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# Comparative analysis of body composition profiles between middle distance runners and long distance runners athletes

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**Abstract**
The purpose of this study is to compare middle distance and long distance runners' body composition profiles, which include height, weight, waist, hip, waist-to-hip ratio, and BMI. The percentages of fat, muscle, and bone make up one's body composition, which has a big impact on both general health and athletic performance. Running is a well-liked and easy workout that has several advantages, including better neurological, digestive, and cardiovascular system functions. Starting with issue formulation and hypothesis development, the research technique handles ethical considerations, data gathering, and analysis. Next, data collection and conclusion drawing are carried out, and results are tested against hypotheses. To accomplish its objectives, the study makes use of both quantitative and qualitative methodologies. Surveys were used to gather data from 112 individuals (56 middle-distance runners and 56 long-distance runners), and SPSS 22.0 was used for analysis. a comparison of the body compositions of normal people and national-level Yogasana athletes indicates notable disparities. Despite having comparable heights, athletes had lower body mass, smaller waist and hip circumferences, a higher waist-to-hip ratio, and a lower BMI than non-athletes. These results emphasize the physical advantages of consistent yoga asana practice, including a more toned body and improved body composition. Comprehending these differences is essential to creating customized training plans, making the most out of dietary adjustments, and improving the general well-being of yogasana practitioners.

**Keywords:** Body composition profiles, middle distance runners, long distance runners, athletes, physical health

## Introduction
Important to one's health and performance in sports is one's body composition, which includes the percentages of various tissues such as fat, muscle, and bone. A person's physiological make-up can be better understood, and it may have a major impact on their health in general (Fan *et al*., 2021) [6]. Because it is such a basic measure of health and fitness, the study of body composition has attracted a lot of interest from a wide range of disciplines, including sports science and clinical medicine. A wide range of variables, including heredity, lifestyle, nutrition, and exercise levels, contribute to the varied body composition profiles seen in the general population of healthy adults. On the other hand, middle distance runners and long distance runners-athletes train specifically for their sport and adhere to regimens established by the Indian government's Ministry of Youth Affairs and Sports. Athletes specializing in different running events often exhibit distinct physiological and anatomical characteristics due to the specific demands of their disciplines. This differentiation is crucial for optimizing performance in their respective events. Middle distance runners, who typically compete in events ranging from 800 meters to 3000 meters (Sandford & Stellingwerff, 2019) [13], and long distance runners, participating in races of 5000 meters or more, are no exception (Alvero-Cruz *et al*., 2020) [1]. These differences are particularly evident in their body composition profiles, which include various metrics such as muscle mass, fat distribution, and overall body weight.
Middle distance runners often require a combination of speed, strength, and endurance. Their training regimens focus on building fast-twitch muscle fibers to enhance explosive power and speed, while also developing the aerobic capacity necessary to sustain a high pace for the

duration of their events. The unique demands of middle distance running necessitate a body composition that balances muscularity with leanness. Typically, middle distance runners exhibit a higher muscle mass and lower body fat percentage compared to non-athletes. This composition allows for the powerful strides and rapid pace changes crucial for success in middle distance events. Additionally, the need for efficient oxygen utilization and lactic acid tolerance further shapes their physiological profile, emphasizing a versatile aerobic and anaerobic capacity (Rakshit & Bag, 2016) [11].

In contrast, long distance runners primarily rely on aerobic endurance, necessitating different physiological adaptations. These athletes often display higher proportions of slow-twitch muscle fibers, which are more efficient at utilizing oxygen for sustained energy production over prolonged periods. Long distance runners typically have lower overall body weight and leaner physiques, with reduced muscle mass compared to middle distance runners. This leaner body composition is advantageous as it minimizes energy expenditure and improves efficiency over long distances. The ability to efficiently metabolize fat and carbohydrates, maintain glycogen stores, and sustain long-term aerobic activity are critical aspects of a long distance runner's physiological profile (Rosado *et al*., 2020) [12].

