIA (Bioelectrical impedance analysis) and their comparison between two training phases. All the parameters were found to be increased except the mineral mass which was decreased after training but the difference was not found to be statistically significant. On the other hand ECW and ICW which was found to be changed after training and the difference was statistically significant at the level of  $p < 0.05\%$ .

**Table I: Comparison of Mean, Standard deviation and Level of significance of various anthropometric and physiological parameters of women soccer players of before and after Training.**

Parameters	Before Training		After Training		Level of significance
	Mean	sd	Mean	sd	
Age (years)	22.3	±3.28	22.3	±3.28	0.000 NS
Height (cm)	158.4	±3.93	158.4	±3.93	0.000 NS
Weight (kg)	52.1	±5.58	52.8	±5.43	0.280 NS
Body Mass Index (BMI)	20.8	±1.81	21.0	±1.74	0.229 NS
Basal Metabolic Rate (BMR ,kcal)	1498.7	±51.98	1504.0	±55.41	0.161 NS
Fat Free Mass (%)	79.4	±4.23	79.9	±4.06	0.172 NS
Fat Mass (%)	19.6	±2.81	18.1	±2.64	0.973 NS
Muscle Mass (Kg)	17.8	±1.19	18.0	±1.24	0.723 NS
Glycogen (gm)	363.4	±67.86	377.5	±26.23	1.085 NS
Right hand grip strength(Kg)	31.1	±2.78	31.3	±3.58	0.060 NS
Left hand grip strength(Kg)	29.6	±3.59	29.7	±3.63	0.047 NS
Relative Back Strength (per kg Body weight)	1.6	±0.19	1.6	±0.21	0.018 NS
Trunk Flexibility (cm)	18.4	±5.26	19.5	±4.60	0.840 NS
Total Body water (Lt)	28.8	±2.26	29.3	±2.46	0.520 NS
Extra cellular Water (ECW ,%)	47.1	±1.06	46.4	±1.73	5.318*
Intra Cellular Water (ICW , %)	53.1	±1 .05	54.1	±1.73	4.831*
ECW/ ICW	0.82	±0.05	0.85	±0.05	2.036 NS
Total Body Potassium (TBK, gm)	93.1	±6.97	94.8	±7.55	0.987 NS
Total Body Calcium (TBCa, gm)	796.2	±50.41	809.2	±54.69	0.98 NS
Mineral (kg)	4.3	±0.30	4.1	±0.3	0.068 NS

Mean ±sd \* $P < 0.05$  \*\* $P < 0.01$  NS= Not significant

Table II is demonstrated the comparison of various anthropometric and physiological parameters of the women footballers according to their respective playing position i.e. midfielder, forward and defender before and after training. Like table I no difference was observed when analyzed according to their field position, except ECW and ICW which was found to be statistically significant ( $p < 0.05$ ) in forward only as compared between training phases. There is no such significant difference was observed in defenders and midfielders when compared between training phases.

**TableII: Comparison of Mean, Standard deviation and Level of significance of various anthropometric and physiological parameters of women soccer players of before and after Training according to their respective field position**

