VOLUME 10 (SPECIAL ISSUE 2) 2024

ISSN 2454 – 3055

Manuscripts under Special Issue are published under the theme "Modern Aspects of Applied Biology"

Guest Editor: Dr. S. Mohanasundaram

Department of Biochemistry and Crop Physiology, SRM College of Agricultural Sceices, SRM Institute of Science and Technolgy, Tamil Nadu, India

Assistant Guest Editors: Dr. Sunil Alphonse

Government College of Physical Education, Khozikode, Kerala, India

Dr. K. Geetha

Meenakshi Academy of Higher Education and Research, Kanchipuram, India

INTERNATIONAL JOURNAL OF ZOOLOGICAL INVESTIGATIONS

Forum for Biological and Environmental Sciences

Published by Saran Publications, India

International Journal of Zoological Investigations Vol. 10 (Special Issue 2), 50-56 (2024)

International Journal of Zoological Investigations
Contents available at Journals Home Page: www.ijzi.net
Editor-in-Chief: Prof. Ajai Kumar Srivastav
Published by: Saran Publications, Gorakhpur, India

ISSN: 2454-3055

Body Mass Index, Body Fat and Waist-Hip Ratio among Middle Distance Runners: A Gender-by-Gender Comparative Study

C. Rajesh[1], C.B. Rajesh[2], Nafih Cherappurath[3]*, Manu Chakravarthy[4], K. Binoy[5] and K.P. Prashobith[6]

[1]Department of Physical Education, Govt. Victoria College, Palakkad, Kerala, India
[2]Department of Physical Education, NSS College of Engineering, Palakkad, Kerala, India
[3]Department of Physical Education, Amal College of Advanced Studies, Nilambur, Kerala, India
[4]Department of Physical Education, Govt. College, Chittur, Palakkad, Kerala, India
[5]Department of Physical Education, Govt. Arts & Science College, Calicut, Kerala, India
[6]Department of Physical Education, Govt. Brennen College, Thalassery, Kerala, India

**Corresponding Author*

Received: 14th September, 2024; **Accepted:** 5th October, 2024; **Published online:** 5th November, 2024

https://doi.org/10.33745/ijzi.2024.v10ispl2.009

Abstract: This study aimed to examine the relationship between body fat, body mass index (BMI), and waist-hip ratio (WHR) of middle-distance runners in Kerala and a gender-by-gender comparison of the selected variables. One hundred and eighty (N = 180) middle-distance running athletes aged between 17 and 23 years were recruited from the schools and colleges of Kerala, India. Body fat, BMI, and WHR scores were calculated through an online calculating system. The gender distribution of participants was one hundred and twenty male and sixty female (1500 m runners). Correlation analysis revealed a strong positive correlation (r = 0.248, p<0.05) between WHR and body fat percentage. The study's primary findings were that middle-distance runners showed a significant difference in body fat and BMI between men and women athletes. The BMI results indicated that the majority of athletes (66.67%) were of average weight, while sixty athletes (33.33%) were underweight. Body fat percentages between males and females are statistically significant. The WHR has a significant positive correlation with body fat. The study concluded that there are substantial disparities in body fat, BMI, and WHR among middle-distance athletes in Kerala, indicating that developing these factors can improve athletic performance.

Keywords: Body fat, Body mass index, Waist-hip ratio, Athletes

Citation: **C**. Rajesh, C.B. Rajesh, Nafih Cherappurath, Manu Chakravarthy, K. Binoy and K.P. Prashobith: Body mass index, body fat and waist-hip ratio among middle distance runners: A gender-by-gender comparative study. Intern. J. Zool. Invest. 10(Special Issue 2): 50-56, 2024.

https://doi.org/10.33745/ijzi.2024.v10ispl2.009

Introduction

In sports and games, muscle mass is associated with performance outcomes that require strength, power, and other physical components (Siders *et al.*, 1993). Morphological optimisation

(i.e. the concept that certain physical characteristics are associated with enhanced performance) varies by event; for example, low body mass and body mass index (BMI) have been associated with distance running success, with researchers hypothesising that improved running economy mediates the relationship (Larsen, 2003). In addition, numerous studies in track and field athletics have researched anthropometric characteristics associated with event participation, and the body composition of runners has been extensively examined (Arazi *et al.*, 2015). Moreover, several factors influenced performance in endurance sports (Knechtle *et al.*, 2009). Apart from physiological variables, several anthropometric factors are associated with endurance performance, including BMI, body fat (Arrese *et al*., 2006), upper leg length and thigh circumference (Tanaka and Matsuura, 2009), limb lengths (Landers *et al.*, 2009), body mass, body height, lower limb skin-fold thickness, and total skin-fold thickness (Bale *et al.*, 1986).

