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EXPLORING THE RELATIONSHIP BETWEEN ANTHROPOMETRIC VARIATION AND RESTING ENERGY EXPENDITURE: IMPLICATIONS FOR PERFORMANCE AND HEALTH IN INDIVIDUAL

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Abstract: This review explores the relationship between anthropometric variation and resting energy expenditure (REE), focusing on body weight, body composition, and body mass index (BMI). The understanding of how these factors influence REE has important implications for optimizing performance and health outcomes in individuals. Higher body weight and fat-free mass (FFM) are associated with increased REE due to higher energy demands. Similarly, higher BMI is correlated with higher REE. These relationships are crucial for athletes, coaches, and healthcare providers in designing personalized training and nutrition plans. The review also highlights the importance of considering individual variations in REE and the interplay between REE and other physiological markers, such as VO2 max and anaerobic capacity, in optimizing athletic performance. Future research directions include exploring the underlying mechanisms, longitudinal studies, investigating other factors' impact, and developing more accurate assessment methods. Overall, a comprehensive understanding of the relationship between anthropometric variation and REE can guide interventions to optimize energy availability, support recovery, and achieve desired performance and health outcomes in individuals.
Keywords: Anthropometric Variation, Resting Energy Expenditure, BMI, Fat-Free Mass

1. Introduction:

Human bodies are complex systems, and their performance depends on several factors, including genetics, lifestyle, and body composition. The latter is particularly important when it comes to physical performance, as it can affect resting energy expenditure (REE), VO2 max, and anaerobic capacity[1]. Understanding the relationships between these variables and body composition is crucial for athletes, coaches, and healthcare providers who want to optimize performance and health outcomes[2]. The relationship between anthropometric variation and resting energy expenditure (REE) has garnered significant interest in the fields of exercise physiology, sports science, and healthcare. Resting energy expenditure refers to the energy required for basic physiological functions at rest and plays a crucial role in overall energy balance and body weight regulation[3]. Anthropometric variation encompasses differences in weight, size, and body composition among individuals, which can greatly influence their resting energy expenditure. Understanding the intricate relationship between anthropometric variation and resting energy expenditure has important implications for optimizing performance and health outcomes in individuals. Athletes, coaches, and healthcare providers can benefit from this knowledge to develop personalized training programs, improve athletic performance, and effectively manage body weight and composition[4,5]. Higher body weight generally leads to higher resting energy expenditure due to increased energy requirements for maintaining a larger body mass. Similarly, individuals with higher fat-free mass (FFM), which comprises metabolically active tissues such as muscles, tend to have higher resting energy expenditure as these tissues demand more energy. Body mass index (BMI), a measure of body composition derived from height and weight, is strongly correlated with resting energy expenditure, with higher BMI often associated with higher energy expenditure[6,7]. This review paper aims to explore the relationship between anthropometric variation and resting energy expenditure, with a specific focus on body weight, body composition, and BMI. It will delve into the existing literature to examine how these factors influence resting energy expenditure and their implications for performance and health in individuals. Furthermore, the review will specifically focus on young, healthy individuals to provide insights into the anthropometric variation-response relationship between resting energy expenditure, VO2 max (maximum oxygen consumption), and anaerobic capacity. By synthesizing the current knowledge and research findings in this field, this review seeks to provide a comprehensive understanding of the interplay between anthropometric variation and resting energy expenditure.

1.1 Resting Energy Expenditure (REE) and Its Significance

Resting energy expenditure (REE) is the amount of energy expended by an individual at rest, in the absence of physical activity or food intake. It represents the energy required for essential physiological functions to maintain basic bodily processes such as respiration, circulation, and organ function[8]. Understanding REE is of paramount importance in the fields of exercise physiology, nutrition, and healthcare, as it plays a crucial role in energy balance, weight management, and overall health. REE accounts for the largest portion of total daily energy expenditure in most individuals, typically ranging from 50% to 75%. It serves as a fundamental component of the total energy expenditure equation, which includes energy expended during physical activity, the thermic effect of food, and adaptive thermogenesis[9,10]. By accurately assessing REE, researchers, athletes, and healthcare professionals can better understand individual energy requirements and make informed decisions regarding nutrition, weight management, and performance optimization (**Figure:1**). The significance of REE lies in its association with body weight regulation. Higher REE levels are generally observed in individuals with greater body weight due to the increased energy requirements of maintaining a larger body mass[11,12]. This has important implications for weight management and obesity prevention, as individuals with higher REE may require more energy intake to maintain their body weight.