Parameters	Midfielder (N=13)			Forward (N=11)			Defender (N=21)		
	Before Training	After Training	Level of significance	Before Training	After Training	Level of significance	Before Training	After Training	Level of significance
Age (Yrs.)	22.8 ±4.37	22.8 ±4.37	0.000 NS	22.2 ±2.39	22.2 ±2.39	0.000 NS	21.9 ±3.22	21.9 ±3.22	0.000 NS
Height (cm)	158.2±3.55	158.2±3.55	0.000 NS	156.1±5.18	156.1±5.18	0.000 NS	159.8±2.71	159.8 ±.71	0.000 NS
Weight (Kg)	48.3 ±4.85	49.5 ±4.50	0.273 NS	51.3±4.63	51.5 ±4.60	0.014 NS	54.8 ±5.31	55.6 ±.27	0.143 NS
Body Mass Index (BMI)	19.4 ±2.10	19.8±1.83	0.219 NS	21.1 ±1.25	21.7±1.42	0.000 NS	21.4±1.53	21.6 ±1.61	0.113 NS
Basal Metabolic Rate (BMR ,kcal)	1475±40.08	1480.6±44.20	0.062 NS	1488±50.59	1490.2 ±51.79	0.004 NS	1519.15±54.69	1527 ±58.05	0.144 NS
Fat Free Mass (%)	82.7±4.23	81.5 ±4.10	0.304 NS	79.5 ±3.22	79.4 ±3.41	0.005 NS	77.3±3.65	77.1±3.68	0.026 NS
Fat Mass (%)	15.3±2.59	16.5±2.01	1.09 NS	17.1±2.92	17.7 ±2.84	0.139 NS	18.9±1.96	19.4±2.32	0.350 NS
Muscle Mass (Kg)	17.1 ±1.09	17.4 ±0.98	0.172 NS	17.5±1.14	17.6 ±1.14	0.763 NS	18.3±1.11	18.6 ±1.24	0.227 NS
Glycogen (gm)	361.4±22.33	365.8±21.04	0.026 NS	332.3±122.28	370.8±24.07	0.038 NS	383.7 ±25.21	388.7 ±27.46	0.008 NS
Right grip strength (Kg)	32.4 ±2.44	31.62 ±3.11	0.287 NS	29.87±2.64	31.25 ±3.28	0.851 NS	31.0 ±2.88	31.07 ±4.23	.003 NS
Left grip strength (Kg)	29.75 ±3.41	29.25 ±3.05	0.095 NS	30.87 ±1.80	30.0 ±3.33	0.425 NS	28.69 ±4.40	29.07 ±4.31	.051 NS
Relative Back Strength (per kg BW)	1.77 ±0.15	1.81 ±0.20	0.170 NS	1.65 ±0.13	1.66 ±0.15	0.031 NS	1.52 ±0.17	1.50 ±0.15	.057 NS
Trunk Flexibility (cm)	18.43 ±6.69	20.62 ±.36	0.520 NS	19.68±1.85	19.87 ±2.04	0.037 NS	17.5 ±5.87	18.69 ±5.34	.293 NS
Total Body water (Lt)	27.6 ±2.06	28.2 ±1.84	0.31 NS	28.7±1.75	28.9 ±1.83	0.063 NS	29.6 ±2.45	30.1 ±2.93	0.243 NS
Extra cellular Water (ECW, %)	47.1 ±1.01	46.2 ±1.59	1.86 NS	47.2 ±0.48	46.5±0.52	5.604*	46.4 ±1.24	45.4 ±2.16	2.11 NS
Intra Cellular Water (ICW, %)	52.76 ±1.01	53.7 ±1.59	1.86 NS	52.7 ±0.51	53.3±0.52	4.493*	53.5±1.21	54.5±2.16	1.88 NS
ECW/ ICW	0.82 ±0.04	0.85 ±0.05	1.42 NS	0.83 ±0.05	0.87 ±0.01	2.79 NS	0.82±0.05	0.83 ±0.06	0.063 NS
Total Body Potassium (TBK, gm)	89.1 ±6.06	91.4±5.60	0.390 NS	91.9 ±5.84	92.9±5.89	0.048 NS	95.9 ±7.20	98.2 ±8.44	0.508 NS
Total Body Calcium (TBCa, gm)	767.6±43.64	783.7 ±40.65	0.587 NS	788.4±42.32	794.7±42.76	0.097 NS	817.1±52.13	833.7 ±61.00	0.555 NS
Mineral (kg)	3.46 ±0.29	3.4±0.32	0.584 NS	3.43±0.37	3.4±0.39	0.090 NS	3.63 ±0.25	3.62 ±0.17	0.562 NS

Mean ±sd \*P<0.05 \*\*P<0.01 BW= Body weight NS= Not significant

**Table III Comparison of Mean, Standard deviation and Level of significance of various anthropometric and physiological parameters of women soccer players of before Training according to their field position**