Several researchers have focused on anthropometric parameters; Bale *et al.* (1986) reported that a thin physique with a high ectomorph composition is connected with increased performance in female long-distance runners (Bale *et al.*, 2007). In other study, body mass was found to impact endurance performance significantly (Knechtle *et al.*, 2008). Additionally, several researchers have investigated the impact of body mass and BMI on performance. Kenyan runners have a BMI of 19.2 kg/m^2, compared to the elite Scandinavian runners who have a BMI of 20.6 kg/m^2 (Knechtle *et al.*, 2007; Vernillo *et al.*, 2013). Moreover, other characteristics have been highlighted for long-distance runners, such as the length of the upper leg and thigh girth (Tanaka and Matsuura, 2009), and cross-country runners, anthropometric parameters appear to be more important in the prediction of performance. Leg length has also been identified as a significant predictor variable for endurance performance (Knechtle, 2014). The circumference of the upper arm, thigh, and calf limbs is another anthropometric parameter linked to endurance performance (Knechtle *et al.*, 2008; Tanaka and Matsuura, 2009).

In the current study, the investigators have gone over a handful of the many findings found in the literature review. Following a comprehensive review of the literature, the researcher focused on studies examining anthropometric parameters, including body fat, BMI, and WHR of middle-distance athletes in Kerala. Kerala athletes are well-known throughout the country for their middle-distance running. Their body fat, BMI, and WHR has not been well investigated. Therefore, this study aimed to look at the relationship between body fat, BMI, and waist-hip ratio (WHR) of middle-distance athletes of Kerala and a gender-by-gender comparison of the selected variables.

Materials and Methods

Participants

The sample included one hundred and eighty (N = 180) middle-distance running athletes aged between 17 and 23 years. More than half of the participants were men (66.6%), and the sample was selected through the purposive and convenience sampling method from the schools and colleges of Kerala, India. Samples were collected from the district, state, and national championships. The participants' prior willingness was taken into consideration. The interview schedule was created to elicit information from athletes.

Measures and procedure

The weight (kg) to height squared was used to calculate BMI (m^2). A skinfold calliper was used to measure the thickness of three skinfolds on the right side of the body (chest, abdominal, and thigh). A tape that can resist stretching at the middle point between the iliac crest and the least palpable rib was reached to the waist circle of participants. In parallel to the ground and around the most significant part of the surface, the hip circumference (HC) was measured using wrapping tape. Subjects were measured for

Table 1: The test of normality of data

Variables	Gender	Shapiro-Wilk		
		Statistic	*df*	Sig.
BFP	Men	0.981	120	0.458
	Women	0.968	60	0.488
WHR	Men	0.953	120	0.058
	Women	0.960	60	0.308
BMI	Men	0.973	120	0.198
	Women	0.956	60	0.062

BFP= Body fat, WHR**=** Waist-hip ratio, BMI= Body mass index

height and weight while wearing minimal clothing and barefoot. For weight (to the nearest 0.1 kg), a digital weighing scale (Tanita, Arlington Heights, IL, USA) was employed, and for height, a stadiometer (SECA, Leicester, UK) was used (0.1 cm). After all, the measurements taken by the researcher, the final scores of body fat, BMI, and the waist-hip ratio were calculated through an online calculating system.

Statistical analysis

The data were checked for correctness, numerically coded, and imported into the SPSS software (IBM SPSS, Inc., Chicago, IL, USA) version 23 for Windows. Before doing the statistical analysis, the data were subjected to a normality test (Table 1). Following statistical analysis, it was concluded that the data were normal. Descriptive statistics were used to analyze the data (percentage, frequency, mean, and standard deviation), an independent *t*-test, Pearson correlation analysis, and Cohen's *d* effect size.

Results

Demographic characteristics

The gender distribution of participants was one hundred and twenty male and sixty female (1500 m runners). The level of participation among the selected categories was international = 10, national position = 30, national participation = 84, state position = 20, state participation = 26, and district position = 10 athletes. The total athletes are grouped as 17-18 years = 72 (40%), 19-20 years = 74 (41.1%) and 21 and above ages = 34 (18.9%) (Table 2). Additionally, Table 2 shows the number and percentage of total athletes based on their BMI. According to the above table, most of the participants (66.7%) are in the normal range according to the World Health Organization BMI chart norms.