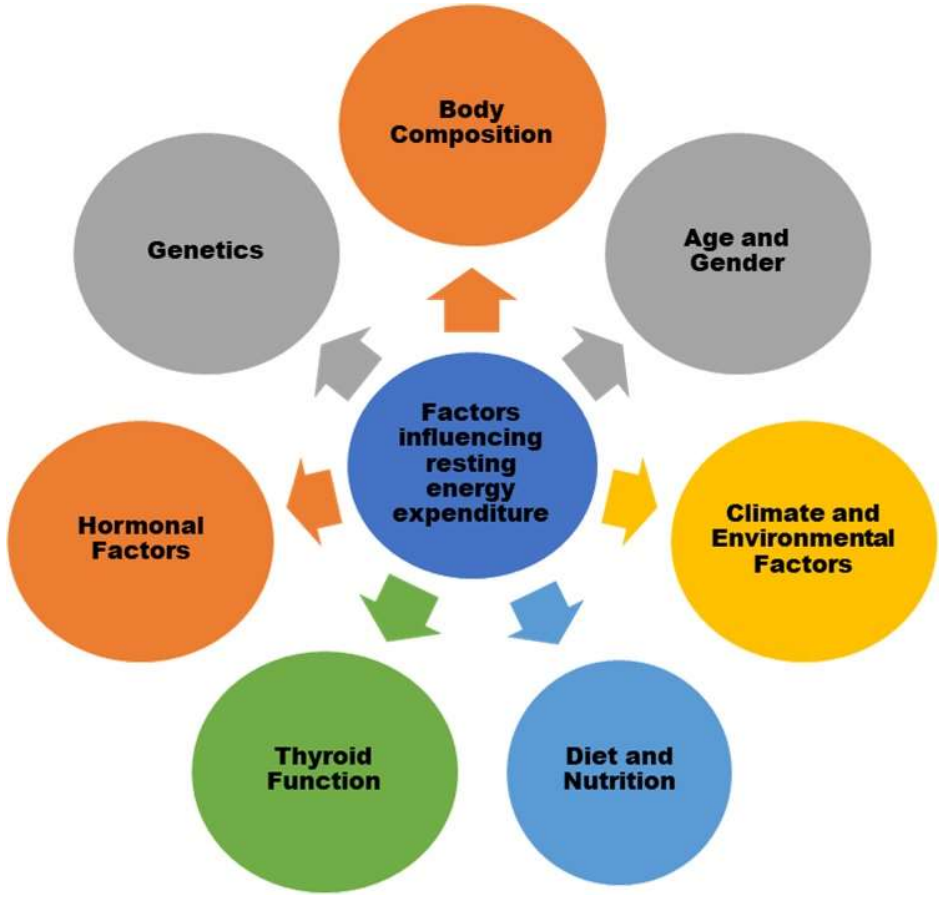

Figure:1 Various factors influencing the REE

Conversely, individuals with lower REE may be at a higher risk of weight gain if their energy intake exceeds their expenditure. Anthropometric factors, such as body weight, composition, and body mass index (BMI), have a direct impact on REE. Body weight is a major determinant of REE, as larger bodies require more energy for metabolic processes[13-16]. Additionally, body composition, specifically the amount of fat-free mass (FFM) and fat mass (FM), influences REE. FFM, which includes metabolically active tissues like muscles, has a higher energy demand compared to FM. Therefore, individuals with higher FFM tend to have higher REE due to the increased energy requirements of maintaining and supporting muscle mass. BMI, a commonly used measure of body composition derived from height and weight, is strongly correlated with REE[17]. Higher BMI values are often associated with higher REE levels. This relationship can be attributed to the fact that individuals with higher BMI generally have larger body mass and higher FFM, both of which contribute to increased REE. Understanding the connection between BMI and REE is crucial for healthcare providers, as it helps assess energy requirements, develop appropriate nutrition plans, and address weight-related health concerns. Accurately measuring REE is essential for determining individual energy requirements and designing personalized nutrition and exercise interventions[18]. Various methodologies are available for assessing REE, including indirect calorimetry, predictive equations, and wearable devices. Indirect calorimetry, which measures oxygen consumption and carbon dioxide production, is considered the gold standard for REE assessment. Predictive equations, such as the Harris-Benedict equation, estimate REE based on factors like age, gender, weight, and height. While these equations provide convenient estimations, they may have limitations in certain populations and may not account for individual variations in metabolism[19-22].