Parameters	Pre Training			
	Midfielder (N=13)	Defender (N=21)	Forward (N=11)	Level of significance
Age (Yrs.)	22.8 ±4.37	21.94 ±3.22	22.2 ±2.39	0.158 NS
Height (cm)	158.2 ±3.55	159.8 ±2.71	156.11 ±5.18	2.403 NS
Weight (kg)	48.33 ±4.85	54.87 ±5.31	51.28 ±4.63	4.348*
Body Mass Index (BMI)	19.38 ±2.10	21.4 ±1.53	21.1 ±1.25	4.127*
Basal Metabolic Rate (BMR ,kcal)	1475 ±40.08	1519.1 ±54.69	1488 ±50.59	2.118 NS
Fat Free Mass (%)	82.7 ±4.23	77.3 ±3.65	79.5 ±3.22	5.135*
Fat Mass (%)	15.27 ±2.59	18.94 ±1.96	17.11 ±2.92	5.751*
Total Body water (Lt)	27.61 ±2.06	29.59 ±2.45	28.7 ±1.75	2.053 NS
Extra cellular Water (ECW, %)	47.13 ±1.01	46.4 ±1.24	47.16 ±0.48	1.913 NS
Intra Cellular Water (ICW, %)	52.76 ±1.01	53.5 ±1.21	52.77 ±0.51	2.193 NS
ECW/ ICW	0.82 ±0.04	0.82 ±0.05	0.83 ±0.05	0.186 NS
Total Body Potassium (TBK, gm)	89.13 ±6.06	95.96 ±7.20	91.98 ±5.84	2.811 NS
Total Body Calcium (TBCa, gm)	767.62 ±43.64	817.0 ±52.13	788.37 ±42.32	2.817 NS
Mineral (kg)	3.46 ±0.29	3.63 ±0.25	3.43 ±0.37	1.291 NS
Muscle Mass (kg)	17.13 ±1.09	18.3 ±1.11	17.47 ±1.14	3.018 NS
Glycogen (gm)	361.37 ±22.33	383.7 ±25.21	332.37 ±122.28	1.474 NS
Right hand grip strength (kg)	32.37 ±2.44	31.0 ±2.88	29.87 ±2.64	1.711 NS
Left hand grip strength (kg)	29.75 ±3.41	28.69 ±4.40	30.87 ±1.80	0.921 NS
Relative Back Strength (/kg BW)	1.77 ±0.15	1.52 ±0.17	1.65 ±0.13	6.319**
Trunk Flexibility (cm)	18.43 ±6.69	17.5 ±5.87	19.68 ±1.85	0.411 NS

Mean ±SD \*P<0.05 \*\*P<0.01 BW= Body weight NS= Not significant

Table III and IV represented the comparison of the footballers according to their field position at the time of the commencement of the training and again at the completion of the training respectively. The defenders were found to

be the youngest in age (21.9 yrs  $\pm$ 3.22) and midfielders were found to be oldest in age (22.8 yrs  $\pm$ 4.37). Again defenders were also found to be tallest (159.8 cm  $\pm$ 2.71) and heaviest (54.8 kg  $\pm$ 5.31) when compared among the groups, whereas forwards were found to be shortest (156.8 cm,  $\pm$ 5.18) in height but not lighter in weight (51.28 kg  $\pm$ 4.63) in fact midfielder were found to be the lighter in weight (48.3 kg  $\pm$ 4.85) though their height (158.2cm  $\pm$ 3.55) was found to be more than midfielder. A significant difference ( $p < 0.05$ ) was observed in body weight and body mass index (BMI) when compared among these three groups. Similar result was also observed in case of body fat percentage, fat free mass ( $p < 0.05$ ) and relative back strength ( $p < 0.01$ ). Table IIIa. and IVa. depicted that the difference was found to be statistically significant in between the midfielders and defenders when Scheffe's post hoc test was applied among these groups.

**Table IIIa. Scheffe's F test for multiple comparison of selected anthropometric and physiological parameters of women soccer players**

Parameters	Midfielder vs Defender	Midfielder vs Forward	Defender vs Forward
Weight (kg)	6.539*	2.950 NS	3.589 NS
Body Mass Index (BMI)	2.066*	1.725 NS	0.341 NS
Fat Free Mass (%)	5.346*	3.200 NS	2.146 NS
Fat Mass (%)	3.671*	1.837 NS	1.833 NS
Relative Back Strength	0.251**	0.125 NS	0.127 NS

\* $P < 0.05$  \*\* $P < 0.01$  NS= Not significance

**Table IV Comparison of Mean, Standard deviation and Level of significance of various anthropometric and physiological parameters of women soccer players of after Training according to their field position**

