American Journal of Sports Science
2014; 2(6-1): 14-18
Published online January 26, 2015 (http://www.sciencepublishinggroup.com/j/ajss)
doi: 10.11648/j.ajss.s.2014020601.13
ISSN: 2330-8559 (Print); ISSN: 2330-8540 (Online)

Anthropometric characteristic, body composition and somatotype of Canadian female soccer players

Anup Adhikari[1], Jady Nugent[2]

[1]Anthropometrica ,Toronto, Canada
[2]A self employed Professional Dietician, Toronto, Canada

Email address:
dranupadhikari@yahoo.com (A. Adhikari)

To cite this article:
Anup Adhikari, Jady Nugent. Anthropometric Characteristic, Body Composition and Somatotype of Canadian Female Soccer Players. *American Journal of Sports Science*. Special Issue: Science & Soccer. Vol. 2, No. 6-1, 2014, pp. 14-18.
doi: 10.11648/j.ajss.s.2014020601.13

Abstract: Canadian female junior soccer players were evaluated for their anthropometrical characteristics including somatotype and body composition with a aim to evaluate with their international counterparts. 18 female soccer players with an average age of 16(±0.5) of a local club were assessed during their peak season time . Somatotype was assessed using Heath-Carter method and body composition (Fat%) was assessed by surface anthropometry . Endomorphic mesomorph (3.0 ±0.8 ─ 3.9±0.8 ─2.58±1.0) body type was observed in average with an average 22.1(±3.1) % body fat. Average waist-hip ratio was 0.7 (±0.03) . Though BMI does not reflect the obesity precisely in athletic population, average BMI of the female soccer group was in normal range with an average value of 21.5 (±1.8) $kg.m^{-2}$ .Thus the Canadian junior female soccer players possessed an average muscularity with slightly higher fat % compare to national level female athletes . The group needed more muscularity with less fattiness.

Keywords: Soccer, Somatotype, Fat %, BMI, Anthropometry, Waist-Hip Ratio

1. Introduction

It is well known that the characteristics of physique apparently associated with success in sports and other form of physical performance [1]. Evaluation of anthropometric characteristics has an immense effect on sports in the preparation and maintenance of training program along with nutrition. Somatotyping guides more scientifically to periodize exercise program along with nutritional applications. For these reason, more attention was given on anthropometric characteristics, body composition and somatotype in sports for the last few decades. For the last few years , somatotyping was also used by the dietitians and nutritionist for the preparation of diet according to endomorphic, mesomorphic and ectomorphic components of the clients to make a change in desired body type. Thus , during the last few decades, great changes had been seen in the application anthropometric characteristics and somatotyping in the area of health and wellness besides sports [2-8] . Hence, kinathropometric measurement is an essential means in search of information that would assist coaches and athletes in the quest for success at the highest level in sports [9].

Soccer is a game where anthropometric characteristic especially somatotype is an important factor for the players specific to the playing position besides other physiological demands [1- 9]. Studies showed that body mass and fat free mass (FFM) had a significant influential role in total distance covered among the international soccer players [2]. More scientific data were available on male and female soccer players of different countries but very few data were available on Canadian female soccer players on their somatotypes . Thus the present study was aimed to evaluate the anthropometric and somatotype characteristics of Canadian female junior soccer player as a pilot study. More research are required in future on the female soccer players for the development of female soccer in Canada.

2. Method

2.1. Subjects

18 junior level female soccer players from a local club near Toronto were selected for the study. The soccer group was a mixed population of caucasian and black who were

born and brought up in Canada . All were regular soccer players in local tournaments and practice on regular basis under the guidance of their coach and physical trainer. The study was done during their tournament season.

2.2. Anthropometric Measurements

Anthropometric measurements were done on same day for each player in same session to avoid technical error. A level 1 Anthropometrist accredited by International Society for the Advancement of Kinanthropometry (ISAK) [10] was involved in the measurements guided by a level 4 Criterion Anthropometrist (ISAK). Methods described in the ISAK manual [11] was followed . Stature was measured with an Anthropometric Rod up to 1 mm and body mass was measured with an electronic weighing machine . Skinfold thicknesses were measured with a Slimguide skinfold caliper (CESCORF). Anthropometric tape and sliding caliper (CESCORF) were used to measure circumferences and bone diameter respectively.

2.3. Somatotype

Heath – Carter [12] method was followed for somatotype rating. The following equations were uses for calculating somatotype.

