BAB IV

RESULTS

In this study, the author took a sample of 20 athletes from the entire population, with the qualification that the athletes regularly train. The results of the calculations and measurements of the research variables' mean values and standard deviations can be seen in Table 1.

Table 1. Characteristics of Respondents

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Body Mass Index	20	19	25	22.10	1.774
Hemoglobin	20	12	18	14.40	2.010
Motivation	20	132	157	147.95	6.863
Cardiorespiratory Endurance	20	32	43	37.30	3.164

Table 2. Hypothesis Summar y

Effect	p_{ij}	t B	p-value	Summary
X_1 on Y (ρ_{y1})	0,705	3,071	0,007	Sig
X_2 on Y (ρ_{y2})	0,946	4,672	0,000	Sig
X_3 on Y (ρ_{y3})	0,087	0,853	0,203	Not Sig
X_1 on X_3 (ρ_{31})	0,670	1,950	0,034	Sig
X_2 on X_3 (ρ_{32})	0,082	0,265	0,397	Not Sig
X_1 on X_2 (ρ_{21})	0,923	5,957	0,000	Sig

    Thus, based on the results of hypothesis testing with the SPSS application, the empirical causal model X1, X2, X3 with Y is visualized as Figure 1.
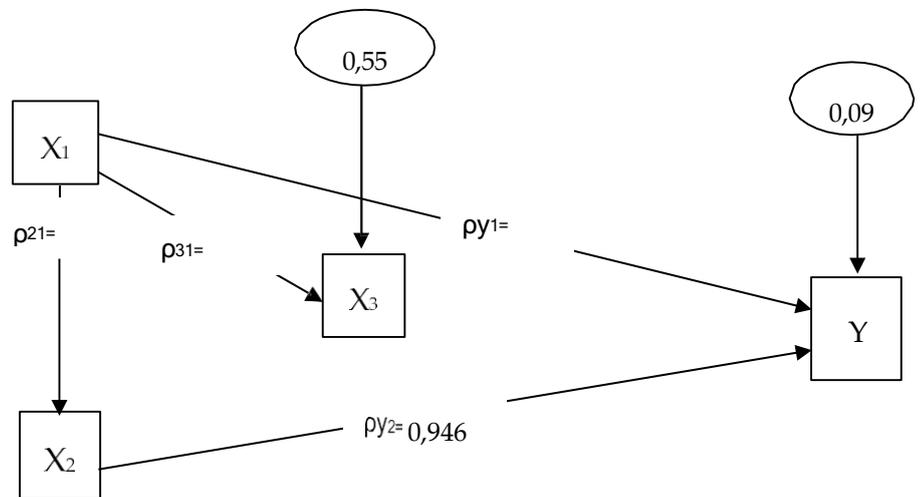

Figure1. Summaryof Average Scoresfor the Technicaland Tactics Group

Model Fit

$H_0 : R = R(\theta)$

$H_0 : R \neq \theta R ( )$

$$Q = \frac{1 - Rm^2}{1 - Re_2}$$

$R^2_m = 1-(1- 0,663)(1- 0,452)(1- 0,909) = 0,983194$

$R_e^2 = 1-(1- 0,663)(1- 0,449)(1- 0,905) = 0,98236$

$$Q = \frac{1 - 0.983194}{1 - \dfrac{0.952707}{0.98236}}$$

With a sample size (n) = 20, and the number of insignificant path coefficients (d) = 2, the chi-square test statistic with W = -(n-d) ln Q = -(20-1) In (0.952707) = 0.920509582 from the chi square table with db = d = 2, at the significance level = 0.05, the tab price = (0.05; 2) = 5.99 is obtained. Because W = 0.920509582 < 9.49 or H0 is accepted. Thus, the model obtained is appropriate or suitable (model fit) with the data.

