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Anthropometric profile and body composition of elite male rowers: a descriptive study

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ABSTRACT

Anthropometric characteristics, including height, body mass, body mass index (BMI), and body fat percentage, provide relevant information about rowers' body dimensions and composition, which may be associated with the biomechanical and physiological demands of rowing. This study sought to characterize the anthropometric characteristics of elite Indonesian male rowers in 2023. A descriptive quantitative design was used, with total sampling of all 14 athletes in the accessible 2023 squad. Height was assessed using a stadiometer (microtoise), while body mass was determined with a digital scale accurate to 0.1 kg. Skinfold thickness was measured using skinfold calipers. Body mass index (BMI) was computed by dividing body mass in kilograms by the square of height in meters (m^2). Descriptive statistics were used to summarize the measured variables; no inferential statistical tests or performance-prediction analyses were conducted. The mean height was 183.3 cm, mean body mass was 80.69 kg, and mean BMI was 23.99 kg/m^2. Based on BMI classification, 79% (11 athletes) were in the normal category and 21% (3 athletes) were classified as overweight. All athletes had estimated body fat percentages above the 14% reference threshold cited in the study; however, the suitability of this threshold and the skinfold-based estimation procedure for this population was not independently validated. Measurement reliability coefficients and technical error of measurement were not available for reporting. These findings provide a descriptive profile of the athletes included in the study but should not be generalized to all Indonesian elite male rowers or interpreted as evidence of rowing performance. Further research should validate body composition assessment procedures and examine anthropometric variables alongside direct performance measures.

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Introduction

In Indonesia, the sport of rowing and paddling encompasses three distinct disciplines: rowing, canoeing, and dragon boat racing. Internationally, each of these disciplines has its own. The international governing organizations comprise the Fédération Internationale des Sociétés d'Aviron (FISA) for rowing, the International Canoe Federation (ICF) for canoeing, and the International Dragon Boat Federation (IDBF) for dragon boat racing. In Indonesia, however, all three disciplines operate under a single umbrella organization: the All Indonesia Rowing Association (PODSI). Within rowing, anthropometric characteristics are relevant because body dimensions and body composition may influence the physical

demands of propelling a boat. The sport of rowing encompasses both sculling and sweep events. Yuliawati et al., (2022) explain that in sculling events, each athlete uses a pair of oars, whereas in sweep rowing, each rower handles one oar, and in both rowing disciplines, athletes sit on sliding seats facing the stern of the boat, with the oars extending from either side of the vessel. These characteristics provide a physiological and biomechanical context for examining rowers' anthropometric profiles.

Rowing is a sport oriented towards achieving high performance by analyzing several key factors, including anthropometry, biological age, and physical fitness (López-plaza et al., 2017). Numerous studies have reported a link between anthropometric variables and success in rowing, indicating that these characteristics can serve as predictors of performance (Mikulic, 2009). Research involving traditional rowers has also examined the relationships between anthropometric characteristics, body composition, and performance, while indicating that these relationships may differ according to sex and rowing context (Castañeda-Babarro et al., 2024; Penichet-Tomas et al., 2021). These findings indicate that anthropometric characteristics are not merely descriptive characteristics of athletes but also represent physical attributes that may be relevant to rowing performance (Majumdar et al., 2017; Suszter et al., 2026). Consequently, monitoring anthropometric characteristics can provide coaches with useful information for evaluating athletes' physical profiles and identifying characteristics that may support competitive performance (Rogers et al., 2022; Sella et al., 2019). However, the relevance of these characteristics should be interpreted in relation to the specific population and competitive context being examined.

