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Analysis of Physical Capacity and Somatotype In Middle Distance and Long Distance Running Athletes 12-15 Years Old In PASI, Pacitan Regency

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Abstract
Middle-distance and long-distance runners have different characteristics. The purpose of this study was to determine the differences in physical capacity and somatotype types between middle-distance and long-distance runners aged 12-15 years at PASI Pacitan. The quantitative descriptive research method with a cross-sectional study design to identify physical capacity and somatotype, the sample consisted of 12 runners. The determination of the research sample used purposive sampling. The results of VO2 max of middle-distance athletes in the moderate, good and excellent categories were 33.33%, respectively. In long-distance athletes, the good category was 33.33% and the excellent category was 66.66%. The somatotype results in middle-distance runners were dominated by the central type which reflects a balance between endomorph, mesomorph, and ectomorph elements, followed by mesomorph, ectomorph, and mesomorph-endomorph. In long-distance runners, the dominant somatotype was ectomorph, followed by mesomorph-ectomorph and mesomorph.

Keywords: *Physical Capacity, Somatotype, Middle Distance Running, Long Distance Running*

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INTRODUCTION

Athletics, known as a sport measured in track and field, is one of the oldest sports in the world, earning it the nickname "the mother of all sports." This sport involves basic human movements such as walking, running, jumping, and throwing (Cania et al., 2019). These two types of runners have distinct physiological characteristics. Middle-distance runners rely more on anaerobic energy consumption, while long-distance runners rely heavily on the aerobic system and generally have a higher VO_2Max (Casado et al., 2022). Endurance running performance is also influenced by anthropometric and morphological aspects.

The age of 12–15 is a crucial phase in the physical and social development of adolescents. Based on the *Long-Term Athlete Development* (LTAD) model, in the *training-to-train phase,* development focuses on endurance, strength, speed, and athletic-specific skills and fitness (Balyi et al., 2015). Anthropometric and physiological monitoring are essential to tailor training programs to the athlete's developmental stage. This study aims to support the development efforts of the Pacitan PASI (Indonesian Association of Athletics Students), particularly in developing middle-distance runners preparing for long-distance running.

Characteristic differences, such as somatotype and physical capacity, serve as the basis for accurately grouping athletes according to race specifications. Somatotype components such as skinfolds, body fat percentage, body circumference, leg length, weight, height, and BMI also influence athlete performance through their relationship to energy efficiency (Alvero-Cruz et al., 2020). Using this characteristic analysis approach, coaches can design more measurable and tailored training programs. This is expected to improve athletic performance, particularly medals in running.

METHOD

In writing this research, a quantitative descriptive research method was used with a *cross-sectional study research design*. The location and place of the research was carried out at the Gelora Pacitan Main Stadium located in Kriyan, Sidoharjo, Pacitan Regency, East Java. The data collection time was carried out in May-June 2025. The population in this study were 40 athletes who were at the PASI coaching center in Pacitan Regency.

The sample determination of this study used *purposive sampling,* so the number of samples was 12 male athletes running middle distances and long distances. Physical capacity consists of resting pulse rate, maximum pulse rate, recovery pulse rate, VO_2Max used Multistage Fitness Test (Wirawan et al.,2020). Somatotype used skinfold caliper (clinically proven accuracy measures within 1%), The accuracy ranges between ± 3.5-5%, measuring tape, vernier caliper. Body weight, height, BMI (Body Mass Index), Triceps skinfold, Biceps skinfold, Subscapular skinfold, Supraspinale skinfold, Calf skinfold, flexed upper arm circumference, relaxed upper arm circumference, thigh circumference, calf circumference maximum, humerus width, femur width (Suhartoyo, 2016). The data analysis technique in this study used descriptive analysis tests, Normality tests because the number of samples was less than 50, so the basic concept of Shapiro Wilk, hypothesis testing.

