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# Anthropometric and body composition differences in sprint and endurance cyclists

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**Abstract**

**Background:** The aim of the current study was to examine anthropometric and body composition differences in sprint and endurance cycling in Indian Junior cyclists.

**Methods:** Fifty Indian junior national cyclists, further the cyclists were divided in to two group Sprinters group (N=25) and endurance group (N=25) their aged from 16 to 19 years. Anthropometric measurements were assessed as per guidelines issued by the International Society for the Advancement of Kinanthropometry (ISAK). Body composition measurements were calculated by applying equations of Durnin and Womersley (1974).

**Results:** The results revealed a significant difference in height, weight, BMI. The sprinters were shorter and heavier. The sprinter showed shorter limbs (total leg length, lower leg length, total arm length, and lower arm length) than endurance cyclists have greater bicondylar humerus diameter, hip diameter and bicondylar femur diameter than endurance cyclists. The sprinters have more flexed arm circumference, upper arm circumference, lower arm circumference, chest circumference, thigh circumference and calf circumference than endurance cyclists. The sprinters have also more skinfold thickness on biceps, triceps, subscapular, suprailiac and calf than endurance cyclists. The sprinters have greater lean body mass and total body fat than endurance cyclists. In somatotype, sprinters were mesomorphic less ectomorphic and endurance cyclists were more ectomorphic.

**Conclusion:** There were differences in anthropometric and body type between sprinter and endurance cyclists. The coach must take considerations during the talent identification programme in a specific event. These findings might have practical implications for both training and talent identification in cycling.

**Keywords:** Anthropometric, body composition, cyclists

## Introduction

In the current era, clear understandings of various determinants are of immense importance. The success of any talent recognition and development program based upon the apparent understanding of the definite performance demands in the sport. [5]. Knowledge on these demands, based on a multiplicity of anthropological, physiological, and physical fitness assessments, is helpful in any sports including cycling, which is highly technical and specialized discipline involving tackling of machine and use of physical and mental prowess. The body type of an athlete is considered to be a key determinant of success in any sports and for success at the top level competition the individual need to gravitate towards the event to which they are anthropometrically best suited [3-4]. The anthropometric attributes are used to decide the morphological type, that is, body makeup and body constitution of an athlete. Research on Olympic athletes, the body type of athletes and top athletes have been usually shown that the speed and strength dependent players be liable to be mesomorphic while endurance dependant players were found to be more ectomorphic with a partial quantity of mesomorphic muscularity [6]. Athletes who have (or) acquired the optimal physique for a particular event are more likely to succeed than those who lack the general features [7]. The 200m flying start is most power demanding contest. The Sprint is the most explosive exertion amongst high-performance track-cycling events. There are three phases: first phase-acceleration (before the start of timed portion of the flying 200m), the second phase -a maximal velocity, and third phase a deceleration (the last phase integrated between the start and finish lines of the 200m).

Exceptional national and international performances are generally finished within 10–11 s. This has not been considerably improved over the last twenty years [10]. Also, in distinguishing with road cycling, without any gear system means that the steady gear ratio chosen before the race directly influences the mean pedaling rate constant in the sprint. Cycling is unique due to the mixture of extreme postural inertia of the upper and lower body together with an extreme repetitious load on the lower limbs [11]. Sprint performance depends on the ability to produce power and to attain a high ratio between body mass and power [12]. The internationally competitive cyclists (n = 4) were lighter and leaner than their lesser successful teammates. This study was cross-sectional in analysis, is 13 years old and was restricted by small sample size (n = 12). [13]. Research is yet to demonstrate the body composition of a large sample of competitive female road and track cyclists. Elite female road cyclists had lower body mass and skinfolds than track endurance cyclists. Lean mass index explained 87% of the variance in lean mass. Top-performing female cyclists were lighter and leaner than their less successful cyclists [14]. Track cycling events are the combination of sprint and endurance events ranged from a 200m flying sprint (long-lasting 10 to 11 seconds). On contrary road cycling events where many events are undertaken at submaximal power outputs, the shorter track events demands the cyclist to exert maximally both the aerobic and anaerobic. Top-level track cyclists acquired key physical and physiological characteristics which are harmonized to the particular demands of their events: these cyclists must have the suitable genetic disposition which is then maximized through helpful training interferences [15].
Therefore, the main aims of this study were: (1) to determine differences in gross body measurement between sprint and endurance cyclists (2) to determine differences in anthropometric measurement between sprint and endurance cyclists (3) to determine differences in body composition between sprint and endurance cyclists and (4) to determine differences in somatotyping between sprint and endurance cyclists.