Greater height enables rowers to achieve a longer stroke length in the water, which is closely associated with enhanced rowing performance (Ingham et al., 2002). In addition, higher body mass and fat-free mass may contribute positively to rowing performance (Izquierdo-Gabarren et al., 2010). The field of anthropometry has seen significant development within the realm of sports, particularly in assessing athletes' nutritional status by applying the Body Mass Index (BMI) to assess whether they are undernourished or, conversely, overweight or obese. Previous studies have highlighted the importance of determining an individual's BMI as a general indicator of health status (Sande et al., 2001; Senbanjo & Oshikoya, 2010). Excessive BMI—specifically falling into the obesity category—is directly linked to various health issues. Obesity and being overweight constitute serious public health concerns (Djalalinia et al., 2015). However, BMI alone does not fully describe an athlete's body composition, as it cannot differentiate between fat mass and fat-free mass. Therefore, the assessment of body fat percentage alongside height, body weight, and BMI provides a more comprehensive description of an athlete's anthropometric profile. For rowing athletes, this assessment is particularly relevant because an appropriate balance between body mass, fat mass, and fat-free mass may influence the physical demands associated with propulsion and overall performance. In rowing, considering these measures together can help describe the balance between body size and body composition without assuming that any single measure independently determines competitive performance.

Although anthropometric characteristics have been widely examined in relation to rowing performance. The available literature cited in this study provides limited information on the combined anthropometric profile of elite Indonesian male rowers, particularly with respect to height, body weight, BMI, and body fat percentage. anthropometric profile of elite Indonesian male rowers remains limited, particularly regarding the combined characteristics of height, body weight, BMI, and body fat percentage within a specific competitive population. Anthropometric characteristics may vary according to sport, event, training background, and competitive level; therefore, findings from rowers in other countries or populations may not necessarily represent the characteristics of Indonesian elite rowers (Abdul Rahim & Sulaiman, 2014; Asmuddin et al., 2025; León Guereño et al., 2018). This population-specific information gap warrants a descriptive investigation of the rowers' anthropometric profiles included in the present study. The study does not seek to establish new anthropometric thresholds or predict performance outcomes; rather, it provides descriptive evidence about the measured characteristics of a specific group of elite Indonesian male rowers. Accordingly, this study examines the height, weight, BMI, and the percentage of body fat among elite Indonesian male rowers in 2023. The results are anticipated to serve as an empirical basis for coaches and athletes to assess anthropometric profiles and formulate suitable training programs and performance-enhancement strategies.

Method

This study employed a descriptive quantitative method aimed at describing the anthropometric characteristics of Indonesian elite male rowers in 2023, specifically height, body weight, body mass index (BMI), and body fat percentage. A descriptive design was selected because the study focused on summarizing

the measured anthropometric characteristics of the participating athletes rather than testing causal relationships or developing a model to predict rowing performance. The study population and sample consisted of 14 Indonesian elite male rowers from the 2023 squad, selected using a total sampling technique. Total sampling was used to include all 14 athletes in the accessible squad who constituted the study population. Accordingly, the findings describe this specific cohort and should not be generalized to all Indonesian elite male rowers without evidence from a larger and more representative sample. Anthropometric measurements were conducted at the Indonesian rowing team's training site in Jatiluhur, West Java, on May 29, 2023, using the following instruments: a stadiometer (microtoise) for height, a digital scale (0.1 kg precision) for weight, and skinfold calipers Skinfold thickness was assessed at four anatomical sites: the biceps, triceps, subscapular, and suprailiac regions. Body mass index (BMI) was computed by dividing body weight in kilograms by height in meters squared (m^2), following the method described by (Mackenzie, 2016), BMI categories were classified according to the World Health Organization (WHO) criteria reported by (Nishida, 2004), severe underweight (less than 16 kg/m^2), moderate underweight (16.0–16.9 kg/m^2), mild underweight (17.0–18.49 kg/m^2), normal weight (18.5–24.9 kg/m^2), overweight (25.0–29.9 kg/m^2), Class I obesity (30.0–34.9 kg/m^2), Class II obesity (35.0–39.9 kg/m^2), and Class III obesity (greater than 40 kg/m^2). Body fat percentage was estimated from the combined measurements of the four skinfold sites measurements using Mackenzie's (2016) body fat percentage table, with the specific category for male rowers falling within the 6–14% range. This range was treated as the reference specified by the cited source and was not independently validated for Indonesian elite male rowers in the present study. Therefore, body fat classifications should be interpreted cautiously, and the 6–14% range should not be considered a population-specific clinical or performance threshold without further validation.