RESULTS AND DISCUSSION

Results

Table 1. Sample Characteristics

Component	Running Number	*Mean ± SD*
BMI (Kg/m ^{2})	Middle distance	19.91 ± 2.28
	Long distance	18.69 ± 1.64
Resting Heart Rate (bpm)	Middle distance	75.00 ± 53.29
	Long distance	84.00 ± 56.57
Maximum Heart Rate (bpm)	Middle distance	167.50 ± 12.80
	Long distance	176.33 ± 84.30
Recovery Pulse Rate (bpm)	Middle distance	47.00 ± 10.41
	Long distance	51.50 ± 58.91
VO2 Max	Middle distance	47.18 ± 4.03
	Long distance	51.31 ± 2.28

Middle-distance runners have a BMI of 19.91 kg/m², while long-distance runners have 18.69 kg/m². The resting heart rate of middle-distance runners is lower at 75.00 bpm compared to long-distance runners at 84.00 bpm, the maximum heart rate is higher in long-distance runners at 176.33 compared to middle-distance runners at 167.50, the recovery heart rate, middle-distance runners recorded 47.00, while long-distance runners recorded 51.50. The VO_2Max value of long-distance runners is higher at 51.31 ml/kg/min) compared to middle-distance runners at 47.18 ml/kg/min.

Figure 1. Classification of somatochart samples

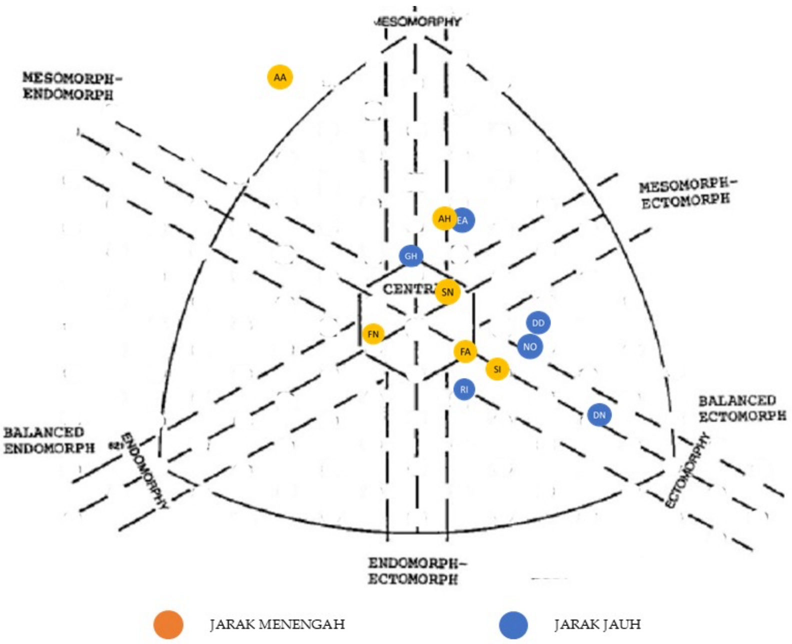

Table 4. Somatotype composition of athletes

Subject	*Gender*	*Somatotype*	Running Number
FN	L	*Central*	Middle distance
FA	L	*Central*	Middle distance
AH	L	*Mesomorph*	Middle distance
SN	L	*Central*	Middle distance
SI	L	*Ectomorph*	Middle distance
AA	L	*Mesomorph-Endomorph*	Middle distance
RI	L	*Ectomorph*	Long distance
GH	L	*Mesomorph*	Long distance
EA	L	*Mesomorph-Ectomorph*	Long distance
DN	L	*Ectomorph*	Long distance
DD	L	*Mesomorph-Ectomorph*	Long distance
NO	L	*Ectomorph*	Long distance

Among the middle-distance runners, three male subjects fell into the Central somatotype category, and one subject fell into the Mesomorph category. Meanwhile, one subject was classified as Ectomorph. One male subject had a mixed somatotype, namely Mesomorph-Endomorph. Meanwhile, among the long-distance runners, three subjects fell into the ectomorph category. The other two subjects had a mixed mesomorph-ectomorph somatotype. Meanwhile, one subject was classified as Mesomorph.