## Methods

### Subjects

Total fifty junior cyclists (n = 50). The athletes were divided into groups (Sprinter (n = 25), and endurance (n = 25). For Sprinter group, 200 m fly start cyclists were recruited and 40 km (road) time trial cyclists were selected for endurance group. The subjects were selected from sports centers of Guru Nanak Dev University (20), Amritsar, Patiala University, Patiala (15 subjects), NSNIS Patiala (8 subjects), Patiala and Indra Gandhi complex, New Delhi (7 subjects).

### Procedure

The subjects were informed in detail about the procedure of the study and signed an informed-assent form. The ethics committee of Guru Nanak Dev University approved the study. Subjects concluded testing over 2 appointments within a period of a week from each sports camp. At the first visit, height, weight, length of limbs, diameters of body parts, were measured. On second visit circumference of body parts, skinfold thickness was assessed. All anthropometric measurements were taken as per guidelines are given by the International Society for the Advancement of Kinanthropometry (ISAK).

### Measurements

Height was measured by stadiometer; measurements were recorded to the nearest 1.0 cm. Bodyweight was assessed by electronic weighing scale; measurements were recorded to the nearest 0.1 kg. Body mass Body mass index (BMI) was calculated by using formula = weight (kg)/ (height) 2. The length of body parts was measured by the anthropometric rod. Skinfold thickness was assessed by using Harpenden caliper. The circumference of body parts was assessed by using a flexible measuring tape. The diameter of body parts was assessed by using vernier caliper. The mean of three trials was taken as the recording of a particular measurement. Body fat and lean body mass were estimated as described by Slaughter *et al*. Body fat % were estimated from the sum of skinfolds was calculated by applying equations of and Durnin and Womersley (1974) [17]. Somatotype constituents (endomorphy, mesomorphy, ectomorphy) were computed as per the procedure of Carter and Heath (1990) [18].

### Statistical Analysis

The Shapiro-Wilk test was used to check the normality of the data. Descriptive statistics (means, standard deviations, Std. Error Mean) were calculated for all components. An Independent t-test was applied to examine the differences in anthropometric, body composition differences between sprinter and endurance cyclists.

## Results

**Table 1:** Description of Gross Body Measurement between Sprinter and Endurance Cyclists.

| Variable | Group | Mean | SD | Std. Error Mean | T Value |
|---|---|---|---|---|---|
| Height | Sprinter | 1.71 | .06 | .012 | -2.220* |
| | Endurance | 1.74 | .04 | .010 | |
| Weight | Sprinter | 72.80 | 5.15 | 1.03 | 3.128* |
| | Endurance | 67.71 | 6.30 | 1.26 | |
| BMI | Sprinter | 26.10 | 2.29 | .32 | 4.732* |
| | Endurance | 22.73 | 1.77 | .25 | |