Skinfold measurements were performed on the right side of the body in millimeters by grasping a skinfold comprising two layers of skin and subcutaneous fat, placing the calipers approximately 1 cm from the fingers, and taking three measurements to calculate an average value for greater consistency; subsequently, the measurements for the biceps, triceps, subscapula, and suprailiac sites were summed to determine body fat percentage in accordance with the procedure outlined by (Mackenzie, 2016). The use of three measurements and their average was intended to improve consistency within the measurement procedure. However, an inter-rater reliability coefficient, technical error of measurement, and instrument calibration records were not reported in the available study documentation; therefore, these indicators cannot be quantified or claimed in this report. The suitability (Mackenzie, 2016) of body fat percentage table for Indonesian elite male rowers also remains unverified within this study, and the resulting estimates should be interpreted in light of this limitation. The obtained data were analyzed using quantitative descriptive statistics to determine mean values and characterize height, weight, BMI, and body fat percentage, with all data processing performed using Microsoft Excel 2019. The analysis was limited to descriptive summaries of the four anthropometric variables. No inferential statistical tests, hypothesis testing, or predictive modelling were conducted. The results should therefore be interpreted as a description of the measured cohort rather than evidence of associations between anthropometric characteristics and competitive performance.

Results and Discussions

Anthropometric characteristics of the 14 Indonesian elite male rowers examined in 2023 are summarized in Table 1. The analysis includes height, body weight, BMI, and body fat percentage. Individual-level measurements are summarized using descriptive statistics, including the mean, standard deviation (SD), and minimum and maximum values, were calculated to provide a comprehensive summary of the cohort's characteristic.

Table 1. Descriptive Statistics of Anthropometric Characteristics of Indonesian Elite Male Rowers (2023)

Variable	n	Mean	SD	Minimum	Maximum
Height (cm)	14	183.29	7.24	174.0	197.0
Body weight (kg)	14	80.69	6.92	71.5	94.0
BMI (kg/m^2)	14	23.99	1.14	22.1	25.6
Body fat (%)	14	23.54	3.09	17.7	26.9

According to Table 1, elite Indonesian male rowers in 2023 had a mean height of 183.3 cm and an average body mass of 80.69 kg, along with a mean body mass index (BMI) of 23.99 kg/m^2. Based on Table 1, 11 athletes (79%) fell into the normal BMI category, while 3 athletes (21%) fell into the overweight category.

More precisely, 78.6% of the athletes fell within the normal-weight category, whereas 21.4% were categorized as overweigh according to the BMI categories applied in this study. These findings describe the distribution of BMI within the observed cohort and do not establish whether the athletes' body mass was associated with rowing performance. The BMI categories for Indonesian elite male rowing athletes in 2023 are illustrated in Figure 1.

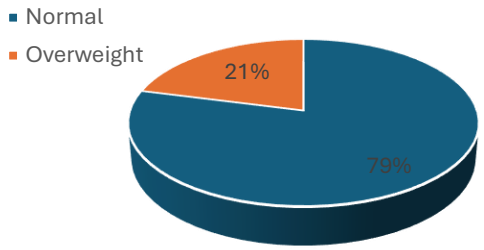


Figure 1. BMI Classification of Indonesian Elite Male Rowers (2023)

The figure should display two categories: normal BMI (11 athletes; 78.6%) and overweight BMI (3 athletes; 21.4%). The percentages should be calculated using the total sample of 14 athletes. Measurements taken using skinfold calipers yielded the skinfold totals (biceps, triceps, subscapular, suprailiac) and body fat percentages for Indonesian elite male rowers in 2023, as shown in Table 2.