Post Training					
Parameters	Midfielder (N=13)	Defender (N=21)	Forward (N=11)	F value	
Age (Yrs.)	22.8 $\pm$ 4.37	21.94 $\pm$ 3.22	22.2 $\pm$ 2.39	0.158 NS	
Height (cm)	158.2 $\pm$ 3.55	159.8 $\pm$ 2.71	156.11 $\pm$ 5.18	2.403 NS	
Weight (kg)	49.56 $\pm$ 4.50	55.66 $\pm$ 5.27	51.56 $\pm$ 4.60	4.213*	
Body Mass Index (BMI)	19.85 $\pm$ 1.83	21.66 $\pm$ 1.61	21.7 $\pm$ 1.42	3.080 NS	
Basal Metabolic Rate (BMR, kcal)	1480.6 $\pm$ 44.20	1527 $\pm$ 58.05	1490.2 $\pm$ 51.79	2.333 NS	
Fat Free Mass (%)	81.55 $\pm$ 4.10	77.1 $\pm$ 3.68	79.38 $\pm$ 3.41	3.552*	
Fat Mass (%)	16.48 $\pm$ 2.01	19.44 $\pm$ 2.32	17.65 $\pm$ 2.84	3.986*	
Total Body water (Lt)	28.16 $\pm$ 1.84	30.11 $\pm$ 2.93	28.92 $\pm$ 1.83	1.730 NS	
Extra cellular Water (ECW, %)	46.22 $\pm$ 1.59	45.39 $\pm$ 2.16	46.56 $\pm$ 0.52	1.305 NS	
Intra Cellular Water (ICW, %)	53.67 $\pm$ 1.59	54.50 $\pm$ 2.16	53.32 $\pm$ 0.52	1.328 NS	
ECW/ ICW	0.85 $\pm$ 0.05	0.83 $\pm$ 0.06	0.87 $\pm$ 0.01	1.398 NS	
Total Body Potassium (TBK, gm)	91.37 $\pm$ 5.60	98.26 $\pm$ 8.44	92.9 $\pm$ 5.89	2.744 NS	
Total Body Calcium (TBCa, gm)	783.75 $\pm$ 40.65	833.76 $\pm$ 61.00	794.75 $\pm$ 42.76	2.768 NS	
Mineral (kg)	3.43 $\pm$ 0.32	3.62 $\pm$ 0.17	3.4 $\pm$ 0.39	1.785 NS	
Muscle Mass (kg)	17.46 $\pm$ 0.98	18.63 $\pm$ 1.24	17.6 $\pm$ 1.14	3.290 NS	
Glycogen (gm)	365.87 $\pm$ 21.04	388.69 $\pm$ 27.46	370.87 $\pm$ 24.07	2.455 NS	
Right hand grip strength (kg)	31.62 $\pm$ 3.11	31.07 $\pm$ 4.23	31.25 $\pm$ 3.28	0.054 NS	
Left hand grip strength (kg)	29.25 $\pm$ 3.05	29.07 $\pm$ 4.31	30.0 $\pm$ 3.33	0.156 NS	
Relative Back Strength (/kg bw)	1.81 $\pm$ 0.20	1.50 $\pm$ 0.15	1.66 $\pm$ 0.15	8.272**	
Trunk Flexibility (cm)	20.6 $\pm$ 5.36	18.69 $\pm$ 5.34	19.87 $\pm$ 2.04	0.446 NS	

Mean  $\pm$ SD \* $P < 0.05$  \*\* $P < 0.01$  NS= Not significant

**Table IV-a. Scheffe's F test for multiple comparison of selected anthropometric and physiological parameters of women soccer players**

Parameters	Midfielder vs Defender	Midfielder vs Forward	Defender vs Forward
Weight (kg)	6.099*	2.000 NS	4.110 NS
Fat Free Mass (%)	4.426*	2.162 NS	2.264 NS
Fat Mass (%)	2.958*	1.162 NS	1.796 NS
Relative Back Strength	0.304**	0.150 NS	0.154 NS

\* $P < 0.05$  \*\* $P < 0.01$  NS= Not significant

## DISCUSSION

It has been believed that suitable physique has an importance to achieve success in particular sports [13, 14]. The estimation of body composition permits the quantification of gross size of an individual into two major structural components namely fat mass and lean body mass. This appraisal provides an important baseline to develop an effective training programme. Stature and body mass have significant impact on elite soccer teams [15]. The present study reveals that the mean value of height (158.4 cm  $\pm$ 3.93) at the age of 22.3 years old players was found to be little more than those of the same aged Indian national women players (156.5 cm  $\pm$ 5.84) as reported by [3]. A trend