Relationship and gender difference in study variables

Results of the independent samples *t*-test show that mean body fat differs between men (M = 10.20, SD = 0.62, n = 120) and women (M = 11.21, SD = 0.87, n = 60) at the 0.05 level of significance (t = -6.30, df = 178, p< 0.05). The value of Cohen's d was 1.33 (<.80) which indicated large effect size. On average women tend to have higher body fat percentage than men. In the case of BMI, between men (M = 18.42, SD = 1.70, n = 120) and women (M = 19.77, SD = 1.70, n = 60) at the 0.05 level of significance (t = -3.42, df = 178, p< .05). The value of Cohen's d was 0.70 (<.50) which indicated medium effect size. It showed significant differences in BMI between men and women. Finally, WHR shows that significant difference between men (M = 0.83, SD = 0.08, n = 120) and women (M = 0.78, SD = 0.05, n = 60)

Table 2: Demographic information of the middle-distance athletes

Particulars	**Frequency**	**%**
Gender		
Male	120	66.7
Female	60	33.3
Age (Years)		
17-18	72	40.00
19-20	74	41.1
21 & above	34	18.9
Level of participation		
International	10	5.6
National Position	30	16.7
National Participation	84	46.7
State Position	20	11.1
State Participation	26	14.4
District Position	10	5.5

Table 3: Comparison of Body fat, BMI, and the waist-hip ratio of the athletes (N=180)

	Men (n=120)	**Women (n=60)**			
Parameters	*M ± SD*	*M ± SD*	*t(178)*	*p*	Cohen's *d*
Body Fat (%)	10.20 ± 0.62	11.21 ± 0.87	-6.30*	0.05	1.33
BMI (kg/m$^{2)}$	18.42 ± 1.70	19.77 ± 1.70	-3.42*	0.05	0.70
Waist-hip ratio (cm)	0.83 ± 0.08	0.78 ± 0.05	2.94*	0.05	0.78

M= Mean, SD= Standard Deviation, *Significant at 0.5 level.

Table 4: Correlations for study variables

S. No.	Variables	1	2	3
1	Body Fat (%)	-		
2	Waist-hip ratio (cm)	0.248*	-	
3	BMI (kg/m$^{2)}$	-0.025	0.102	-

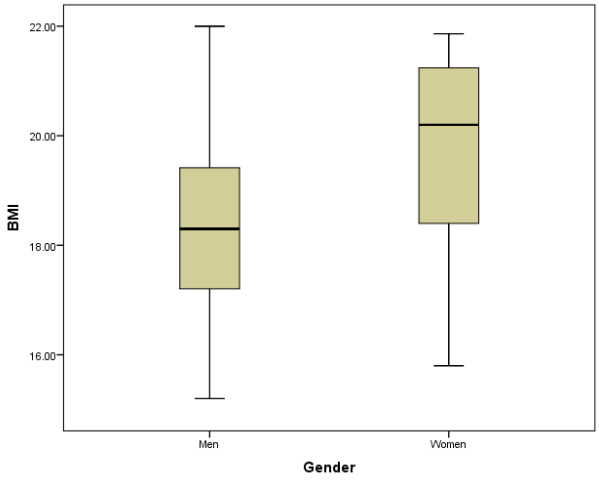

Fig. 1: Boxplot of BMI between men and women athletes.

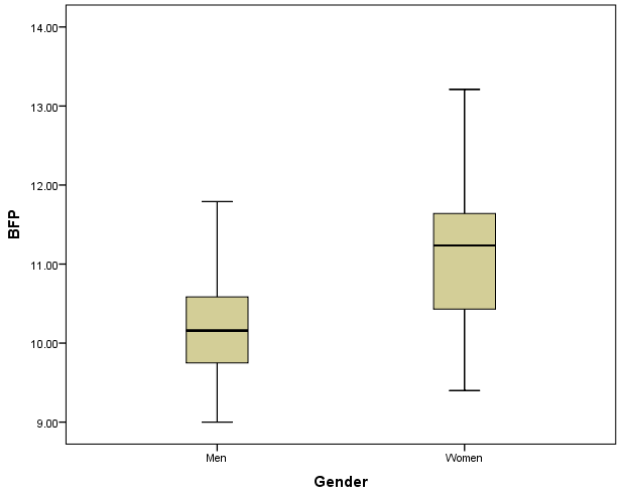

Fig. 2: Boxplot of body fat between men and women athletes.