Table 2. Summary of Descriptive Statistical of Skinfold Totals and Body Fat Percentage of Indonesian Elite Male Rowers (2023)

Variable	n	Mean	SD	Minimum	Maximum
Sum of four skinfolds (mm)	14	74.93	17.54	45	98
Body fat (%)	14	23.54	3.09	17.7	26.9

Table 2 shows that the mean estimated body fat percentage was 23.54% (SD = 3.09), with values ranging from 17.7% to 26.9%. All 14 athletes had estimated body fat percentages above 14%. However, this finding represents a comparison with the reference threshold cited in the original method, not independent evidence that every athlete had excessive body fat. The classification should be interpreted cautiously because the suitability of the 6–14% reference range from Mackenzie (2016) for Indonesian elite male rowers has not been established in this study.

Research findings indicate that in 2003, the average height of Indonesian elite male rowers was 183.3 cm, and their average body weight was 80.9 kg. For comparison, the average height of rowers at the London 2012 Olympics was 189.9 cm with an average weight of 87 kg, while the average height of rowers at the Rio 2016 Olympics was 190 cm with a weight of 86.5 kg. These Olympic figures should be retained only after their original sources and the populations used to calculate the averages have been verified. Mikulic, (2009) noted that studies on Olympic rowers show similar trends regarding both height and body mass; male Olympic rowers often exceed 190 cm in height and 90 kg in weight. This provides a useful comparison with an international heavyweight cohort, although it is not a direct comparison with the Indonesian sample because competitive categories and study protocols may differ. Penichet-Tomás et al. (2019) stated that height is widely accepted as a crucial anthropometric characteristic for rowing performance, as greater height increases the amplitude of movement in the water. Cosgrove et al., (1999) indicated that data suggest taller rowers with high lean body mass may have an advantage due to longer lever arms. Compared with these international references, the average height and body weight of Indonesian elite rowers were relatively lower, suggesting that anthropometric characteristics may still represent an important area for evaluation in developing competitive rowing performance (Asmuddin et al., 2025; Penichet-Tomas et al., 2021). Nevertheless, body size should not be interpreted as the sole determinant of performance because technical ability, physiological capacity, training status, and body composition also contribute substantially to rowing performance.

The observed differences in mean height and body weight provide a descriptive comparison with the cited Olympic cohorts. However, the present study did not conduct a direct statistical comparison with those populations, and differences in competitive level, event category, selection criteria, and measurement procedures may influence the results (Kim et al., 2019; Vega-Monzó et al., 2026). Therefore, the lower mean height and body weight observed in this cohort should not be interpreted as evidence of inferior competitive ability or as a basis for establishing athlete-selection thresholds. Future comparative research should use clearly defined and comparable rowing categories, standardized anthropometric procedures, and direct performance measures to determine whether these differences are associated with competitive outcomes.

Based on calculations using the BMI formula—Body Weight (kg) / Height (m)²—the average Body Mass Index (BMI) for Indonesian male rowers in 2023 was found to be 23.99 kg/m². For context, the BMI of athletes at the 2012 London Olympics was 24.9 kg/m², while that of athletes at the Rio Olympics was 23.9 kg/m². The BMI results indicate that 79% (11 individuals) of the 2023 Indonesian male elite rowers fell into the normal category, while 21% (3 individuals) fell into the overweight category. These results suggest that the majority of these athletes maintain a normal BMI, though the three individuals in the overweight category require special attention. Raharjo, (2006); Wibowo & Hakim, (2019) note that previous research highlights maintaining an ideal BMI as a crucial step toward achieving peak performance, although certain sports—such as martial arts or sumo—require specific body weight profiles. The average BMI observed in the present study was also relatively comparable with the BMI reported among Olympic rowers, indicating that the overall body mass relative to height of Indonesian rowers was within a similar range (Baranauskas et al., 2024; De Larochelambert et al., 2020; Penichet-Tomas et al., 2021). However, BMI should be interpreted cautiously in athletes because a higher BMI may reflect greater muscle mass rather than excessive fat accumulation (Simpson, 2021; Stojković et al., 2022). Therefore, additional assessment of body composition, particularly body fat percentage, is necessary to provide a more meaningful interpretation of the athletes' physical characteristics.