of secular change in increment of body height was observed over the time. Jankovic et al [16] found that body height had a discriminative role in the selection of young soccer players, in favor of those who were taller. This, however, is not in congruence with a still existing opinion established by [17] quite a long time ago after analyzing a large sample of soccer players, which claims that more successful players are shorter and weigh less than the ones who are not so successful. But still the Indian players are less in height than those of their International counterparts as the Australian women soccer players were possess 158.1cm height [4] and Turkish women soccer players were of 162.4 cm in height [18]. However Dennis National squads were reported tallest (169.0 cm) women soccer players as reported [5]. Additionally, when dealing with body height, the fact that it is connected with the ethnic component should be taken into consideration. For instance, the height of Asian teams significantly shorter than their peers from Europe or American counterpart [2]. The smaller size of Indian players is probably due to their genetic trait. It is well established that ethnic and racial factors which affects the average body size [19]. The comparison of body height of present players playing in various field positions were also analyzed and showed that defender was the tallest (159.8 cm  $\pm$ 2.71), as compared to the forwards (156.1 cm  $\pm$ 5.18) and the midfielder (158.2 cm  $\pm$ 3.55). Similar trend was also reported of Indian national teams [3] that the defender was tallest as compare to their midfielders and forward counterparts. The present study also confirms the findings of above observation. Body height is favorable for defenders in actions in which the ball is received or fought for by the head, on the jump or standing on the ground. Body height is, therefore, definitely important when directing a player towards specific position-related or tactical roles in the game. Such observation was also reported in professional players in England [2], the national teams participating in the World Cup in France in 1998. Portuguese first league goalkeeper's height was 186 cm, center-halves were 185.3 cm, and midfield players were 176.8 cm and forwards were 174.6 cm [20]. The similar observation were also made in the present study, where the forwards were the shortest although it could have been expected that they would be more similar to the defenders, as taking into the account direct duels on the jump in front of the goal. However, no significant change in stature of the present women soccer players was observed after training phase, this is probably due to the players have completed their growth in height and moreover the duration of training phase was very short and as a result the training has no effect on their body height. The present study reveals that the body weight of women soccer players (52.1 kg) was found to be very much similar to those of the Indian National women soccer players (52.2 kg) studied by Dey & Debray [3]. However, the body weight of Australian [4] Danish [5] and Turkish [18] women soccer players were found to be much heavier than the players of the present study. But the body weight of these soccer players is well comparable with Indian National Female hockey players [21] and female cyclists [22]. However, the body height values were accompanied by the size of mass, thus leading to the conclusion that defenders were, at the same time, the ones who weighted the most (54.8 kg,  $\pm$ 5.31) whereas instead of forward (51.3 kg,  $\pm$ 4.63), midfield players weighted the least (48.3 kg  $\pm$ 4.85). It was also noted that the forwards were the shortest although it could have been expected that they would be least in weight. Present study further reveals that like height, no such significant change in body weight was observed after three weeks training program. This also may be due to the short span of training as implemented on them. Sergej [23] has also reported that short term exercise training has no significant effect on athlete's body mass. However, body mass come into play since soccer is a body contact game. Heavy weight (not over weight) players get an advantage in defense. So, a standard body mass is required for every playing positions in the field. The anthropometric profiles and physiological fitness level required for match play depend on the work rate demands of the game, which vary with the level of competition. Specific positional roles within each soccer code may demand unique morphological attribute. These are reflected in the physical and physiological fitness profiles of the soccer players [7].

The percent body fat is an another parameter which plays an important role for the assessment of soccer players' physical fitness ability. On an average, the amount of body fat in young healthy men who underwent no organized type of physical training is within 18–20% of the total body mass, whereas the amount of fat in athletes is generally less [24]. The lowest values are found in long distance runners and range between 4 and 7% [25]. With regard to the requirements of a soccer game it could be expected that a lean body is desirable for sports like soccer [26]. It is well established that a low body fat may improve athletic performance by improving the strength-to-weight ratio. But excess body fat adds to the load without contributing to the body's force-producing capacity [27]. In average fat percentage of the present players (19.6%) was found to be quite more than the players studied by [3] but lower than Indian sedentary female population of the same age [28]. Whereas Indian women soccer players corresponds with the Turkish women soccer players (19.5%) though it difficult to explain the probable cause of the result due to lack of information about the socio economic life style, food habit and method of assessment of body fat percent of Turkish footballers. It is, however, The present findings is significantly higher than Brazilian first league players (10.9%), Portuguese players (10.5%) or English players (12.4%) as reported by Dunbar and Power [29]. However,