Endomorphy = ─ 0.7182 + 0.1451 × ∑SF ─ 0.00068 × $\sum SF^2$ + 0.0000014 × $\sum SF^3$

where ∑SF = (sum of triceps, subscapular and supraspinale skinfolds) multiplied by (170.18/height in cm). This is called height-corrected endomorphy and is preferred method for calculating endomorphy)

Mesomorphy = 0.858 × humerus breadth + 0.601 × femur breadth + 0.188 × corrected arm girth + 0.161 × corrected calf girth ─ height × 0.131 +4.5

Three different equations are used to calculate ectomorphy according to the height -weight ratio (HWR) :

If HWR is greater than or equal to 40.75 then,

Ectomorphy = 0.732 × HWR ─ 28.58

If HWR is less than 40.75 and greater than 38.25 then,

Ectomorphy = 0.463 × HWR ─ 17.63

If HWR is equal to or less than 38.25 then,

Ectomorphy = 0.1

2.4. Body Fat %

Durnin and Womersley [13] technique was followed for body density. Body fat% was derived from the equation of Brozek et al [14].

2.5. Waist-Hip Ratio

Waist girth was measured at the narrowest point between the lower costal (10th rib) border and the top of the iliac crest, perpendicular to the long axis of the trunk , according to ISAK manual[12]. Hip (Gluteal) girth was measured at the level of the greatest posterior protuberance, perpendicular to the long axis of the trunk. The ratio was calculated by dividing waist girth by hip girth measurements.

3. Result

In the present study, subjects were all from junior group with an average age of 16(±0.5) yr . The minimum age was 14 yr whereas the maximum was 16 yr (Table 1). Average height was 164 (±6.6) cm with an average weight of 57.8 (±6.6) kg .

Table 1 showed the 5 skinfold thicknesses at different sites with arm girth, calf girth, waist girth, gluteal (hip) girth and bi-epicondylar humerus and femur breadth of 18 junior female soccer players.

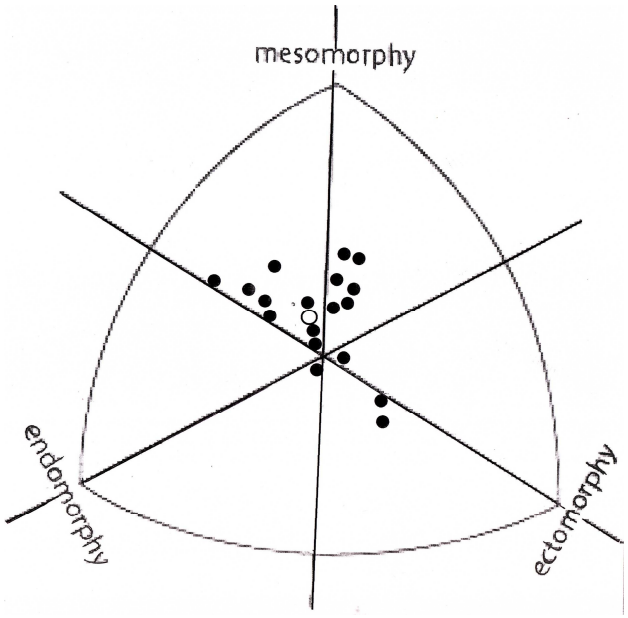
Table 2 showed the endomorph, mesomorph and ectomorph components of the soccer players of the present study.

Table 1. *Physical characteristics , skinfold thickness, girth and breadth of junior female soccer players*