2. Anthropometric Variations and Resting Energy Expenditure:

Resting energy expenditure refers to the amount of energy the body needs to maintain basic functions, such as breathing, circulating blood, and maintaining body temperature, while at rest[23]. It is influenced by several factors, including age, sex, and body composition. Several studies have investigated the relationship between anthropometric variations and REE in young, healthy individuals[24]. One such study found that individuals with higher amounts of body fat had lower REE than those with lower amounts of body fat, even after controlling for age, sex, and lean body mass (LBM)

1. Another study found that REE was positively correlated with LBM and negatively correlated with body fat percentage in both male and female athletes
2. These findings suggest that body composition, specifically body fat percentage and LBM, play important roles in determining REE in young, healthy individuals

2.1 Relationship between anthropometric variations and resting energy expenditure:

1. Fat-free mass (FFM): Resting energy expenditure (REE) is largely determined by FFM, which includes all non-fat tissues in the body, such as muscle, organs, and bone. Individuals with higher amounts of FFM have a higher REE, as these tissues require more energy to maintain than adipose tissue (body fat). Fat-free mass (FFM) refers to the total mass of all non-fat tissues in the body, including muscle, bone, organs, and other lean tissues[25-26]. FFM is an important predictor of overall health and well-being, as well as an important factor in determining resting energy expenditure (REE) and metabolic rate. Studies have shown that individuals with higher amounts of FFM have a higher REE, due to the increased energy requirements of maintaining muscle, bone, and organ tissues[27-29]. FFM is the primary determinant of REE in young, healthy individuals. As a result, FFM has been suggested as a better predictor of energy needs and nutritional requirements than body weight alone.

   Research has also shown that maintaining and increasing FFM through exercise and resistance training can have significant health benefits, such as improved insulin sensitivity, increased bone density, and a reduced risk of chronic diseases such as type 2 diabetes and heart disease[30-31]. Therefore, it is important to note that FFM is not the only determinant of metabolic rate and energy expenditure. Other factors, such as genetics, age, sex, and lifestyle, can also have a significant impact on energy needs and metabolic rate [32]-[33]. The study also found that women had a lower REE than men, even when accounting for differences in FFM, due to differences in hormonal and metabolic factors[34]. Another study published in the International Journal of Obesity found that FFM was a better predictor of metabolic rate than body mass index (BMI) or body fat percentage. The study also found that resistance training was an effective way to increase FFM and metabolic rate in overweight and obese individuals. Overall, FFM is an important factor in determining energy needs and metabolic rate and maintaining and increasing FFM through exercise and resistance training can have significant health benefits[35] (**Figure:2**).