* Indicates $p<0.05$, SD: standard deviation, SEM: standard error of mean

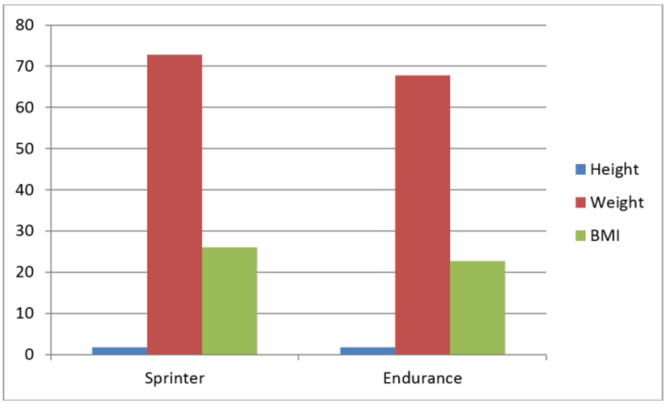


**Fig 1:** Gross Body Measurements of Sprinter and Endurance Cyclists.

The gross body measurements of sprinter and endurance cyclists were revealed in table-1. The gross body measurements of sprinter and endurance cyclists are graphically presented in figure 1 the mean values of height of sprinter and endurance cyclists were 1.71 and 1.74 respectively. As revealed in the table there was significant difference found in the height of sprinter and endurance cyclists (t=-2.220*, $p<0.05$).
The mean value of weight of sprinter and endurance cyclists

was 72.80 and 67.71 respectively. As revealed in the table there was significant difference found in weight of sprinter and endurance cyclists (t =3.128*, $p<0.05$). The sprinter cyclists were heavier than endurance cyclists. The mean value of BMI of sprinter and endurance cyclists was 26.10 and 22.73 respectively. As revealed in the table there was significant difference found in BMI of sprinter and endurance cyclists (t=-4.208, $p<0.05$).

**Table 2:** Description of Anthropometric Measurement between Sprinter and Endurance Cyclists.

| Variable | Group | Mean | SD | Std. Error Mean | T Value |
|---|---|---|---|---|---|
| Total leg length | Sprinter | 89.17 | 2.87 | .57 | -3.613* |
| | Endurance | 92.48 | 3.56 | .71 | |
| Upper leg length | Sprinter | 41.69 | 2.14 | .43 | -1.339 |
| | Endurance | 42.50 | 2.13 | .42 | |
| Lower leg length | Sprinter | 47.36 | 1.81 | .36 | -4.619* |
| | Endurance | 50.56 | 2.95 | .59 | |
| Total arm length | Sprinter | 77.65 | 2.80 | .56 | -2.984* |
| | Endurance | 79.77 | 2.19 | .44 | |
| Upper arm length | Sprinter | 32.91 | 1.32 | .26 | -1.138 |
| | Endurance | 33.31 | 1.18 | .23 | |
| Lower arm length | Sprinter | 44.52 | 2.21 | .44 | -2.428* |
| | Endurance | 45.74 | 1.15 | .23 | |
| Bicondylar humerus diameter | Sprinter | 6.96 | .61 | .12 | 6.152* |
| | Endurance | 6.14 | .26 | .05 | |
| Biacromial diameter | Sprinter | 39.55 | 2.86 | .57 | -.948 |
| | Endurance | 40.16 | 1.40 | .28 | |
| Hip diameter | Sprinter | 30.62 | 1.37 | .27 | 2.447* |
| | Endurance | 29.78 | 1.01 | .20 | |
| Bicondylar femur diameter | Sprinter | 9.71 | .51 | .10 | 6.133* |
| | Endurance | 9.01 | .26 | .05 | |
| Flexed arm circumference | Sprinter | 33.72 | 1.91 | .38 | 4.382* |
| | Endurance | 31.34 | 1.92 | .38 | |
| Upper arm circumference | Sprinter | 30.62 | 1.92 | .38 | 4.417* |
| | Endurance | 28.23 | 1.91 | .38 | |
| Lower arm circumference | Sprinter | 28.44 | 1.41 | .28 | 4.281* |
| | Endurance | 26.82 | 1.25 | .25 | |
| Chest circumference | Sprinter | 94.80 | 2.91 | .58 | 3.996* |
| | Endurance | 90.52 | 4.51 | .90 | |
| Thigh circumference | Sprinter | 59.09 | 2.38 | .48 | 5.248* |
| | Endurance | 54.48 | 3.69 | .74 | |
| Calf circumference | Sprinter | 37.44 | 1.61 | .32 | 2.423* |
| | Endurance | 36.03 | 2.42 | .48 | |
| Biceps skinfold thickness | Sprinter | 4.66 | .49 | .09 | 2.332* |
| | Endurance | 4.08 | 1.13 | .23 | |
| Triceps skinfold thickness | Sprinter | 8.06 | 1.26 | .25 | .819 |
| | Endurance | 7.59 | 2.62 | .52 | |
| Subscapula skinfold thickness | Sprinter | 9.89 | 2.11 | .42 | 2.599* |
| | Endurance | 8.22 | 2.41 | .48 | |
| Suprailiac skinfold thickness | Sprinter | 7.83 | 2.73 | .55 | 1.033 |
| | Endurance | 6.97 | 3.16 | .63 | |
| Calf skinfold thickness | Sprinter | 11.02 | 3.13 | .62 | 3.254* |
| | Endurance | 8.12 | 3.18 | .64 | |