The difference in body composition between these two types of runners is a result of both genetic predisposition and specialized training. Middle distance runners often engage in interval training, resistance exercises, and plyometrics to build muscle strength and speed, whereas long distance runners focus on high mileage, steady-state aerobic workouts, and tempo runs to enhance endurance and aerobic capacity (Barnes & Kilding, 2015) [3]. Nutritional strategies also play a pivotal role; middle distance runners may prioritize protein intake for muscle repair and growth, while long distance runners might focus on carbohydrate loading to maximize glycogen stores before races (Burke, 2010) [4].

## Objectives

To compare body composition profiles (Height, weight, waist, hip, waist hip ratio and BMI) between middle distance runners and long distance runners athletes.

## Literature review

(Mooses *et al*., 2013) [10]. This study evaluated the anthropometric, body composition, and physiological parameters of middle- and long-distance runners at the same performance level to identify traits that could indicate the likelihood of being a middle- or long-distance runner. Twenty middle-distance runners (mean body mass = 70.5 kg, standard deviation = 6.3 kg, mean height = 1.80 m, standard deviation = 0.05 m) and twenty long-distance runners (mean body mass = 69.0 kg, standard deviation = 4.5 kg, mean height = 1.81 m, standard deviation = 0.05 m) from throughout the country participated in an incremental treadmill test. In addition to measuring anthropometric and body composition parameters, we calculated various body length to mass ratios. Leg mass, length proportions, and evaluated anthropometric and body composition characteristics showed no difference ($p$>.05) between middle- and long-distance runners, with the exception of lower leg length. The performance of middle-distance runners was best represented by the second ventilatory threshold time (Adj R2=.33; $p$<.05) and the lower leg to upper leg mass ratio (Adj R2=.41; $p$<.05), whereas the performance of long-distance runners was best described by the total amount of time spent on a treadmill (Adj R2=.36; $p$<.05). The model that was created showed that middle-distance runners were classified according to their VO2maxtime (OR=1.01, 95% CI 1.001-1.012) and age (OR=1.57; 95% CI 1.065-2.310). In conclusion, this study's results demonstrate that certain anthropometric variables are helpful in predicting performance over medium-distance runs, but not over long-distance runs.

(Stachoń *et al*., 2023) [14]. Accurate anthropometric measurements are a must for competing at the elite level in running sports. Athletes in less taxing sports, such intellectual contests, may not be affected by these variables. To aid coaches and selectors at this level, we have analyzed the anthropometrics and body composition of 68 student-athletes: 26 sprinters, 22 middle-distance runners, and 20 long-distance runners. More muscle and cellular mass, wider shoulders, narrower hips, and shorter lower legs relative to thigh length characterize a sprinter's larger body. In terms of subcutaneous fat thickness, extracellular mass, and shin length, long-distance runners are unrivaled. Running intermediate distances results in a narrow trunk and minimal subcutaneous fat, making the runner the leanest. Sprinters and long-distance runners are mesomorphic, whereas middle-distance runners are more of a mixed-type mesomorph-ectomorph. Using principal component analysis, we can see how important it is to include the overall body size, limb musculature, total lower limb length (Including segments), and obesity. Running performance can be predicted using somatic traits, and this method brings attention to the physical differences amongst runners at different distances.

(Maldonado *et al*., 2002) [7]. Previous studies examining the effect of physical parameters on running economy did not compare athletes with specialized training in different competition events. This study set out to answer the question, "How does one's energy cost of running (Cr) vary with height (h) and body mass (mb)?" in a sample of 38 male runners with varying levels of experience and expertise in three different distance categories: short middle-distance (SMD; n = 12), long middle-distance (LMD; n = 14), and marathon (M; n = 12). The evaluation was also to take into account any possible variations in body dimensions between the events. The volunteers were asked to gradually increase their maximal activity on a treadmill in order to evaluate their oxygen uptake (V:O2) at different submaximal velocities and their peak oxygen uptake (V\O2max). The calculation of Cr was done by measuring V˷O2. The average levels of carbon monoxide and maximal oxygen consumption in LMD runners were significantly greater than in MMD runners (74.1±3.7, 68.5±2.9 and 69.7±3.4 ml × $kg^{-1}$ × $min^{-1}$), and in SMD runners (0.192±0.007, 0.182±0.009, and 0.180±0.009 ml O2 × $kg^{-1}$ × $m^{-1}$, respectively). Cr only showed a link with h (r = -0.86, $p$ < 0.001) and mb (r = -0.77, $p$< 0.01) in the SMD group. Therefore, these results suggest that middle- and long-distance events have different anthropometric characteristics linked to good performance, and that distance runners with a lot of training usually have contrasting profiles of running economy and $V˙O_{2max}$, where higher Cr is associated with higher $V˙O_{2max}$ and vice versa.