Sl no	Age (yr)	Height (cm)	Weight (kg)	Triceps (mm)	Sub Scapular (mm)	Biceps (mm)	Supra-Spinale (mm)	Calf (mm)	Arm Girth (cm)	Calf Girth (cm)	Humerus width (cm)	Femur width (cm)
01	16	157.2	56.3	8.0	10.0	8.0	19.5	13.5	24.9	38.1	5.8	9.1
02	16	156.2	55.0	9.5	10.0	12.5	10.0	14.5	25.6	36.3	5.7	9.2
03	16	160.0	52.7	5.0	7.0	6.0	7.5	9.0	21.4	36.6	6.0	9.3
04	16	160.6	53.6	6.0	11.0	16.0	6.5	14.5	23.5	35.3	6.0	9.1
05	16	165.4	61.3	5.0	6.0	11.5	5.0	10.0	25.4	37.8	6.1	9.5
06	16	167.1	62.2	6.0	7.0	9.5	8.0	9.5	24.3	35.6	6.7	9.9
07	16	158.6	54.1	4.0	6.5	9.0	6.5	5.4	23.8	37.1	6.1	9.0
08	16	172.0	60.9	15.0	9.0	9.5	11.5	12.5	24.5	37.2	6.1	9.5
09	16	156.5	47.7	7.0	6.0	4.0	10.0	4.0	24.1	33.2	6.2	8.6
10	16	165.5	50.0	8.5	8.0	8.5	8.0	8.0	24.2	32.3	5.5	8.6
11	16	165.0	68.2	16.5	15.5	11.0	13.0	15.0	28.8	37.2	6.0	9.9
12	16	168.8	65.4	10.0	9.5	11.0	10.0	10.0	27.4	37.3	6.2	9.4
13	16	177.0	70.0	11.5	9.0	9.0	12.0	11.0	28.1	36.9	6.3	9.4
14	16	176.4	59.0	12.0	8.5	12.0	7.5	15.0	24.1	36.2	6.3	9.4
15	14	165.9	57.7	10.5	10.5	7.0	9.0	7.0	25.2	37	6.4	9.2
16	16	157.5	47.2	11.5	8.5	6.0	6.0	8.5	22.6	33.5	5.6	8.7
17	16	157.5	56.3	8.0	10.0	8.0	19.5	13.5	24.9	38.1	5.8	9.1
18	15	165.0	63.4	15.0	9.0	5.0	11.0	16.0	26.4	37	5.8	9.2
mean	16	164.0	57.8	9.4	8.9	9.1	10.0	10.9	25.0	36.3	6.0	9.2
SD	0.5	6.6	6.6	3.7	2.2	3.0	4.1	3.6	1.8	1.7	0.3	0.4

Table 2. *Somatotype, fat % and waist-hip ratio of Canadian junior female soccer players*

Sl no	Age (yr)	Height (cm)	Weight (kg)	Endo-morph	Meso-morph	Ecto-morph	Fat %	BMI ($kg.m^2$)	Waist/ Hip ratio
01	16	157.2	56.3	4.2	4.8	1.5	24.8	22.7	0.76
02	16	156.2	55.0	3.3	4.7	1.5	23.8	22.5	0.78
03	16	160.0	52.7	2.0	4.0	2.6	17.2	20.6	0.72
04	16	160.6	53.6	2.5	3.8	2.6	22.9	20.8	0.7
05	16	165.4	61.3	1.5	4.4	2.1	18.2	22.4	0.75
06	16	167.1	62.2	2.1	4.4	2.3	19.5	22.3	0.7
07	16	158.6	54.1	1.7	4.7	2.3	17.4	21.5	0.7
08	16	172.0	60.9	3.6	3.0	3.4	24.7	20.6	0.73
09	16	156.5	47.7	2.5	4.7	3.1	17.9	19.5	0.75
10	16	165.5	50.0	2.5	2.1	4.4	20.6	18.4	0.74
11	16	165.0	68.2	4.7	4.8	1.1	27.7	25.1	0.77
12	16	168.8	65.4	3.0	4.1	2.2	23.3	23.0	0.71
13	16	177.0	70.0	3.2	3.2	2.9	23.8	22.3	0.77
14	16	176.4	59.0	2.7	2.4	4.6	23.1	19.0	0.68
15	14	165.9	57.7	3.2	3.8	2.9	22.2	21.0	0.73
16	16	157.5	47.2	2.9	3.1	3.5	20.4	19.0	0.71
17	16	157.5	56.3	4.1	4.7	1.7	24.8	22.7	0.76
18	15	165.0	63.4	3.7	3.8	1.8	25.5	23.3	0.74
mean	16	164.0	57.8	3.0	3.9	2.6	22.1	21.5	0.70
SD	0.5	6.6	6.6	0.8	0.8	1.0	3.1	1.8	0.03



O = average value

Fig 1. *Somatotype distribution of the Canadian junior level female soccer players.*

Fig 1 showed the Somatotype distribution of the Canadian junior level female soccer players.

4. Discussion

Soccer is a game where a standard physical characteristics with height and weight are required for good performance . Due to concept of total football in modern soccer , most of the players except the goal keeper possessed very similar height and weight irrespective of positions like forward, defence etc. An average height of 164(±6.6) cm for the female junior soccer players of the present study was within normal range of average Canadians of same age group[15,16,17]. Similarly, observed average body weight of 57.8(±6.6) kg was also in normal range of average Canadian of same age group [15,16,17]. The height of the Canadian female junior soccer players of the present study could not be compared with other Canadian studies on female soccer due unavailability of published data . But when compared with other international studies, the Canadian female junior soccer players had very similar height with the Spanish female junior Tennis players [18]. Canadians were also possessed similar height with Serbian female rhythmic gymnasts [19], but taller than the Japanese female junior high school students[20] and shorter than Australian female junior net ball players [21] and female junior rugby players of New

Zealand [22]. When body weight was considered , Canadian female soccer players were very similar with Australian female netball players [21], but lower than the New Zealand female junior rugby players [22] and Serbian female junior rhythmic gymnasts [19].