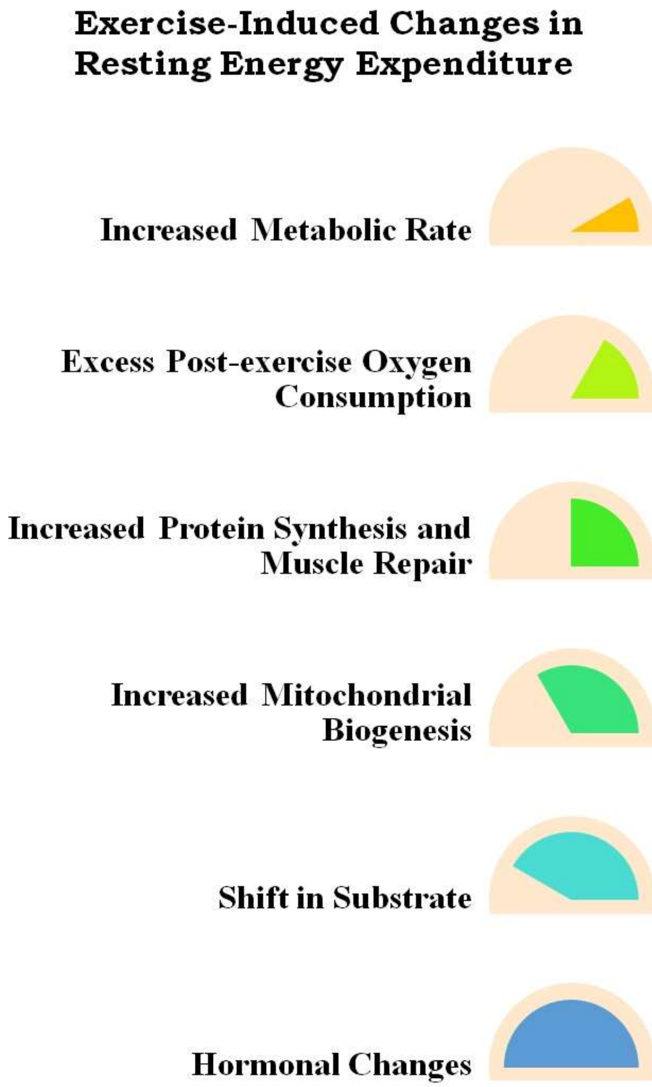

Figure:2 Effects of Exercises on REE

2.2 Anthropometric Variations and VO2 Max:

VO2 max refers to the maximum amount of oxygen that the body can use during exercise. It is considered one of the most important predictors of cardiovascular health and athletic performance. The relationship between VO2 max and body composition has been investigated in numerous studies. One study found that body fat percentage was negatively correlated with VO2 max in male and female athletes (3). Another study found that VO2 max was positively correlated with LBM and negatively correlated with body fat percentage in young, healthy men (4). These findings suggest that body composition, specifically body fat percentage and LBM, are important predictors of VO2 max in young, healthy individuals[36-38].

2.3 Anthropometric Variations and Anaerobic Capacity:

Anaerobic capacity refers to the ability of the body to produce energy without oxygen. It is an important factor in high-intensity exercise, such as sprinting or weightlifting. Several studies have investigated the relationship between anthropometric variations and anaerobic capacity in young, healthy individuals[30-40]. One such study found that body fat percentage was negatively correlated with anaerobic power output in male and female athletes (5). Another study found that LBM was positively correlated with anaerobic power output in young, healthy men (6). These findings suggest that body composition, specifically body fat percentage and LBM, play important roles in determining anaerobic capacity in young, healthy individuals[41-42].

3. **Body Composition and Resting Energy Expenditure**

Fat-Free Mass (FFM) refers to the weight of the body's non-fat components, including muscles, bones, organs, and water. FFM plays a crucial role in resting energy expenditure (REE), as metabolically active tissues demand more energy for their maintenance and functioning. Understanding the relationship between FFM and REE is essential for assessing individual energy requirements, designing effective weight management strategies, and optimizing athletic performance[43-44]. FFM contributes significantly to the overall energy expenditure of an individual at rest. Compared to adipose tissue (body fat), FFM has a higher metabolic rate, resulting in increased energy expenditure. This is primarily due to the energy demands of maintaining and supporting metabolically active tissues such as skeletal muscles and organs. Muscles, in particular, are highly metabolically active, requiring a substantial amount of energy for contraction, repair, and protein synthesis[45-47]. The relationship between FFM and REE is well-documented. It has been consistently observed that individuals with higher FFM tend to have higher REE levels. This means that individuals with greater amounts of lean muscle mass generally have a higher energy expenditure, even when at rest. Consequently, individuals with higher FFM may require more energy intake to meet their daily energy needs and maintain body weight compared to those with lower FFM[48-50].