(Mooses & Hackney, 2017) [9]. Riding efficiency (RE), maximal oxygen uptake ($VO_{2max}$), and fractional utilization of $VO_{2max}$ when running are essential elements of running performance for all endurance athletes. Notwithstanding the dearth of statistics, investigations into these critical variables point to a unique mix of these factors as the primary cause of East Africans' distance running superiority. Rather than being attributable to any specific metabolic feature of exercising muscles, the exceptionally high RE seen in East African runners is probably associated with their anthropometric characteristics. To rephrase, there is evidence that anthropometrics and body composition play a major role in the exceptional performance of distance runners from East Africa. A lot of research papers treat this job as a descriptive one instead of an explanatory one, which is unfortunate. In this short review article, we take a look at the evidence showing anthropometrics and body composition are crucial factors in the distance running performance of runners from East Africa. One negative aspect of these athletes' body types is that they are more likely to suffer from relative energy deficiency in sport (RED-S) issues, which can have serious consequences for the health of runners of both sexes.

(ARAZI *et al*., 2015) [2]. The researchers set out to determine the anthropometric characteristics of selected national sports teams' players. This research set out to collect data on the somatotypes, anthropometric measurements, and body composition of Iranian cross-country runners. The event featured nine male national cross-country runners from Iran. The competitors' ages varied from twenty-two to thirty-two. The participants' personal bests for cross-country running were 36 minutes and 55 seconds (47 seconds); their training volumes ranged from 120 to 180 kilometers per week; and they were measured for height, weight, width, length, girth, and skin-fold thickness. To find the proportion of body fat, the seven skin-fold thickness measurements were averaged. There were also calculations for somatotype, skin-fold extremity to trunk ratio (E: T), and height-to-weight ratio (HWR). The mean values of the following parameters were recorded: Lean Body Mass (LBM), Body Fat Percentage (%BF), Waist Hip Ratio (WHR), Height to Weight Ratio (HWR), Extremity to Trunk (E: T) skin-fold ratio, Somatotype Attitudinal Distance (SAD), Manourrier, and 44.01 (1.00). A mean (standard deviation) of 1.43 (.43) was recorded for the endomorph, 4.10 (.56) for the mesomorph, and 3.63 (.73) for the ectomorph. In national Iranian cross-country runners, the ectomorph and mesomorph seem to be about the same size, with the difference being less than half a unit; however, the endomorph is noticeably smaller. Researchers and practitioners alike can benefit greatly from the reference data offered by this study, even though more studies comparing populations are needed to establish any correlations between specific anthropometric dimensions. Future research on cross-country running talent discovery, training program building, and endurance runner selection can also make use of this data.

(Yadav & Paul, 2023) [15]. When it comes to athletic performance and achievement, body composition is paramount. In order to perform at their best and avoid injuries, athletes should keep their fat-to-muscle mass ratio in a healthy range. An individual's ideal body composition may be attained by a mix of healthy eating and regular activity, however this might differ from sport to sport. In order to provide Indian athletes with a reference database, this research details the body composition of national level boxers and weightlifters in India. A descriptive cross-sectional research was conducted with a total of 144 participants: 72 weightlifters (Average age: 23.97±3.01 years), 72 boxers (Average age: 23.5±2.27 years), and 169.33±7.81 cms (Height) and 60.93±9.9 kg (Weight). Standard protocols were followed for the recording of anthropometric measurements, and the percentages of body fat and lean mass were determined using the Siri equation. Body composition and anthropometric characteristics were compared in elite weightlifters and boxers using an independent t-test. The results demonstrate that weightlifters and boxers are significantly different. Due to the demanding nature of boxing, fighters often have a lower body fat percentage and a greater fat free mass. In contrast, weightlifters often have a lower center of gravity and a larger amount of body fat to help them stay stable. This research sets national norms for body composition and anthropometric factors among male and female weightlifters and boxers. Future training purposes, as well as the identification and selection of talented boxers and weightlifters, may make use of this data.