The mean BMI of 23.99 kg/m² was close to the Olympic reference values cited above. Nevertheless, BMI is a screening measure based on body weight and height and cannot distinguish fat mass from fat-free mass. Consequently, the three athletes classified as overweight should not automatically be considered to have excessive body fat or impaired rowing performance. Their individual body composition and performance characteristics would need to be examined before drawing athlete-specific conclusions. The combination of BMI and estimated body fat percentage provides a broader descriptive profile, although the accuracy of the body fat estimates depends on the measurement and conversion procedures used.

It is important to determine values derived from skinfold measurements, as these are used to predict fat mass (Penichet-Tomas et al., 2021). Calculations reveal that the body fat percentage of all 2023 Indonesian male rowers fell into the "excess" category, exceeding 14%. According to (Mackenzie, 2016), the target body fat percentage for male rowers is 6–14%. Mielgo-Ayuso et al., (2015) state that excessive fat mass in rowers acts as dead weight, negatively impacting speed and reducing acceleration capabilities. Although all 14 athletes had estimated body fat percentages above the cited 14% threshold, the present study did not independently validate this threshold for the Indonesian rowing population. The results should therefore be reported as estimated body fat values exceeding the reference range, rather than definitive evidence that all athletes had excessive body fat. The finding that all athletes exceeded the recommended range therefore represents an important aspect of the anthropometric profile of the Indonesian elite rowers examined in this study. Although body fat provides an important energy reserve, excessive non-functional mass may increase the total load that must be moved during each stroke without directly contributing to force production (Giuriato et al., 2026). Consequently, the assessment of body fat percentage can complement BMI in identifying whether body mass is predominantly associated with functional lean tissue or excessive fat mass (Goossens, 2017; Smith & Madden, 2016). However, the present study did not directly measure lean mass, rowing speed, acceleration, or competitive outcomes. Accordingly, the relationship between body fat percentage and performance cannot be established from these descriptive data alone

Based on these findings, the anthropometric profile of Indonesian elite male rowers in 2023 shows a relatively normal BMI but a body fat percentage that exceeds the recommended range for male rowing athletes. This finding highlights an important distinction between BMI and body composition, as a normal BMI does not necessarily indicate an optimal proportion of fat and lean mass. The relatively lower average height and body mass compared with international Olympic rowers, combined with the elevated body fat percentage, may provide useful information for coaches when evaluating the physical characteristics of Indonesian rowers. However, the findings should be interpreted as descriptive rather than as direct evidence that body fat alone determines rowing performance. Future training and athlete-monitoring programs may

therefore consider body composition alongside physical performance, physiological capacity, and technical characteristics to establish more individualized performance strategies for elite Indonesian rowers

Conclusions

Drawing on the findings and discussion presented, it can be concluded that the mean height of Indonesian elite male rowers in 2023 was 163.3 cm, and their average body weight was 80.9 kg. The average Body Mass Index (BMI) for these athletes was 23.99 kg/m². BMI calculations revealed that 11 athletes (79%) fell into the normal category, while 3 athletes (21%) fell into the overweight category. Furthermore, the findings indicate that the body fat percentage for all these athletes exceeded 14%, based on the reference range cited in the study. However, this threshold has not been independently validated for Indonesian elite male rowers; therefore, these findings should be interpreted as estimated body fat percentages exceeding the cited reference value rather than definitive evidence of excess body fat. These findings describe the anthropometric characteristics of the 14 athletes included in this study and should not be generalized to all Indonesian elite male rowers. The relatively small, cohort-specific sample and the absence of reported measurement reliability coefficients limit the interpretation and generalizability of the results. Future studies should include larger samples, verify the suitability of body fat estimation methods and reference ranges for the target population, and examine anthropometric characteristics alongside direct measures of rowing performance.

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