defenders of the present study possessed more body fat ( $18.9 \pm 1.96$ ) than the players of other field position. The lowest values of body fat percentage were found in forward and midfield players, which was not surprising as their tasks in the play and the requirement for an extremely high dexterity. These players could not achieve the required high intensity of the play if they had larger amounts of body fat, which was expected if we consider physiological demands. A reduction in percent body fat and increment in fat free mass was noted among the players of present study after the training though it was not significantly changed. The possible reason for slight reduction of body fat may be the aerobic exercise training, was introduced twice in a week and which increases greater utilization of body fat for energetic processes [30, 31]. It has been reported that the soccer players can accumulate body fat in the 'off seasons' when there is no training and lose body fat more during the 'preparatory phase' and the 'competitive phase' of training [32]. This might be due to intensive training during the preparatory phase and a high level of performance during the competitive phase. Before and after the season, during the interval, most soccer players have their fat content increased, presumably owing to reduced aerobic activity along with nutritional and behavioral changes [33, 34].

The average relative back strength of present midfielders was found to be higher than defender and forward though Dey & Debray [3] have explained in their study that the maximum strength distributed according to first goal keeper, midfielder, defender and lastly forward. It is believed that strength is the central component of a soccer training program and strength of the back muscles plays a key role of fitness among soccer players, as kicking, passing, changing pace etc. are part of the game. Therefore, the game demands a high level of back muscle strength of the body. Furthermore, strength of hand grip muscle also has a significant impact on the performance of soccer players, which is needed for throw-in, catching or fisting the ball (goal keeping) [35, 27]. In the present study, the static strength of the players remains almost same after three week of formal training. This may reflect inadequate attention to resistance training in their training program or may be due to the short span of training.

Trunk flexibility is another important factor in soccer. Average flexibility of the of the present players (18.4 cm) was found to be more than those of Turkish women soccer players (12.23 cm) which was concluded as a satisfactory result for the soccer players [18]. In a sport such as soccer, which needs running, stopping, starting, changing direction, and dodging, it is very important to have good flexibility to improve performance level and also to prevent sports injuries. The present study revealed that the trunk flexibility was increased after training. However, mean value of trunk flexibility was noted higher in forward at the commencement of training but after training midfielders were acquired the maximum trunk flexibility. However, Douge [36] has reported that the American footballers tend to have greater flexibility as compared to other International counterparts.

Total body water (TBW) is required to accurately assess individual's body composition changes resulting from diet and exercise [37]. TBW estimations have been used to monitor nutritional status and identify disease states, such as dehydration and chronic kidney disease [38] Limiting dehydration during training and competition is a major concern for soccer players. A moderate exercise workout generally produces a 0.5 to 1.5 liter sweat loss over a 1 hour period, depending on training status and individual features. Changes in body weight (before/after match) indicate the extent of body water loss during exercise and the adequacy of fluid supply during the match. However, it's also important to consider fluid shifts between different body compartments i.e. intra cellular water (ICW) vs. extra cellular water (ECW) and the influence of fluid loss and shifts on functional and subjective parameters and fatigue [39]. Therefore, this factor helps to confirm about the possible role in monitoring physical conditions with the capability to identify players who are at an increase risk of dehydration because the greater degree of dehydration, the more negative impact on physiologic systems and overall athletic performance as soccer, in generally being played for longer duration at least 1.5 hours in the outdoor where temperature and humidity cannot be controlled.

Overall analysis of morphological characteristics in defender showed that more glycogen mass, muscle mass accompanied a more body height. Naturally, such body type contributes to self-confidence of a defender when trying to cover the broad area. Total body potassium, calcium, and mineral content are also higher particularly the case of defenders, because the character of their tasks in the game.

## CONCLUSION

So, from the above discussion and comparison with different author's findings, it may be concluded that many characteristics which are required for playing soccer at top level. It is essential to consider positional requirements

when interpreting fitness test result. Anthropometric factors can also determine the positional role most appropriate for the players which was reflected in the present study. Training effects were reflected in various parameters, such as body fat, strength and total body water profile of the women soccer players. These profiles should be taken into consideration while administering training protocol to the players. As the studies on women soccer players are limited in India, the data of the present study can be a handy tool and can act as a frame of reference for monitoring of training of women soccer players.

### Acknowledgements

The authors express their sincere gratitude to the SAI Eastern center, Kolkata for providing facilities and expertise. The authors are extremely grateful to the footballers who were volunteer for this study. The authors are also grateful to the All India Football Federation (AIFF) for their generous support.

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