(Mitchell *et al*., 2020) [8] Due to its cardiovascular benefits, aerobic exercise may promote healthy aging. Long-term aerobic exercise training may build muscle, increase areal BMD, and reduce fat mass. Middle-aged endurance runners with a long history of running were compared to non-runners of the same age, weight, sex, and height. Dual-energy X-ray absorption spectroscopy examined BMD, total and regional fat, and lean mass. Lumbar multifidus thickness and cross-sectional area were measured using sagittal magnetic resonance imaging. The 10 male runners averaged 49 years old, weighed 67.8 kg, stands 178.9 cm, and has a BMI of 21.4 kg/m2. Along with running 82.6 (27.9) km/week for 23 (13) years. Nine controls, averaged 51 years and 5 months old and 5.1 standard deviation, were 176.0 cm tall, 72.8 kg heavy, and 23.7 kg/m2. BMI was greater in the control group ($p = 0.010$). Compared to the control group, runners had 10% more total lean mass ($p = 0.001$) and 14% more trunk lean mass ($p = 0.010$). Their fat levels were considerably lower than controls in the following areas: Gynoid (64%; $p < 0.001$), arm (58%; $p = 0.002$), leg (52%; $p < 0.001$), trunk (73%; $p < 0.001$), android (91%; $p < 0.001$), and total body 8.6 kg ($p < 0.001$). Multifidus size and BMD findings were similar across categories. These data show that endurance running improves middle-aged body composition.

(Campa *et al*., 2021) [5]. Body composition may affect athletes' health and performance. Take this test to assess a diet's efficacy or your athlete's nutrition. Despite traditional body composition measurement methods, bioelectric impedance analysis (BIA) and BIVA are becoming more prominent in sports and research. Regression equations and reference tolerance ellipses for athletes are new, and there are few quantification methods. Thus, this narrative review presents the newest body composition analysis studies, particularly BIA and BIVA. The article describes athlete body composition measurement methods and sample frequencies and suggests further research. We also cover athletes' new tools, such as quantitative analysis for body composition estimation and qualitative analysis for bioelectrical data interpretation. Finally, BIA and BIVA didn't work for athletes until 2020 because they employed generic formulae and references. New ideas are emerging, so researchers and practitioners may receive better results.

BIA and BIVA can be used to track athletes' nutritional status and seasonal body composition changes, as well as to conduct valid comparisons within and between athletes.

**Research Methodology**

Ethical considerations, data gathering, and analysis are covered in this chapter along with the study's methodologies and measures. Academically speaking, research is an endeavor in the realm of scholarship. Researchers claim that the research process begins with issue formulation and re-definition, moves on to hypothesis generation on possible solutions, data collection, and conclusion drawing. Finally, the results are tested to determine if they align with the hypotheses.

**Research Design**

A study design helps in figuring out the best way to tackle a set of research goals and considerations. A well-organized strategy for gathering and analysing data may be developed from the research questions stated at the outset of the enterprise. Comparative analysis of body composition profiles between middle distance runners and long distance runners athletes is the Overarching Goal of this Descriptive Research Product. Numerous methods exist for carrying out descriptive studies, encompassing both qualitative and quantitative approaches. Within this study, researchers employed a mix of quantitative and qualitative approaches. Such a strategy makes use of a combination of methods. Research requires defining the aims of the study, collecting data from participants, and analyzing the results.

