MINI REVIEW

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Relation between anthropometric variations and resting energy expenditure, VO_2 max and anaerobic capacity of young, healthy individuals – an update

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Author contributions

Savarna Kumari conceived the study, collected information about the literature and wrote the manuscript; Madhusudan Tiwari critically revised the manuscript. Authors read and approved the final manuscript.

Competing interests

The authors declare no conflicts of interest.

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Abbreviations

NMs, nutrition majors; TNF, tumour necrosis factor; BMI, body mass index; REE, resting energy expenditure; CF, cystic fibrosis; RMR, resting metabolic rate.

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Abstract

Anthropometric variations can affect resting energy expenditure, VO_2 max and anaerobic capacity of young, healthy individuals. Studies have shown that body fat percentage, weight, and height can all affect the three measures. The study aimed to study VO_2 max and 24-hour thermogenesis measures in predominantly sedentary individuals and weight changes afterwards. VO_2 max-associated research shows that taller individuals tend to have higher VO_2 max levels compared to shorter individuals. This could be because taller individuals have a larger lung capacity and greater oxygen delivery to the muscles. Weight can also affect VO_2 max, as heavier individuals tend to have higher VO_2 max levels than lighter individuals. Weight is also associated with resting energy expenditure, as heavier individuals tend to have a higher resting energy expenditure than lighter individuals. The purpose of this study was to conduct a systematic review of the existing literature related to resting energy expenditure and metabolic effects of VO_2 max, and anaerobic capacity in sedentary active adults of anthropometric variations. Several studies have recently examined the possibility of improving aerobic and metabolic functions ensuring cardiorespiratory fitness within the population of anthropometric variations. Everyday physical activity and heredity ability influenced mainly the gold standard measuring tool for cardiorespiratory fitness, VO_2 max, predicting mortality and morbidity. Weight gain has also been shown to be associated with lower cardiorespiratory fitness, regardless of physical activity levels.The VO_2 max may have a different effect on energy balance apart from physical activity's energy expenditure (EE), possibly by affecting the resting metabolic rate (RMR) or triggering a common mechanism associated with diet-induced thermogenesis. Weight change is predicted by sedentary energy expenditure, but directly measured VO_2 max does not appear to be correlated with weight change. The relationship between resting energy expenditure, VO_2 max, and anaerobic capacity in individuals is complex. Resting energy expenditure is directly related to anaerobic capacity, as it is an indicator of the body's ability to work anaerobically. VO_2 max is also related to anaerobic capacity, as it reflects the body's maximal aerobic power. However, the strength of this relationship is not known. Overall, both resting energy expenditure and VO_2 max are important determinants of anaerobic capacity in individuals and are worth considering when evaluating an individual's anaerobic potential.

Keywords: BMI; body mass index; VO_2 max; anaerobic capacity

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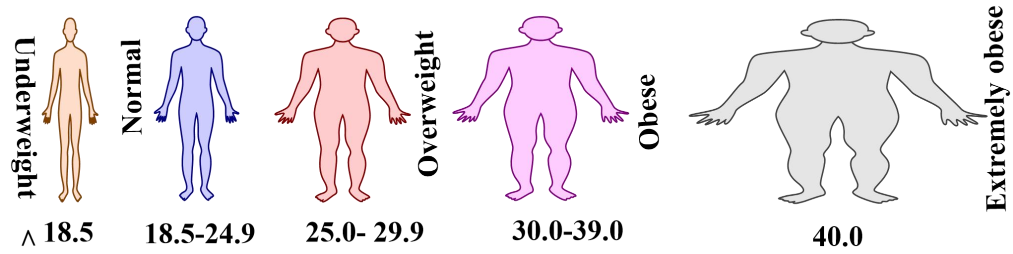
Introduction

Physical performance measures based on self-reports and performance-based assessments are not sufficient to identify limitations in physical function across BMI categories among middle-aged adults. The influence of BMI on function measurement has also not been examined. It was determined that BMI has a significant impact on the relationship between physical function and BMI in adult women based on self-report and performance-based approaches. Weight change is predicted by sedentary energy expenditure, but directly measured VO_2 max does not appear to be correlated with a weight change [1]. The study aimed to study VO_2 max and 24-hour thermogenesis measures in predominantly sedentary individuals and weight changes afterwards. It is a statistical measurement used to compare a person's weight and height. It does not evaluate body fat percentage, yet it is an essential tool to predict a healthy body weight based on the person's height. It is most commonly used to recognize weight problems within the underweight, overweight and obese population because of its easy measurement and calculation. Belgian polymath Adolphe Quetelet invented it between 1830 and 1850 while developing "social physics." *Body mass index* is defined as dividing the individual's body weight by the square of his/her height [2].