* Indicates $p<0.05$, SD: standard deviation, SEM: standard error of mean

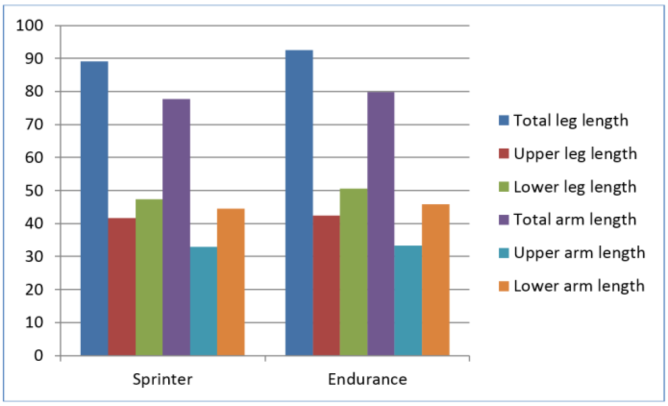


**Fig 2:** Limbs Measurements of Sprinter and Endurance Cyclists.

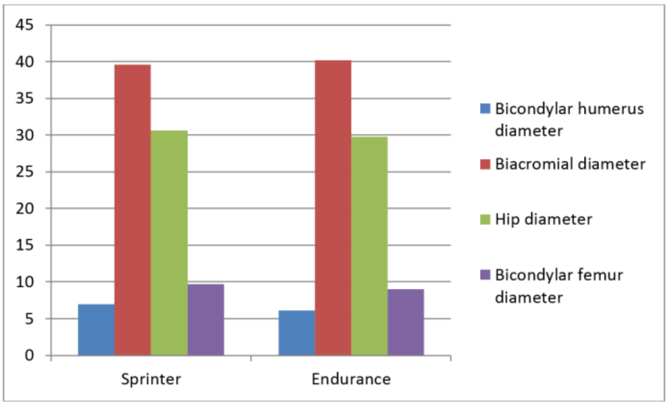


**Fig 3:** Diameter Measurements of Sprinter and Endurance Cyclists.

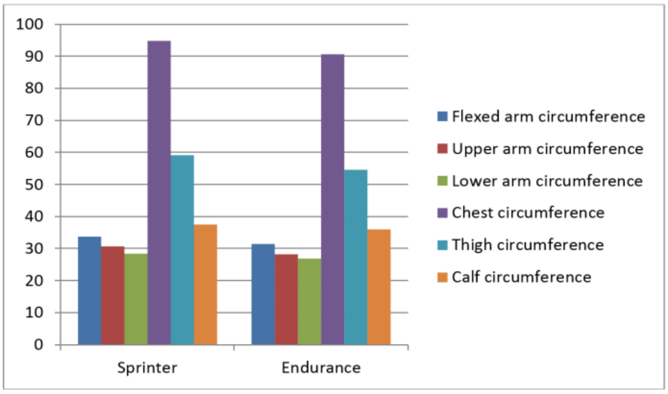


**Fig 4:** Circumference Measurements of Sprinter and Endurance Cyclists.

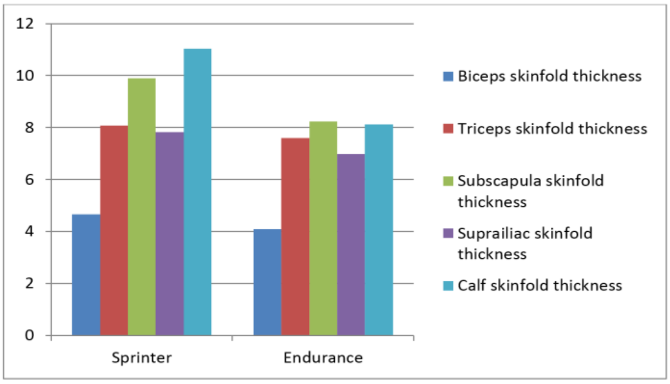


**Fig 5:** Skinfold thickness Measurements of Sprinter and Endurance Cyclists.

The length of body measurements of sprinter and endurance cyclists were revealed in table-2. The length of body measurements of sprinter and endurance cyclists are graphically presented in figure - 2 the mean values of total leg length of sprinter and endurance cyclists were 89.17 and 92.48 respectively. As revealed in the table there was significant difference found in of total leg length of sprinter and endurance cyclists (t=-3.613*, $p<0.05$).

The mean values of upper Leg length of sprinter and endurance cyclists were 41.69 and 42.50 respectively. As revealed in the table there was no significant difference found in upper Leg length of sprinter and endurance cyclists (t = -1.339, $p>0.05$).

The mean value of lower Leg length of sprinter and endurance cyclists was 47.36 and 50.56 respectively. As revealed in the table the there were significant difference found in lower Leg length of sprinter and endurance cyclists (t = -4.619*, $p<0.05$).

The mean value of total arm length of sprinter and endurance cyclists was 77.65 and 79.77 respectively. As revealed in the table there was significant difference found in total arm length of sprinter and endurance cyclists (t = -2.984*, $p<0.05$).