**Methods and Tools used**

The data was collected using a survey. One method to gather information from middle distance runners and long distance runners is through surveys. The composition profile of middle distance runners and long distance runners is determined through surveys that use a sample for this purpose. Researchers utilized a criteria to assess a study comparing body composition characteristics between middle distance runners and long distance runners athletes. Researcher surveyed 56 athletes and 56 non-athletes in this study.

**Sample size:** 112 (56 middle distance runners and 56 long distance runners)

**Statistical Analysis**

SPSS 22.0, a statistical software application, to analyze the data in this study.

**Result**

In-depth analysis of the interpretation of the survey data. Analyses statistically were performed using Independent T test.

**Table 1:** Comparative analysis of height of athletes and normal individuals

| Group Statistics | | | | | |
|---|---|---|---|---|---|
| | **Group** | **N** | **Mean** | **Std. Deviation** | **Std. Error Mean** |
| Height | Athlete | 56 | 1.6254 | .07630 | .01020 |
| | Normal Individual | 56 | 1.6538 | .08372 | .01119 |

| Independent Samples Test | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **Levene's Test for Equality of Variances** | | **t-test for Equality of Means** | | | | |
| | | **F** | **Sig.** | **t** | **df** | **Sig. (2-tailed)** | **Mean Difference** | **Std. Error Difference** |
| Height | Equal variances assumed | .373 | .543 | -1.880 | 110 | .063 | -.02845 | .01514 |
| | Equal variances not assumed | | | -1.880 | 109.065 | .063 | -.02845 | .01514 |

The table above presents a comparative comparison of the height of athletes and normal individuals. A significance value of 0.06 suggests a slight variation in height between athletes and normal individuals.

**Table 2:** Comparative analysis of weight of athletes and normal individuals

| Group Statistics | | | | | |
|---|---|---|---|---|---|
| | **Group** | **N** | **Mean** | **Std. Deviation** | **Std. Error Mean** |
| Weight | Athlete | 56 | 54.2321 | 7.81837 | 1.04477 |
| | Normal Individual | 56 | 67.4643 | 13.23626 | 1.76877 |

| Independent Samples Test | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **Levene's Test for Equality of Variances** | | **t-test for Equality of Means** | | | | |
| | | **F** | **Sig.** | **t** | **df** | **Sig. (2-tailed)** | **Mean Difference** | **Std. Error Difference** |
| Weight | Equal variances assumed | 23.979 | .000 | -6.441 | 110 | .000 | -13.23214 | 2.05429 |
| | Equal variances not assumed | | | -6.441 | 89.214 | .000 | -13.23214 | 2.05429 |

The table presents a comparative examination of the weight of athletes and normal individuals. A significance value of 0.00 indicates a significant difference in weight between the two groups.

**Table 3:** Comparative analysis of waist of athletes and normal individuals

| Group Statistics | | | | | |
|---|---|---|---|---|---|
| | **Group** | **N** | **Mean** | **Std. Deviation** | **Std. Error Mean** |
| Waist | Athlete | 56 | 28.6054 | 2.54640 | .34028 |

| | | | | | |
|---|---|---|---|---|---|
| | Normal Individual | 56 | 30.0196 | 4.01861 | .53701 |

| Independent Samples Test | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | |
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference |
| Waist | Equal variances assumed | 14.971 | .000 | -2.225 | 110 | .028 | -1.41429 | .63574 |
| | Equal variances not assumed | | | -2.225 | 93.035 | .029 | -1.41429 | .63574 |

The table above presents a comparative analysis of waist measurements between athletes and normal individuals, showing a significant difference with a significance value of 0.02.

**Table 4:** Comparative analysis of hip of athletes and normal individuals

| Group Statistics | | | | | |
|---|---|---|---|---|---|
| | Group | N | Mean | Std. Deviation | Std. Error Mean |
| Hip | Athlete | 56 | 35.5875 | 2.98317 | .39864 |
| | Normal Individual | 56 | 39.0232 | 5.06672 | .67707 |

| Independent Samples Test | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | |
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference |
| Hip | Equal variances assumed | 17.304 | .000 | -4.373 | 110 | .000 | -3.43571 | .78571 |
| | Equal variances not assumed | | | -4.373 | 89.042 | .000 | -3.43571 | .78571 |

The table above presents a comparative examination of hip measurements between athletes and normal individuals. A significance value of 0.00 indicates a significant difference in hip measurements between the two groups.