Universally the formulas used in medicine produce a unit of measure of kg/m^2BMI chart (Figure 1) can also be used to determine BMI, which interprets BMI as a function of weight (horizontal axis) and height (vertical axis) using contour lines for different values of BMI or colors for different BMI categories [3].

Calculation of BMI is very easy, non-expensive and done very quickly. However, BMI categories cannot evaluate many factors like frame size and muscularity. The categories were also found to fail to account for varying proportions of bone, fat, water, cartilage, weight, and more (Figure 2). The Differences in bone density in the proportion of bone to total weight can mean the number at which these people are considered underweight should be adjusted downward in children and the elderly population [4]. The purpose of this study was to conduct a systematic review of the existing literature related to resting energy expenditure and metabolic effects of VO_2 max, and anaerobic capacity in sedentary active adults of anthropometric variations.



BMI = weight (kg)/height^2 (m^2)

Figure 1 Classification of BMI

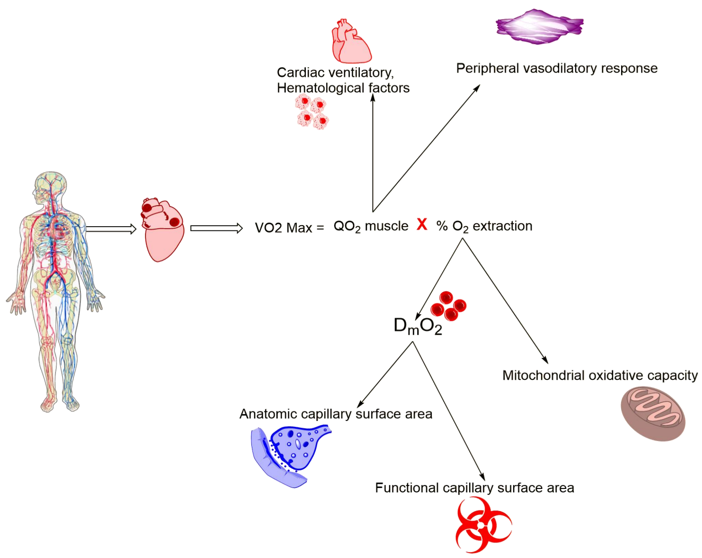


Figure 2 VO_2 max calculation and its importance

Relation between anthropometric variations and Body mass index

According to the study by MY Hong and all [5], dietary behaviour, BMI, and food choices of nutrition majors (NMs) and non-nutrition majors (OMs) were compared based on questionnaire-based cross-sectional surveys. According to the study results, higher nutrition education is strongly associated with healthier eating habits and better food choices in young adult females. Regular meal patterns and adherence to dietary guidelines may be more beneficial to NMs than healthier snack choices for reducing BMI values.

116 children aged between 8-11 years, pooled from four prior studies, were re-examined by LB Raine and S Kao [6] to assess the effects of acute PA on inhibitory control task performance. His correlation study determined the influence of BMI and demographic variables on inhibitory control. The results showed that treadmill walking for 20 minutes and restful reading followed by a modified flanker task could deploy inhibitory control demands. Thus, performance can be negatively affected by BMI's acute effects of exercise. A validated 147-item semi-quantitative food frequency body composition analysis, an indirect calorimeter, and a questionnaire of a validated 147-item semi-quantitative food frequency body composition analysis were used to determine dietary acid load

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connotation and resting metabolic rate among 375 Iranian obese and overweight adult females aged 18 to 48 years. In this study, researchers observed a decrease in resting metabolic rate as dietary acid load scores increased, accompanied by an increase in waist circumference and waist-to-hip ratio, as well as higher diastolic blood pressure from the Homeostatic Model Assessment for Insulin Resistance (HOMA-IR). During a non-active period, the body requires a certain number of calories for 24 hours. Energy expenditure prediction is commonly based on the Harris benedict equations.