One reason behind the higher energy demands of FFM is the greater mitochondrial density in muscle tissue. Mitochondria are the powerhouses of the cells, responsible for producing adenosine triphosphate (ATP), the energy currency of the body. The higher mitochondrial content in muscles leads to increased oxidative metabolism and subsequent energy expenditure. Additionally, FFM has a higher protein content than adipose tissue and protein turnover requires energy for processes like synthesis, degradation, and maintenance[51]. Changes in FFM can have a significant impact on REE. For instance, resistance training or strength training can increase FFM by promoting muscle growth and hypertrophy. As a result, individuals who engage in regular strength training may experience an elevation in their REE, even at rest. This is due to the increased energy requirements of the additional muscle mass. Conversely, conditions that lead to FFM loss, such as prolonged bed rest or certain diseases, may result in a decrease in REE[52]. In addition to its influence on energy expenditure, FFM is also important for overall health and athletic performance. Greater FFM is associated with improved physical strength, functional capacity, and performance in various sports and activities. Athletes, especially those involved in strength and power sports, often strive to increase their FFM to enhance their performance. Optimizing FFM through resistance training and appropriate nutrition can contribute to improved athletic capabilities and overall physical well-being[53]. Accurately assessing FFM is crucial for understanding an individual's unique energy requirements and designing personalized nutrition and exercise interventions. Methods such as dual-energy X-ray absorptiometry (DXA), bioelectrical impedance analysis (BIA), and skinfold thickness measurements are commonly used to estimate FFM. These techniques provide valuable information about body composition, allowing for tailored approaches to energy balance and weight management. Overall, Fat-Free Mass (FFM) significantly influences resting energy expenditure (REE). Higher FFM, particularly lean muscle mass, is associated with increased energy demands due to the metabolic activity of metabolically active tissues. Individuals with higher FFM generally have higher REE levels, requiring more energy intake to meet their daily energy needs. FFM also plays a crucial role in athletic performance, as greater muscle mass is associated with improved strength and functional capacity. Accurate assessment of FFM is vital for tailoring nutrition and exercise interventions to optimize energy balance, weight management, and performance outcomes[54-55].

3.1 **Fat Mass (FM) and Resting Energy Expenditure**

The relationship between fat mass (FM) and resting energy expenditure (REE) remains complex and multifaceted. While FM is often overlooked in favour of fat-free mass (FFM) when discussing energy expenditure, it does play a role in overall energy balance and weight management. The distribution of fat, particularly visceral fat, may have some influence on REE, but the precise mechanisms are not well understood. Adipokines released by adipose tissue can impact energy metabolism, but their specific relationship with REE is still unclear. Weight loss interventions targeting FM reduction may lead to decreases in REE, posing challenges for long-term weight management[56-57]. Accurate assessment of FM is crucial for developing personalized strategies, but measurement techniques have limitations. Factors such as age, sex, and health status may further modulate the relationship between FM and REE. The interplay between FM, FFM, and other factors like physical activity and dietary intake must be considered when examining their impact on REE[58]. To advance our understanding, future research should explore the underlying mechanisms, genetic and epigenetic factors, and the role of inflammation and metabolic health. Longitudinal studies and population-specific investigations are needed to provide a comprehensive understanding of the complex relationship between FM and REE. Overall, a holistic approach that considers multiple factors is crucial for unravelling the intricate interplay between FM and REE and its implications for energy balance and weight management[59].

4. **Body Mass Index (BMI)- A Predictor of Resting Energy Expenditure**

Body Mass Index (BMI) is a commonly used measure of body composition and is often considered a predictor of resting energy expenditure (REE). However, the relationship between BMI and REE is complex and warrants critical examination. While BMI provides a simple and readily available tool for assessing weight status, it fails to differentiate between fat mass (FM) and fat-free mass (FFM), which have distinct metabolic properties. Research has shown that BMI may not accurately reflect an individual's metabolic status or energy expenditure. Individuals with similar BMI values can have varying levels of FM, FFM, and body fat distribution, which can significantly influence REE. Additionally, factors such as age, sex, and ethnicity can impact the relationship between BMI and REE, further complicating the predictive value of BMI alone[60-61].