**Table 5:** Comparative analysis of waisthip ratio of athletes and normal individuals

| Group Statistics | | | | | |
|---|---|---|---|---|---|
| | Group | N | Mean | Std. Deviation | Std. Error Mean |
| Waist hip ratio | Athlete | 56 | .8046 | .04604 | .00615 |
| | Normal Individual | 56 | .7710 | .05454 | .00729 |

| Independent Samples Test | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | |
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference |
| Waist hip ratio | Equal variances assumed | 2.595 | .110 | 3.526 | 110 | .001 | .03364 | .00954 |
| | Equal variances not assumed | | | 3.526 | 106.987 | .001 | .03364 | .00954 |

The table presents a comparative analysis of the Waist-Hip Ratio between athletes and normal individuals. A significance value of 0.00 shows a significant difference in the Waist-Hip Ratio between the two groups.

**Table 6:** Comparative analysis of BMI of athletes and normal individuals

| Group Statistics | | | | | |
|---|---|---|---|---|---|
| | Group | N | Mean | Std. Deviation | Std. Error Mean |
| BMI | Athlete | 56 | 20.5368 | 2.73862 | .36596 |
| | Normal Individual | 56 | 24.4830 | 3.41503 | .45635 |

| Independent Samples Test | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | |
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference |
| BMI | Equal variances assumed | 8.045 | .005 | -6.746 | 110 | .000 | -3.94625 | .58497 |
| | Equal variances not assumed | | | -6.746 | 105.044 | .000 | -3.94625 | .58497 |

The table above presents a comparative examination of the Body Mass Index (BMI) of athletes and normal individuals. A significance value of 0.00 indicates a significant difference in the BMI between athletes and normal individuals.

**Discussion**

There are considerable variances in various physical features when comparing the body composition profiles of normal individuals with national-level Yogasana athletes. The statistical analysis using independent t-tests has provided insights into the variations in height, weight, waist-hip ratio, hip circumference, waist-hip ratio, and body mass index (BMI) between the two groups. The sig. value of 0.06

for height suggests a slight variation in height between athletes and non-athletes, but this difference is not statistically significant. It follows that height might not be a useful factor for differentiating between the two groups. The sig. value (p = 0.00) for weight indicates an important and statistically significant difference between athletes and non-athletes. Athletes have a much lower average weight than those normal individuals. The difference is most likely brought about by the rigorous diet plans and exercise regimens that contestants follow to improve their proficiency in yoga poses. Comparing athletes with normal individuals reveals similar significant differences in hip and waist measurements. Athletes' lower hip and waist measurements show a slimmer body composition than those who do not participate in sports activities. This finding aligns with the physical prerequisites of Yogasana, which emphasize muscle coordination, flexibility, and balance. Another important indicator of health and body composition that shows a clear difference between the two groups is the waist-hip ratio. Compared to normal individuals, athletes have a higher Waist-Hip Ratio, indicating a more favorable distribution of muscle and fat mass. Lastly, the BMI analysis confirms the differences between athletes and the general public. Athletes have a much lower Body Mass Index (BMI) than people who are not athletes. This is a result of their decreased body fat percentage and thinner figure, both of which help them do yoga poses as well as possible.

**Conclusion**

In conclusion, the study of body composition profiles in normal individuals and Yogasana athletes competing at the national level reveals notable variations across a range of physical parameters. Although height may not serve as a defining characteristic, athletes demonstrate reduced body mass, decreased waist and hip circumferences, an increased waist-to-hip ratio, and a lower body mass index in comparison to non-athletes. The results of this study emphasize the physical changes that are linked to consistent Yogasana practice, such as improved body composition and a more streamlined physique. Comprehending these distinctions is of the utmost importance in order to develop customized training regimens, optimize dietary interventions, and advance the general health of Yogasana athletes.

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