The mean value of upper arm length of sprinter and endurance cyclists was 32.91 and 33.31 respectively. As revealed in the table there was no significant difference found in upper arm length of sprinter and endurance cyclists (t = 4.417*, $p<0.05$).

The mean value of lower arm length of sprinter and endurance cyclists was 44.52 and 45.74 respectively. As revealed in the table there was no significant difference found in lower arm length of sprinter and endurance cyclists (t = -2.428*, $p>0.05$).

The diameter of body measurements of sprinter and endurance cyclists are graphically presented in figure - 3 the mean value of bicondylar humerus diameter of sprinter and endurance cyclists was 6.96 and 6.14 respectively. As revealed in the table there was significant difference found in bicondylar humerus diameter of sprinter and endurance cyclists (t = 6.152*, $p<0.05$).

The mean value of biacromial diameter of sprinter and endurance cyclists was 39.55 and 42.94 respectively. As revealed in the table there was no significant difference found in biacromial diameter of sprinter and endurance cyclists (t = -.948, $p>0.05$).

The mean value of hip diameter of sprinter and endurance cyclists was 30.62 and 29.78 respectively. As revealed in the table there was significant difference found in hip diameter of sprinter and endurance cyclists (t = 2.447*, $p<0.05$).

The mean value of bicondylar femur diameter of sprinter and endurance cyclists was 9.71 and 9.01 respectively. As revealed in the table there was significant difference found in bicondylar femur diameter of sprinter and endurance cyclists (t = 6.133*, $p<0.05$).