Table 5. Normality Test

	Shapiro-Wilk	
Statistics	df	**Sig**
0.851	8	**0.097**

The normality test used the Shapiro-Wilk test, the significance value was 0.097 > 0.05, so it can be concluded that the data is normally distributed.

Table 6. Independent t-test

	t	df	**Sig (2-tailed)**
VO2 Max	-2,186	10	**0.054**

The independent t-test shows that the significance value is greater than 0.05.

Discussion

The resting heart rate of middle-distance runners is lower than that of long-distance runners. Meanwhile, the maximum heart rate is higher in long-distance runners than in middle-distance runners. Meanwhile, the recovery heart rate of middle-distance runners is lower than that of long-distance runners. However, these differences occur due to adaptation factors from the training program that has been undertaken.

The VO_2Max value shows no significant difference, but based on the average value, the VO_2 Max value is greater for long-distance runners than for middle-distance runners because of the greater oxygen requirement to support endurance and the length of the race. The results of this study are also in line with research by (Rozek-Piechura et al., 2020) and (Nigussie & Tegegne, 2024) Explaining, high VO_2Max in long-distance runners is the main result of training adaptation, especially through high-intensity training, intervals, and increased training volume

In the middle-distance runner group, three subjects (FN, FA, SN) had a Central somatotype, and were supported by good upper-limb muscle mass, suitable for maintaining speed endurance. Subject (AH) was classified as Mesomorph, with dominant muscle but less height, still suitable for the middle event. Subject (SI) was Ectomorph type with a slender body and low upper muscle mass, so it was less suitable for this event. Meanwhile, subject (AA) was Mesomorph-Endomorph, with characteristics of large muscle and fat mass, was considered suitable for middle running. In the long-distance group, three subjects (RI, DN, NO) were Ectomorph type with a slender build and high endurance, suitable for this event. The other two subjects (EA and DD) were Mesomorph-Ectomorph type, showing the ability to build muscle and strength quite well, so they have potential in both long and middle distance events. Subject (GH) was Mesomorph type, with prominent muscle strength, was considered less suitable for long distance events.

These findings align with research by Muñoz et al. (2020) and Kamath et al. (2024), which stated that middle runners are generally mesomorph-ectomorph, while long distance runners are more ectomorph-dominant. However, a discrepancy was found in subjects (GH) who were more suited to middle distance events and (SI) who were more suited to long distance events. Meanwhile, (EA) and (DD) have the potential for both, so coaches are advised to consider physical capacity and somatotype variables when placing athletes in running competitions.

CONCLUSION

Based on the research results and discussion above, it can be concluded that the physical capacity and somatotype profiles of male middle- and long-distance runners in the 12-15 age group at the PASI Pacitan Regency are different. Among these, long-distance runners have an advantage in VO2Max values, with lower resting heart rates in middle-distance runners.

Meanwhile, long-distance runners have higher maximum heart rates. Meanwhile, middle-distance runners have lower recovery heart rates.

Meanwhile, Based on the somatotype classification, most middle and long-distance athletes have been placed in the race numbers that match their body characteristics. Middle-distance athletes generally have Central, Mesomorph, and Mesomorph-Endomorph somatotypes, although some are less appropriate because they have Ectomorph somatotypes. Meanwhile, long-distance athletes are dominated by Ectomorph and Mesomorph-Ectomorph somatotypes, but one case of incompatibility was found in an athlete with Mesomorph somatotype. Overall, there are several incompatibilities between somatotype and the running numbers they participate in. Therefore, coaches can consider the suitability of their athletes' somatotypes and physical capacity in determining and grouping suitable and potential athletes with the specifications of the running numbers they participate in. This approach is expected to increase the effectiveness of training programs and the achievement of athlete achievements in a more focused and sustainable manner.

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