S Neubronner and scientists [7] explored how excess body weight affected menstrual cycle length, hair growth, and other phenotypic characteristics of healthy women without PCOS, and how PCOS affected high body mass index (BMI) among healthy women between the ages of 21 and 45. The results showed that women with PCOS who had a high BMI had maximum mFG scores, which might hurt their self-esteem by showing that body weight could increase hair growth.

Based on anthropometric measurements and spirometry using the Yoshioka-Kawada method [8], investigated the BMI determinants in 52 COPD patients. As a result of this study, we found a correlation between body mass and smoking status. Tumour necrosis factor (TNF) does not appear to be a good indicator of weight loss in this group of patients. The information is based on 3.6 months of data collected from the QR database for 2020.

S Smati and coworkers [9] examined the association between post-SARC-CoV-2 obesity and behavioral and demographic characteristics in patients with type 2 diabetes. According to the results, younger and black people had higher HR/KG/MM2 than white people, regardless of their BMI, ethnicity, or age. People with Type 2 diabetes, hypertension, and cardiovascular diseases were found to have a slightly lower risk of hospitalization and ICU admission due to the symptoms of COVID-19 and an increase in BMI compared to those without these conditions.

Relation between anthropometric variations and resting energy expenditure (REE)

The resting energy expenditure of human's accounts for approximately 60 per cent of total energy expenditure, according to RL Leibel and his colleagues [10] Aside from maintaining transmembrane ion gradients, these metabolic costs also include resting cardiopulmonary activity. Approximately 10 per cent of total energy expenditure is attributed to the thermal effect of feeding resulting from digestion, transport, and deposition of nutrients; physical activity involves non-resting energy expenditure, which accounts for the remainder of total energy expenditure.

It has been reported that REE (Resting energy expenditure) is effective in maintaining weight loss and continues to consume a low-energy and low-fat diet. A diet and exercise plan appropriate to your energy needs can improve weight loss and maintenance, according to the American dietician association. It is important to commit to a healthy lifestyle for a lifetime.

Among humans, REE is primarily determined by differences in lean body mass, mainly of muscles, according to [11]. In addition, changes in lean mass accompany changes in fat mass, meaning that REE and fat mass are always linked. There is a potential for confounding by the association between body size and other traits, such as cardiovascular risk factors, when the association is seen between body size and REE. According to Ravussin and Burnand *et al.* [12], obesity is associated with a higher resting metabolic rate and 24-hour energy expenditure. Zakeri and Puyau *et al.* [13] noted that metabolic rate was a research topic that biologists and statisticians have worked on for decades; however, it has not been extensively studied in childhood and adolescence when body mass and composition are changing drastically. In human studies, basal metabolic rate and maximum oxygen consumption were scaled with body weight. There should be a variation in the exponents of intermediate rates of energy expenditure depending on the level of exertion and the weight-bearing component.

According to D Ridder [14], REE has the benefit of preventing under and over-feeding in clinical settings. People's health is negatively affected by excessive or harmful calories.FE Pelly and his friends [15] stated that resting energy expenditure is an essential component of nutritional assessment in athletes. It contributes to 65 to 75% of an athlete's daily energy expenditure. Physiologic levels of androgens and their precursors were assessed in a study by Keller and his colleagues [16], in premenopausal, cycling, healthy women regarding body composition, energy, substrate metabolism, and aerobic capacity. The parameters she evaluated in her study included total and regional body composition, glucose tolerance, aerobic capacity, resting energy expenditure, and substrate oxidation. A serum androgen assay and their precursor assay were used to assess the low levels of androgen in this population. A positive correlation was found between serum testosterone levels and fat mass but not between fat mass and abdominal adiposity. In contrast, a negative correlation existed between DHEA levels and visceral fat. It appears that testosterone predicts normal physiologic levels of overall adiposity. As a result, there are no concomitant changes in resting energy or substrate metabolism that could contribute to weight gain.