The circumference of body measurements of sprinter and endurance cyclists are graphically presented in figure - 4 the mean value of flexed arm circumference of sprinter and endurance cyclists was 33.73 and 31.34 respectively. As revealed in the table there was significant difference found in of flexed arm circumference of sprinter and endurance cyclists (t=4.382*, $p<0.05$).

The mean value of upper arm circumference of junior and senior cyclists was 30.63 and 28.23 respectively. As revealed in the table there was significant difference found in upper arm circumference of junior and senior sprinter cyclists (t = 4.417*, $p<0.05$).

The mean value of lower arm circumference of sprinter and endurance cyclists was 28.43 and 26.82 respectively. As revealed in the table there was significant difference found in lower arm circumference of sprinter and endurance cyclists (t = 4.281*, $p<0.05$).

The mean value of chest circumference of sprinter and endurance cyclists was 94.80 and 90.52 respectively. As revealed in the table there was significant difference found in chest circumference of sprinter and endurance cyclists (t = 3.996*, $p<0.05$).

The mean value of thigh circumference of sprinter and endurance cyclists was 59.09 and 54.48 respectively. As revealed in the table there was significant difference found in thigh circumference of sprinter and endurance cyclists (t = 5.248*, $p<0.05$).

The mean value of calf circumference of sprinter and endurance cyclists was 37.43 and 36.03 respectively. As revealed in the table there was significant difference found in calf circumference of sprinter and endurance cyclists (t = 2.423*, $p<0.04$).

The skinfold thickness of body measurements of sprinter and endurance cyclists are graphically presented in figure - 5 the mean values of biceps skinfold thickness of sprinter and endurance cyclists was 4.65 and 4.08 respectively. As revealed in the table there was significant difference found in of biceps skinfold thickness of sprinter and endurance cyclists (t=2.332*, $p<0.04$).

The mean value of triceps skinfold thickness of sprinter and endurance cyclists was 8.06 and 7.59 respectively. As revealed in the table there no was significant difference found in triceps skinfold thickness of sprinter and endurance cyclists (t = .819, $p>0.05$).

The mean value of subscapula skinfold thickness of sprinter and endurance cyclists was 9.89 and 8.22 respectively. As revealed in the table there was significant difference found in

subscapula skinfold thickness of sprinter and endurance cyclists (t = 2.599*, *p*<0.05).
The mean value of suprailiac skinfold thickness of sprinter and endurance cyclists was 7.83 and 6.97 respectively. As revealed in the table there was no significant difference found in suprailiac skinfold thickness of sprinter and endurance cyclists (t = 1.033, *p*>0.05).
The mean value of calf skinfold thickness of sprinter and endurance cyclists was 11.02 and 8.12 respectively. As revealed in the table there was significant difference found in calf skinfold thickness of sprinter and endurance cyclists (t = 3.254*, *p*<0.05).

**Table 3:** Description of Body Composition Measurement between Sprinter and Endurance Cyclists.

| Variable | Group | Mean | SD | Std. Error Mean | T Value |
|---|---|---|---|---|---|
| Body density (BD) kg/m$^3$ | Sprinter | 1.069 | .0052 | .0010 | -2.133* |
| | Endurance | 1.073 | .0081 | .0016 | |
| % of Body fat | Sprinter | 13.05 | 2.27 | .46 | 2.113* |
| | Endurance | 11.27 | 3.53 | .71 | |
| Total Body fat (kg) | Sprinter | 9.51 | 1.81 | .36 | 2.398* |
| | Endurance | 7.80 | 3.07 | .61 | |
| Lean Body mass (kg) | Sprinter | 63.29 | 4.68 | .94 | 2.748* |
| | Endurance | 59.91 | 3.99 | .80 | |