DISCUSION

The relationship between various factors and cardiorespiratory endurance was investigated in a study. Body mass index was found to have a strong positive effect on cardiorespiratory endurance ($\rho y1 = 0.705$), indicating that individuals with higher body mass indices tend to have better cardiorespiratory endurance. Research indicates a significant relationship between body mass index (BMI) and cardiorespiratory endurance in athletes, particularly martial arts athletes. Studies have shown that individuals with higher BMIs tend to have better cardiorespiratory endurance (Dharma et al., 2021). This association is further supported by findings that increased body mass correlates with decreased cardiorespiratory fitness (Bonney et al., 2018). Additionally, BMI has been identified as a significant influencing parameter in cardiorespiratory endurance (Astuti et al., 2019). Moreover, the relationship between BMI and physical fitness, including cardiorespiratory fitness, has been explored in various studies (Eddolls et al., 2018; Chen et al., 2020; Firdausi & Simbolon, 2018). Higher cardiorespiratory fitness is linked to better quality of life, while overweight or obese individuals typically experience poorer quality of life (Eddolls et al., 2018). BMI correlates more with lean body mass than other anthropometric indices and is associated with better abdominal muscular and cardiorespiratory endurance (Chen et al., 2020). Maintaining an appropriate body weight and body fat rate in martial arts is crucial for athletes to perform well in competitions (Sadia, 2022). Athletes with higher body mass indices may experience decreased muscle strength and power, affecting their aerobic endurance during competitions (Mardiana et al., 2019). Therefore, optimizing BMI and cardiorespiratory fitness levels is essential for enhancing the performance of martial arts athletes. In conclusion, the evidence suggests a significant relationship between BMI and cardiorespiratory endurance in athletes, highlighting the importance of maintaining appropriate body weight and composition for optimal physical performance, especially in martial arts. Similarly, cardiorespiratory endurance positively affected hemoglobin levels ($\rho y2 = 0.946$), suggesting that individuals with higher hemoglobin levels may exhibit better cardiorespiratory endurance.

Hemoglobin levels have been found to positively affect cardiorespiratory endurance in martial arts athletes. Research indicates that cardiorespiratory endurance, which is the maximum capacity to utilize oxygen during physical activity, can be influenced by factors such as hemoglobin (Hb) levels and body mass index (BMI) (Astuti et al., 2019). Additionally, studies have shown that supplementing with beetroot juice may help mitigate the adverse effects of hypoxia on cardiorespiratory endurance in athletes, suggesting a potential link between certain supplements and improved endurance (Domínguez et al., 2017). Furthermore, genetic factors play a role in martial arts athletes' athletic performance, with those with higher total genetic scores demonstrating superior skill levels (Vostrikova et al., 2022). As supported by scientific literature, interval training has been shown to benefit athletes' endurance levels when practicing martial arts, emphasizing the importance of specific training methods in enhancing performance (Osipov et al., 2019). In addition to genetic and training factors, maintaining high levels of cardiorespiratory fitness has been associated with a reduced risk of conditions like type 2 diabetes, highlighting the importance of endurance training for overall health and performance in athletes (Someya et al., 2014). Core training has also been identified as a key factor in enhancing martial arts athletes' stability, strength, power, and endurance (Li & Du, 2023). Overall, a combination of factors, including genetic predisposition, appropriate training methods, and maintaining optimal cardiorespiratory fitness levels, can positively impact the endurance and performance of martial arts athletes. Further research is needed to explore this population's intricate relationship between hemoglobin levels, cardiorespiratory endurance, and athletic performance. In contrast, motivation was found to have no direct effect on cardiorespiratory endurance ($\rho y3 = 0.087$), implying that motivation levels do not significantly impact an individual's cardiorespiratory endurance. Motivation has been a key factor studied in athlete performance in martial arts. While many studies have explored the impact of motivation on athletes' performance in various sports (Aftab et al., 2022), it was found that motivation does not have a direct effect on cardiorespiratory endurance in martial arts

athletes (Setyawati et al., 2019). This finding suggests that factors other than motivation may significantly influence cardiorespiratory endurance in this specific group of athletes. The lack of a significant link between motivation and cardiorespiratory endurance in athletes can be attributed to several interconnected factors, including sample homogeneity, the method of motivation assessment, and uncontrolled training variables. Athletes often demonstrate high baseline motivation due to their commitment to regular training, which may result in a homogeneous sample and mask individual differences in motivational levels (Röthlin, 2022). For instance, perseverance, a dimension of achievement motivation, has been linked to better endurance in young cyclists, yet such effects may be too subtle to detect in highly motivated populations (Röthlin, 2022). Additionally, motivation was measured using self-reported questionnaires, which were prone to response biases such as social desirability or lack of self-awareness, potentially compromising the accuracy of psychological assessments (Perry et al., 2017). This concern is supported by findings from McHugh (2017), who reported no significant relationship between pre- competition motivation scores and subsequent endurance performance in collegiate rowers. Another critical issue is the lack of control over training variables. Endurance adaptations are highly sensitive to training intensity and modality, and even when overall energy expenditure is equal, different training intensities can produce vastly different outcomes (Reuter et al., 2024). Without accounting for these factors, the role of motivation may appear negligible. Moreover, standardized training regimens could lead to uniform endurance levels among athletes, further diminishing the observed effect of motivation (Usharani, 2017). Similarly, while some studies report a weak but significant correlation between physical activity and endurance, they underscore the more dominant influence of training intensity and specificity (Qhuzairi et al., 2023). Thus, while motivation is undoubtedly a component of athletic performance, its direct impact on cardiorespiratory endurance might be obscured by these methodological and contextual factors. Future research should include more robust, objective assessments of motivation and carefully controlled training conditions to elucidate better the interplay between psychological and physiological determinants of endurance.