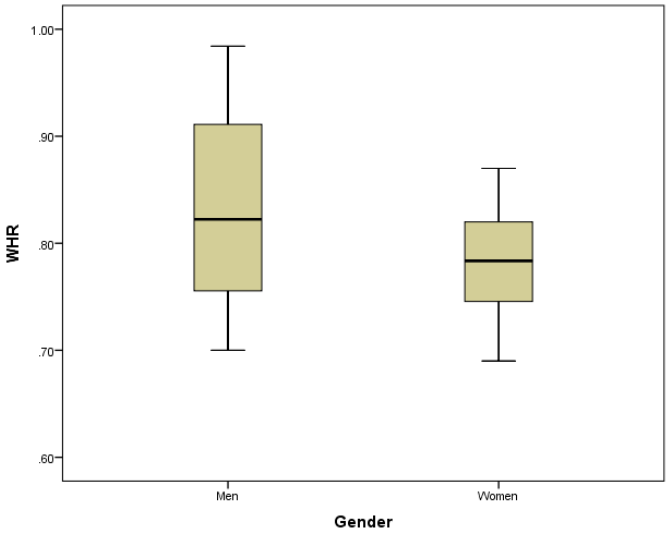

Fig. 3: Boxplot of waist-hip ratio between men and women athletes.

middle-distance runners (t = 2.94, df = 178, p<.05). The value of Cohen's d was 0.78 (<.50) which indicated medium effect size (Table 3). The findings revealed a significant mean difference in WHR between men and women (Figs.1-3).Results of the correlation among study variables, WHR has positively correlated (r = 0.248, p<0.05*)* with body fat percentage (Table 4). At the 0.05 level of significance, there are statistically significant differences in body fat, BMI, and WHR scores between men and women middle-distance runners.

Discussion

The study's primary findings were that middle-distance runners showed a favourable significant difference in body fat, BMI, and WHR between men and women. The independent *t*-test results revealed that body fat percentages between males and females are statistically significant. Wilson (2021) indicates that men generally have more muscle mass, a lower body fat percentage, and a higher VO2 max than women due to testosterone. Oestrogen helps women prepare for pregnancy by assisting them in storing fat. This difference in body fat does not vary; their body fat percentage decreases (Wilson Zoe, 2021). Another study showed that athletes who participated in sports in which their body weight was supported, such as canoeing, kayaking, and swimming, had a higher per cent fat value. Athletes compete in sports requiring a weight class, such as boxing and wrestling events such as the 100, 200, and 400 meters in extremely anaerobic and aerobic (Fleck, 1983). The present study supports the previous findings by Larsson and Henriksson-Larsen (2008), which contend that the body composition of cross-country and alpine skiers can be utilised as an independent predictor of performance (Larsson and Henriksson-Larsen, 2008). This is of interest to both coaches and athletes. Small sample numbers also constrain it, whether adult males or females or both (Larsson *et al.*, 2002). Another finding is that a Healthy Lifestyle in Europe by Nutrition in Adolescence study indicated a correlation between body composition and performance (Moliner-Urdiales *et al*., 2011).

The BMI results indicated that the majority of athletes (66.67 %) were of average weight, while sixty athletes (33.33 %) were underweight. When men (n = 120) and women (n = 60) had their BMIs compared, both were normal. According to the current study's findings, the BMI of athletes (1500 m) in Kerala was within the normal range. The results indicate a statistically significant difference in BMI between men and women athletes. Knabe (2013) reported that women's BMIs follow the same general trend as men's BMIs. Strength athletes, predictably, have high BMIs, whereas endurance athletes have low BMIs. Those who participate in sports need quick bursts of speed fall in the centre. He also noted that the BMI is low, with athletes at 1500 m, 5000 m, and 10000 m of distance and sports competitors in the performance sport of diving, skating, and gymnastics (Knabe, 2013).

The current study's findings confirm a statistically significant difference in the WHR between male and female athletes. In a previous study, researchers at Queens University in Ontario, Canada, reported that those with a high waist circumference faced a greater risk of health problems than those with a small waist circumference, even though both groups had the same BMI value (Janssen *et al*., 2002).

Applying a specific skin-fold thickness assessment instrument was a limitation of our investigation. Only three thickness assessments, such as chest, abdominal, and thigh, were used in this study. It has been recognised that various skin folds yield varied estimates for body fat, mostly using a smaller number of skinfolds. Therefore, consideration would be required if the results of this study are generalised to other evaluation methods. Future research should compare the skinfold method's assessment of fat distribution to other accurate measures of body fat, such as the ultrasound technique, underwater weighing bioelectrical impedance, etc.