BMI is limited in its ability to account for variations in body composition and fails to capture the intricacies of metabolic function. It does not consider the relative proportions of FM and FFM or the influence of factors such as muscle mass and fat distribution, which can significantly impact REE. Therefore, relying solely on BMI as a predictor of REE may lead to inaccurate estimations of energy requirements. To improve the accuracy of predicting REE, it is crucial to incorporate additional measures, such as body composition analysis using techniques like dual-energy X-ray absorptiometry (DXA) or bioelectrical impedance, which provide a more comprehensive assessment of FM, FFM, and body fat distribution[62-63]. Considering individual characteristics and factors beyond BMI will enhance the understanding of the relationship between body composition and REE. So, while BMI is widely used as an indicator of weight status, its utility as a predictor of REE is limited. The complex interplay between BMI, FM, FFM, and other factors underscores the need for a more comprehensive approach that includes body composition analysis and considers individual variations. Further research is necessary to elucidate the specific mechanisms linking BMI to REE and to identify more accurate predictors of resting energy expenditure for personalized nutritional and weight management strategies [64].

4.1 There are several methodologies available for assessing resting energy expenditure (REE), each with its advantages and limitations[65]:

a) **Indirect Calorimetry:** This method measures oxygen consumption (VO2) and carbon dioxide production (VCO2) to estimate energy expenditure. It can be performed using either a facemask or a ventilated hood system. Indirect calorimetry is considered the gold standard for measuring REE, providing accurate and precise results. However, it requires specialized equipment and trained personnel.
b) **Predictive Equations:** Various equations have been developed to estimate REE based on factors such as age, sex, weight, height, and sometimes body composition measurements. Examples include the Harris-Benedict equation, Mifflin-St. Jeor equation, and the Schofield equation. These equations are convenient, cost-effective, and non-invasive. However, they have limitations, as they may not account for individual variations in body composition or metabolic rate.
c) **Bioelectrical Impedance Analysis (BIA):** BIA measures the resistance and reactance of electrical currents passing through the body to estimate body composition, including fat-free mass. Some BIA devices also provide an estimate of REE based on body composition data. BIA is relatively simple to use, non-invasive, and provides quick results. However, its accuracy can be influenced by factors such as hydration status and body position.

d) **Dual-Energy X-ray Absorptiometry (DXA):** DXA is primarily used for assessing bone mineral density but can also estimate body composition, including fat mass and fat-free mass. Some DXA systems provide an estimate of REE based on body composition measurements. DXA provides accurate and detailed information on body composition, but it requires specialized equipment and can be expensive.

e) **Resting Metabolic Rate (RMR) Measurement:** RMR is similar to REE but is measured under more relaxed conditions, such as after a short period of rest and without strict fasting requirements. RMR can be assessed using methods like the ventilated hood system, portable metabolic carts, or handheld indirect calorimeters. RMR measurement provides a close approximation of REE and is often used interchangeably. However, the distinction between REE and RMR should be considered in research and clinical practice.

5. The Relationship between Resting Energy Expenditure and Athletic Performance:

The relationship between resting energy expenditure (REE) and athletic performance is a complex and multifaceted topic that requires careful examination. While REE provides the baseline energy required for basic physiological functions at rest, its direct impact on athletic performance is still under debate. While higher REE may seem advantageous for athletes, it is important to consider the interplay of other factors such as training, nutrition, and genetics. Athletes involved in endurance sports, such as long-distance running or cycling, may benefit from higher REE due to the sustained energy demands of prolonged aerobic activity. However, the type and intensity of training can also influence REE, with resistance training potentially leading to increased metabolic rate during rest and recovery periods. Additionally, individual variations in REE among athletes highlight the importance of personalized approaches to training and nutrition[66]. Body composition, specifically fat-free mass (FFM), is often positively correlated with REE in athletes. Metabolically active tissues, such as muscles, require more energy, leading to higher energy expenditure[67]. However, it is crucial to consider that REE alone is not the sole determinant of athletic performance. Other physiological markers, such as VO2 max and lactate threshold, along with skill, technique, and psychological factors, also play significant roles in athletic performance. Caloric intake must be carefully balanced to meet the energy demands of athletes without causing excessive energy deficits or surpluses. The timing and composition of meals can also influence REE, with factors such as nutrient timing and macronutrient distribution potentially affecting metabolic rate. Additionally, changes in body weight and composition can impact REE, necessitating regular monitoring and adjustments in nutrition and training strategies [68]. While understanding the relationship between REE and athletic performance is crucial, it is important to approach it with caution and consider a holistic view of all contributing factors. Athletes should work with qualified professionals who can develop individualized training and nutrition plans that optimize energy availability, promote recovery, and enhance overall performance outcomes [69]. Further research is needed to gain a more comprehensive understanding of the mechanisms underlying the relationship between REE and athletic performance and to develop evidence-based guidelines for athletes at different levels and across various sports disciplines.