* Indicates *p*<0.05, SD: standard deviation, SEM: standard error of mean

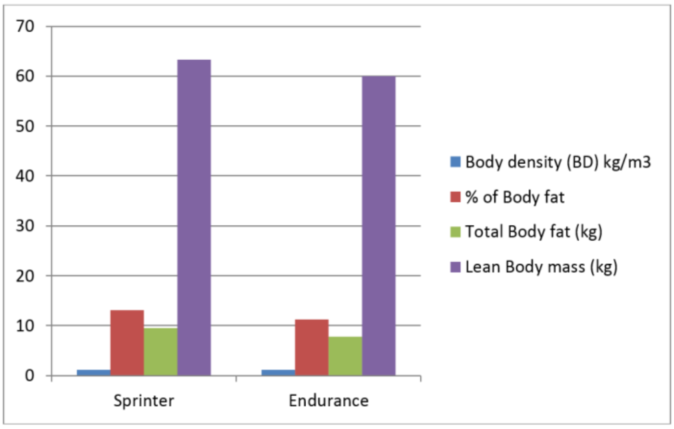


**Fig 6:** Body Composition Measurements of Sprinter and Endurance Cyclists.

The body composition measurement of sprinter and endurance cyclists was revealed in table-3 the body composition measurement of sprinter and endurance cyclists are graphically presented in figure– 6 the mean values of BD of junior and senior cyclists were 1.069 and 1.073 respectively. As revealed in the table there was significant difference found in BD of sprinter and endurance cyclists (t = -2.133*, *p*<0.05).
The mean value of % body fat of sprinter and endurance cyclists was 13.04 and 11.27 respectively. As revealed in the table there was significant difference found in % body fat of sprinter and endurance cyclists (t = 2.113*, *p*<0.05).
The mean value of total body fat of sprinter and endurance cyclists was 9.51 and 10.59 respectively. As revealed in the table there was significant difference found in total body fat of sprinter and endurance cyclists (t = 2.398*, *p*<0.05).
The mean value of total body fat of sprinter and endurance cyclists was 63.29 and 59.91 respectively. As revealed in the table there was significant difference found in total body fat of sprinter and endurance cyclists (t = 2.748*, *p*<0.05).

**Table 4:** Description of Somatotyping Measurement between Sprinter and Endurance Cyclists.

| Variable | Group | Mean | SD | Std. Error Mean | T Value |
|---|---|---|---|---|---|
| Endomorphy | Sprinter | 2.58 | .62 | .12 | 1.680 |
| | Endurance | 2.22 | .87 | .17 | |
| Mesomorphy | Sprinter | 2.98 | 1.15 | .23 | 5.071* |
| | Endurance | 1.29 | 1.20 | .24 | |
| Ectomorphy | Sprinter | 1.53 | .78 | .16 | -4.671* |
| | Endurance | 2.79 | 1.09 | .22 | |

* Indicates *p*<0.05, SD: standard deviation, SEM: standard error of mean

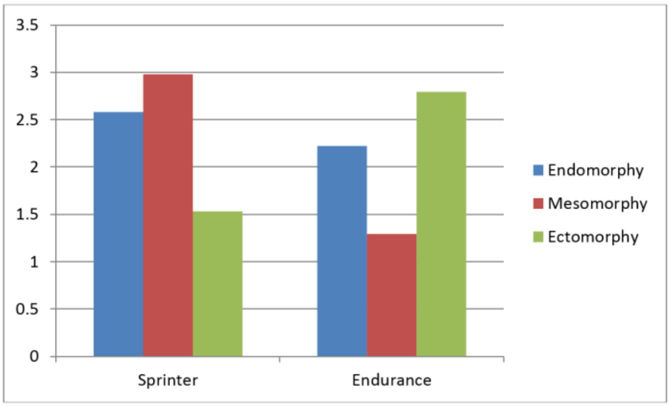


**Fig 7:** Somatotyping Measurements of Sprinter and Endurance Cyclists.

The somatotyping measurement of sprinter and endurance cyclists was revealed in table-4. The somatotyping measurement of sprinter and endurance are graphically presented in figure-7 the mean values of endomorphy of sprinter and endurance cyclists were 2.58 and 2.22 respectively. As revealed in the table there no was significant difference found in endomorphy of sprinter and endurance cyclists (t= 1.680, *p*>0.05).
The mean value of mesomorphy of sprinter and endurance cyclists was 2.98 and 1.29 respectively. As revealed in the table there was significant difference found in mesomorphy of sprinter and endurance cyclists (t= 5.071*, *p*<0.05).
The mean value of ectomorphy of sprinter and endurance cyclists was 1.53 and 2.79 respectively. As revealed in the table there was significant difference found in ectomorphy of sprinter and endurance cyclists (t= -4.671*, *p*<0.05).