Conclusion

The present study concluded that substantial disparities in body fat, BMI, and WHR existed between men and women athletes in Kerala, indicating that developing these factors can improve athletic performance. Correlation analysis of the study variables revealed a strong positive correlation between waist-hip ratio and body fat percentage. In addition, BMI showed that most of the sportspersons were average, and thirty were underweight. Comparing the BMI between men and women, showed both are normal. Hence, we recommended that the coaches and physical education professionals take the necessary steps to develop nutritional knowledge among men and women athletes.

References

Arazi H, Mirzaei B, Nobari H and Arazi H. (2015) Anthropometric profile, body composition and somatotyping of national Iranian cross-country runners. Turkish J Sport Exercise 17: 35-41.

Arrese AL, Ostáriz ES, Osta´riz ES and Osta´riz O. (2006) Skinfold thicknesses associated with distance running performance in highly trained runners. J Sports Sci. 24: 69-76.

Bale P, Bradbury D and Colley E. (1986) Anthropometric and training variables related to 10km running performance. Br J Sports Med. 20: 170-173.

Bale P, Rowell S and Colley E. (2007) Anthropometric and training characteristics of female marathon runners as determinants of distance running performance. J Sports Sci 3:115-126.

Fleck SJ. (1983) Body composition of elite American athletes. Am J Sports Med. 11: 398-403.

Janssen I, Katzmarzyk PT and Ross R. (2002) Body mass index, waist circumference, and health risk: Evidence in support of current national institutes of health guidelines. Arch Intern Med. 162: 2074-2079.

Knabe K. (2013) BMIs of Champions (Women's Edition) Runner's World. https://www.runnersworld.com/health-injuries/a20793992/bmis-of-champions-womens-edition/.

Knechtle B. (2014) Relationship of anthropometric and training characteristics with race performance in endurance and ultra-endurance athletes. Asian J Sports Med. 5: 73.

Knechtle B, Duff B, Welzel U and Kohler G. (2009) Body mass and circumference of upper arm are associated with race performance in ultra-endurance runners in a multistage race—The Isarrun 2006. Res Q Exerc Sport 80: 262-268.

Knechtle B, Knechtle P, Andonie JL and Kohler G. (2007) Influence of anthropometry on race performance in extreme endurance triathletes: World challenge deca iron triathlon 2006. Br J Sports Med. 41: 644-648.

Knechtle B, Knechtle P, Schulze I and Kohler G. (2008) Upper arm circumference is associated with race performance in ultra-endurance runners. Br J Sports Med. 42: 295-299.

Landers GJ, Blanksby BA, Ackland TR and Smith D. (2009) Morphology and performance of world championship triathletes. Ann Hum Biol. 27: 387.

Larsen HB. (2003) Kenyan dominance in distance running. Comp Biochem Physiol A Mol Integr Physiol 136: 161-170.

Larsson P and Henriksson-Larsén K. (2008) Body composition and performance in cross-country skiing. Int J Sports Med. 29: 971-975.

Larsson P, Olofsson P, Jakobsson E, Burlin L qnd Henriksson-Larsén K. Physiological predictors of performance in cross-country skiing from treadmill tests in male and female subjects. Scand J Med Sci Sports 12(6): 347-353.

Moliner-Urdiales D, Ruiz JR, Vicente-Rodriguez G, Ortega FB, Rey-Lopez JP, España-Romero V, Casajús JA, Molnar D, Widhalm K, Dallongeville J, González-Gross M, Castillo MJ, Sjöström M, Moreno LA and HELENA Study Group (2011) Associations of muscular and cardiorespiratory fitness with total and central body fat in adolescents: the HELENA study. Br J Sports Med. 45(2): 101-108.

Siders WA, Lukaski HC and Bolonchuk WW. (1993) Relationships among swimming performance, body composition and somatotype in competitive collegiate swimmers. J Sports Med Physical Fitness 33: 166-171.

Tanaka K and Matsuura Y. (2009) A multivariate analysis of the role of certain anthropometric and physiological attributes in distance running. Ann Hum Biol. 9: 473-482.

Vernillo G, Schena F, Berardelli C, Rosa G, Galvani C, Maggioni M, Agnello L and La Torre A. (2021) Anthropometric characteristics of top-class Kenyan marathon runners. J Sports Med Phys Fitness 53(4): 403-408.

Wilson Z. (2021) Female vs male athletes: same, same or different? - https://www.ambmag. com.au/feature/female-vs-male-athletes-same-same-or-different-530302.