6. The Relationship between VO2 Max and Resting Energy Expenditure

VO2 max, which refers to the maximum amount of oxygen an individual can utilize during intense exercise, is a key determinant of aerobic fitness and athletic performance. It is commonly believed that higher VO2 max values are associated with better athletic performance. When examining the relationship between VO2 max and resting energy expenditure (REE), several considerations come into play[70]. Firstly, VO2 max is influenced by factors such as genetics, training status, and exercise modality. Athletes with higher VO2 max values tend to have greater oxygen uptake and utilization, allowing for improved aerobic capacity during exercise. However, it is important to note that VO2 max is primarily a measure of maximal oxygen consumption during exercise, rather than an indicator of REE at rest[71]. Secondly, while VO2 max and REE are distinct concepts, they are interconnected. Individuals with higher VO2 max values generally have higher metabolic rates, including higher REE. This relationship can be attributed to the increased energy demands of supporting greater aerobic capacity and maintaining a higher level of physical fitness [72]. Furthermore, regular aerobic exercise training can lead to adaptations that affect both VO2 max and REE[72]. Engaging in endurance activities can increase aerobic capacity, which in turn may contribute to higher REE due to greater energy expenditure during exercise and subsequent recovery. These adaptations can positively influence overall athletic performance. The relationship between VO2 max, REE, and athletic performance is complex. Higher VO2 max values often indicate superior aerobic fitness, which may contribute to increased REE due to higher energy demands during exercise and recovery. However, it is crucial to differentiate between VO2 max and REE, as they represent different aspects of an athlete's physiology. Understanding and optimizing both VO2 max and REE can provide valuable insights into an individual's metabolic capacity and overall athletic performance, thus guiding training and nutrition strategies for athletes [73-74].

6.1 Anaerobic Capacity and Resting Energy Expenditure

Anaerobic capacity refers to the ability of an individual to perform high-intensity, short-duration activities that rely on energy sources other than oxygen. It plays a crucial role in athletic performance, particularly in sports that involve explosive movements and power, such as sprinting, weightlifting, and jumping. When considering the relationship between anaerobic capacity and resting energy expenditure (REE), some important points come to light. Unlike aerobic exercise, which relies on oxygen to generate energy, anaerobic activities primarily utilize stored energy sources like creatine phosphate and glycogen[75]. These intense bursts of energy during anaerobic exercise result in a significant increase in metabolic rate, even after the activity has ceased. This elevated metabolic rate can contribute to an increase in REE during the post-exercise recovery period. Additionally, anaerobic training can lead to adaptations in the body, such as an increase in muscle mass and improved muscular efficiency. These adaptations can influence REE by raising the overall metabolic demand of the body at rest. While the contribution of anaerobic capacity to REE may be relatively small compared to aerobic exercise, it still plays a role in the overall energy expenditure of an individual[76]. It is important to note that the direct impact of anaerobic capacity on REE may vary among individuals based on factors such as training status, body composition, and overall fitness level. Furthermore, the magnitude and duration of the anaerobic activity can also influence the post-exercise metabolic response. Activities with higher intensity and longer duration are likely to result in a more pronounced effect on REE.