## Discussion

The main purpose of the study was discovered anthropometrical, body composition and somatotyping difference in sprint and endurance cyclists. Understanding of these variables is useful for coaches who devote time and energy to train young potentials for upcoming competition. Gross body measurement results revealed significant differences in height, weight and BMI, The sprint cyclists were shorter than endurance cyclists, the sprinter cyclists have also greater weight and BMI than endurance, and these results are similar to the results stated by McLean, B.D. (2014) the sprint cyclists were shorter and stronger than endurance cyclists. The anthropometric measurements revealed significant differences in total leg length, lower leg length, total arm length, lower arm length, bicondylar humerus diameter, hip diameter, bicondylar femur diameter, flexed arm circumference, upper arm circumference, lower arm circumference, chest circumference, thigh circumference and calf circumference. Foley, J.P. *et al.* (1989) [8] exposed that sprinter cyclists have shorter limbs than pursuit and time trial cyclists. The biophysics connotations of these variations in body may be associated to the high rate of pedal revolutions needed by sprinters and the higher gear ratios used by pursuit and time trial cyclists Foley J.P. *et al.* (1989) [8]. the results related to diameter of body parts revealed that sprint cyclists have greater bicondylar humerus diameter, hip diameter and bicondylar femur diameter these results are in line with the results exposed by McLean, B.D. (2014). The results related to circumference of body parts revealed that sprint cyclists are better in flexed arm circumference, upper arm circumference, lower arm circumference, chest circumference, thigh circumference and calf circumference, similar results shown by (de Garay *et al.*, 1974) [4], the sprint cyclists' greater absolute size in mass and limb girths reflects that seen in sprint and endurance track and field athletes The results related to skinfold thickness revealed significant differences between sprint and endurance cyclists the sprinter have more Biceps, Subscapula and Calf skinfold thickness than endurance cyclists Novak *et al.* (1968) [1] observed that sprinter have more iliacrest, umbilical, thigh and calf and Subscapula skinfold thickness than middle and long distance runner.

The results related to body composition revealed significant differences between sprint and endurance cyclists. The endurance cyclists revealed higher body density as compare to sprint cyclists. Whereas, sprint cyclists revealed higher % of body fat, total body fat and lean body mass.

The results of somatotyping revealed that sprinter were more mesomorphic and less ectomorphic on counterpart endurance cyclists were more ectomorphic Tanner (1964) [3] in his research also exposed that the sprinters were short and muscular men as compared to middle distance runners.

## Conclusion

A number of difference deducted in anthropometric and body composition variables between sprinter and endurance cyclists. The sprinters were shorter, greater body mass, had short limbs length. They also had significantly greater bicondylar humerus diameter, hip diameter and bicondylar femur diameter. The sprinter cyclists dominated in all circumferences of body parts. The sprinters were more mesomorphic and less ectomorphic while endurance cyclists were more ectomorphic than sprinter. Higher body mass and shorter limbs may have biomechanical gives advantage to sprinter. Greater body mass helps to generate more force and shorter limbs may be related to the high rate of pedal revolutions required by sprinters. The endurance cyclists also had less body fat % and skinfold thickness. Number of studies revealed that low fat having positive association with distance performance.

The sprint and endurance cycling demands different anthropometric implications so coaches, scientists must be conscious during talent identification of particular event and training must be according to particular event. Moreover, a good coach should believe in both “athlete is born” and “athlete is created”.

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