Additionally, research has shown that youth athletes' physical fitness levels, particularly cardiorespiratory endurance, can vary significantly, with a considerable percentage classified in the "health risk" category (Pfeifer et al., 2019). This highlights the importance of addressing and improving cardiorespiratory fitness in athletes to ensure adequate endurance for sport participation and to mitigate potential health risks. Furthermore, studies have emphasized the importance of core strength training in enhancing flexibility, stability, and explosive strength in martial arts athletes (Feng, 2023). Core strength has been linked to improved overall strength quality and standardized execution of martial arts movements, indicating its significance in optimizing athletic performance. In conclusion, while motivation is a crucial aspect of athlete performance in sports, including martial arts, the direct impact of motivation on cardiorespiratory endurance in martial arts athletes may not be as pronounced as in other performance areas. Enhancing cardiorespiratory fitness levels and focusing on core strength training are essential components in improving martial arts athletes' physical capabilities and overall performance.

However, body mass index was positively correlated with motivation ($\rho_{31} = 0.670$), indicating that individuals with higher body mass indices may also have higher motivation levels. Body mass index (BMI) positively correlates with motivation, suggesting that individuals with higher BMIs may exhibit higher motivation levels (Kaap-Deeder et al., 2014). This relationship was further supported by a study highlighting the positive effects of a task-oriented motivational climate and adherence to a Mediterranean diet on BMI (CastroSánchez et al., 2019). Additionally, a meta-analysis study indicated a positive correlation between high BMI and an increased incidence of pes planus in athletes (Resubun et al., 2022). On the other hand, hemoglobin levels were not found to directly affect motivation ($\rho_{32} = 0.082$), suggesting that hemoglobin levels do not play a significant role in determining an individual's motivation levels. On the other hand, hemoglobin levels were not directly linked to motivation levels (Kaap-Deeder et al., 2014). However, a study revealed a direct relationship between BMI and martial arts athletes' hemoglobin levels (Shah et al., 2008). Furthermore, the study revealed a direct relationship between body mass index and hemoglobin levels ($\rho_{21} = 0.923$), indicating that individuals with higher body mass indices may also have higher hemoglobin levels. This finding suggests a potential link between body composition and blood parameters. Hemoglobin levels were associated with BMI and decreased renal function, indicating a complex interplay between these factors (Shah et al., 2008). with BMI and decreased renal function, indicating a complex interplay between these factors (Shah et al., 2008).

Overall, the results of this study highlight the complex interplay between body mass index, hemoglobin levels, motivation, and cardiorespiratory endurance. Further research is warranted to explore the underlying mechanisms driving these relationships and their implications for overall health and fitness.

Limitations of the study

This study only involved 20 Pencak Silat athletes from one university, so the generalizability of the results is limited. All participants were athletes with relatively similar motivational and fitness backgrounds, which may mask the influence of psychological variables such as motivation. Self-report measures of motivation are prone to social bias and do not always reflect actual motivation during training or competition. The study used a cross-sectional approach that only describes the relationship between variables at one point. Therefore, future research should include larger and more diverse samples from different institutions or sports to increase external validity, use data triangulation methods, such as direct observation or behavior-based measurement, to assess motivation more objectively, and longitudinal studies are recommended to identify long-term causal relationships between BMI, hemoglobin, motivation, and cardiorespiratory endurance.

CONCLUSIONS

This study concludes that body composition and hemoglobin levels significantly predict cardiorespiratory endurance among martial arts athletes, while motivation does not directly influence endurance outcomes. The strong correlation between BMI, hemoglobin, and motivation suggests an interdependent relationship among physiological and psychological variables. However, the physiological markers, particularly hemoglobin concentration and BMI, play a more decisive role in determining aerobic performance. These findings emphasize the need for targeted training and nutritional strategies to optimize body composition and blood oxygen- carrying capacity to enhance endurance. Further research with larger samples and more diverse athletic populations is recommended to generalize these results and explore deeper psychological dimensions that may indirectly impact physical performance. These findings may not be generalizable to non-bodybuilding athletes due to the specific demands of the sport