7. Implications for Optimizing Performance and Health Outcomes

Understanding the relationship between anthropometric variation and resting energy expenditure (REE) has significant implications for optimizing performance and health outcomes in various contexts, including athletics, coaching, and healthcare. Here are some key implications[77]:

1. **Performance Enhancement:** By comprehending how anthropometric factors such as body weight, body composition, and body mass index (BMI) relate to REE, athletes and coaches can tailor training and nutrition strategies to optimize energy availability. Adjusting caloric intake, macronutrient distribution, and meal timing based on individual variations in REE can enhance performance potential, promote recovery, and support optimal energy balance.
2. **Body Composition Management:** Recognizing the association between fat-free mass (FFM) and REE allows for targeted interventions in athletes aiming to improve body composition. Strategies that focus on increasing FFM, such as resistance training and proper nutrition, can help elevate REE, facilitating weight management and metabolic health.
3. **Health Outcomes:** Understanding the relationship between anthropometric variation and REE has implications for general health. Higher REE in individuals with greater body weight or FFM may indicate increased metabolic demands, potentially influencing weight management, energy balance, and overall metabolic health. Healthcare providers can utilize this knowledge to develop personalized interventions for weight management, metabolic disorders, and chronic disease prevention
4. **Energy Expenditure Assessment**: Accurate assessment of REE is essential for designing individualized nutrition plans and monitoring energy balance. By incorporating methodologies such as indirect calorimetry, predictive equations, or body composition analysis, practitioners can obtain reliable estimates of REE to guide nutritional interventions, manage weight loss or gain, and prevent metabolic disorders.
5. **Personalized Approaches:** Recognizing the impact of anthropometric variation on REE highlights the importance of individualized approaches. Athletes, coaches, and healthcare providers should consider an individual's unique characteristics, including body weight, body composition, and metabolic rate when developing performance enhancement strategies, nutritional plans, and health interventions.

6. **Training Adaptations:** The relationship between REE and athletic performance implies that adaptations in energy expenditure can occur with specific training regimens. Coaches can utilize this knowledge to design training programs that optimize metabolic efficiency, improve aerobic and anaerobic capacity, and enhance overall athletic performance.

8. Summary

Understanding the relationship between anthropometric variation and REE provides valuable insights for optimizing performance and health outcomes. Tailoring training, nutrition, and healthcare interventions based on an individual's body composition and metabolic rate can enhance performance potential, facilitate body composition management, and promote overall metabolic health. Personalized approaches that consider anthropometric factors and individual variations in REE are essential for maximizing performance and optimizing health outcomes in athletes, coaches, and healthcare settings.

9. Conclusion

The relationship between anthropometric variation and resting energy expenditure (REE) is complex and multifaceted. Body weight, body composition (specifically fat-free mass and fat mass), and body mass index (BMI) all play important roles in determining REE. Individuals with higher body weight, higher fat-free mass, and higher BMI generally have higher energy expenditure at rest. Understanding the interplay between these factors is crucial for optimizing performance and health outcomes in athletes, coaches, and healthcare providers. Fat-free mass (FFM) is a major determinant of REE, as metabolically active tissues such as muscles require more energy for maintenance. Individuals with higher FFM tend to have higher REE levels. On the other hand, fat mass (FM) and body fat percentage have a more complex relationship with REE, and their impact on energy expenditure is still not fully understood. While higher FM may contribute to increased REE due to the energy requirements of maintaining adipose tissue, weight loss interventions targeting FM reduction can lead to decreases in REE, posing challenges for long-term weight management. BMI, although a commonly used measure of body composition, has limitations in predicting REE accurately, as it does not differentiate between FM and FFM. However, higher BMI values are often associated with higher REE levels due to larger body mass and higher FFM. Accurately assessing REE is essential for determining individual energy requirements and designing personalized nutrition and exercise interventions. Indirect calorimetry is considered the gold standard for REE assessment, although predictive equations can provide convenient estimations in certain populations. Further research is needed to better understand the underlying mechanisms and interactions between anthropometric variation and REE. Longitudinal studies and population-specific investigations are necessary to provide a comprehensive understanding of the complex relationship between body composition and energy expenditure. Taking a holistic approach that considers multiple factors is crucial for optimizing performance, health, and weight management based on individual needs and goals.

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