Soccer is a game where talent is an important factor. But apart from talent in skill, body type or somatotype , which is determined by the human genotype [1], is an important factor for good performances besides other physiological demands. Soccer is a game where mesomorphic component is an important factor for strength with a prevalence of ectomorphic components. Thus, an ectomorphic mesomorph body type is more desirable for speed and endurance with strong muscle power. For a game like soccer where muscle strength with speed and endurance plays an important role for performance based skills. This could be reflected in different studies where male soccer players were distributed over much of the mesomorphic sector of the somatochart [1]. Different studies revealed that the Czechoslovaks, Brazilians and Boliviar male soccer players were more endo-mesomorphic whereas the Cubansn Nigerians and English male soccer players were more ecto-mesomorphic [1]. Whether it was ecto-mesorphic or endo-mesomorphic, the mesomorphic components were higher than 4.7 and went upto 5.9 in average which proved that soccer needed more muscularity to gain more muscle power with speed and endurance.

Like male soccer players, female soccer players also demanded more muscularity which was revealed by the study of Withers et al [23] where Australian female senior soccer players possessed an average somatotype of 4.2(±1.3)─4.6(±1.0)─2.2(±1.2) . Salmela [24] reported an average somatotype of 1.7─4.3─3.1 for French-Canadian female gymnasts with an average age of 15.3(±1.8) yr whereas Yuhasz et al [25] reported an average somatotype of 2.3─3.0─3.8 for Ontario club female gymnasts with an average age of 14.3 yr. Yuhasz et al [25] also reported an average somatotype of 3.7─4.3─1.2 for university gymnasts with an average age of 21.1 yr. Ross et al [26] reported an average somatotype of 3.3(±1.0)─3.6(±0.9)─3.4(±1.1) for Canadian female synchronized swimming who possessed an average age of 16.8±2.3 yr. Ross et al [27] also reported an average somatotype of 2.6(±0.7)─3.8(±0.6)─3.0(±0.9) for the Canadian junior female skating and skiing group of average 15.7(±1.6) yr age. Faulkner [28] also reported an average value of 2.5(±0.7)─4.1(±0.5)─3.2(±0.9) for an average 14(±1.7) year old Canadian female skating group .

In the present study, the Canadian female junior soccer players possessed an average somatotype of 3.0(±0.8)─3.9(±0.8)─2.6(±1.0) which was very close to other Canadian studies on different games. The value was less than Australian senior female soccer group though both Canadian female soccer players and Australlian senior female soccer players were endomorphic mesomorph .

Amount of fat present in the body had a significant role in sport performance [1,29]. A certain amount of fat is required for maintenance of body metabolism but excess adiposity has a negative influence in the performance especially in soccer. Different studies showed that female athletes had a range of 8.4% to 28 % body fat depending on the type of sport . Female body builders possessed a minimum 8.4 % body fat whereas female shot putters reported had the maximum value of 28 % [29]. Wilmore et al [30] reported an average 22% body fat for senior soccer players . The Canadian junior female soccer players of the present study possessed an average value of 22.1(±3.1) % body fat which was in normal range, compared to the body fat% of different female athletes reported by different studies [18,20,29,30]. Average BMI of 21.5(±1.8) $kg.m^2$ observed for the Canadian female junior soccer players of the present study also indicated normal range of bodyweight supporting the normal range of fat % .

According to World Health Organisation (WHO) , Waist-Hip ratio is an indicator of obesity [31]. A Waist Hip ratio of 0.7 or less for women had been shown to correlate strongly with general health and physical fitness [31]. Average Waist Hip ratio of 0.7 (±0.03) for the Canadian female junior soccer players of the present study indicated a good general health and physical fitness.

Thus from the above discussion it might be concluded that the Canadian female junior soccer players had an endomorphic mesomorph somatotype with an average mesomorphic component which should be improved . The average body fat % in normal range, but it should be slightly lower to change the body type into ectomorphic mesomorph from endomorphic mesomorph. More studies were recommended for future reference.

Acknowledgement

The author was highly indebt to the players of the local soccer club near Toronto for their participation . The author was also highly indebted to Jady Nugent,RD, MHSc, who was also the co-author of the article , for her immense help to organise the study.

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