In a study with 40 non-obese humans with a BMI between 18.5-26.0 kg/m^2 [17], investigated the role of plasma lactate in predicting resting energy expenditure. Near-infrared spectroscopy (NIRS) was used to examine blood measurements and oxidative capacity, as well as RER at submaximal exercise intensity (low intensity at 50% VO_2 peak). The levels of lactate, insulin and glucose in the blood were not different in the laboratory testing. The authors conclude that non-obese Caucasian females are at risk for resting energy expenditure when they are high in lactate. There may be a lesser mitochondrial and capillary density in higher lactate individuals because they are unable to match the number of fat substrates utilized by lower lactate individuals. A decreased energy transduction capacity may contribute to obesity when early signs of lactate accumulation are present.

An examination of the exercise capability of 16 female athletes (at the clinical and cellular level) and the resting energy expenditure was conducted by [18]. While the resting energy expenditure of girls with Cystic fibrosis (CF) was significantly higher with their usual daily activities, peak aerobic capacity was not changed. Peak anaerobic power, however, was found in girls with cystic fibrosis. It was observed that as the exercise progressed, these differences increased. The results of this study demonstrate that women with CF have significant deficiencies in some measures of fitness and muscle metabolism despite good lung function and nutritional status. To test the hypothesis that REE can be predicted using the combination of organ and tissue mass, a specific resting metabolic rate for each organ and tissue, and a cellular fraction of fat-free mass [19], developed a cellular-level REE prediction. Indirect calorimetry, magnetic resonance imaging, whole-body K counting, and dual-energy X-ray absorptiometry were used in a study of 54 healthy subjects aged 23–88y. Based on a cellular model, the current approach establishes a link between REE and body composition. The lower REE observed in elderly people may be due to a combination of two ageing-related factors i.e., the decline of both organ and tissue mass and cellular fraction.

The REE, respiratory quotient and body composition were compared among patients with and without COPD in a case-control study [20]. Through indirect calorimetry and bioimpedance, oxygen consumption, carbon dioxide consumption, resting energy expenditure, BMI, waist circumference, respiratory quotient, body fat percentage, lean mass, and muscle mass were assessed. Furthermore, they calculated the fat-free mass index as well as the muscle mass index. Compared to non-COPD subjects, COPD subjects had a lower BMI than controls. Nevertheless, no significant differences were observed between the groups regarding waist circumference, body fat percentage, fat-free mass index, and muscle mass index. There were higher RQs, REEs, and carbohydrate oxidation rates in the COPD group. Elderly patients with COPD had higher REE, RQ and carbohydrate oxidation than control. An increase in obesity has been linked to a decrease in energy expenditure, according to Walls and Wolfe [21] An increase in physical activity could increase energy expenditure, but REE accounts for 70–80% of a human's energy expenditure, so an increase in REE would have a profound effect on total energy expenditure. Neither the FAO Committee on Calorie Requirements (FAO 1957; FAO/WHO 1973) nor any similarly commissioned bodies (e.g. Department of Health and Social Security, 1979; National Research Council, 1980) have used this approach since the original FAO Committee on Calorie Requirements published its report in 1950, which used BMR as a factor in its 'factorial' calculation of energy requirements. This article does not intend to elaborate on the utility or otherwise of estimating BMR as a first step in calculating energy requirements, but, as its name implies, it has at least the potential to serve as the basis for calculating an individual or group's total energy requirements. By in the past and has indeed frequently been misused. However, it may, in the future, be the critical factor in a more flexible assessment of energy requirements for populations. AB Parekh *et al.* [22] for this observation could be found in the interaction between REE and sympathetic tone, transmembrane ion exchange, or other metabolic processes which determine energy expenditure during rest. Denise Schwartz stated that the REE takes the guesswork out of determining the goal for the calorie intake to achieve the desired physical fitness outcome [23].

Relation between anthropometric variations and VO_2 max

A person's maximum capacity to consume oxygen while exercising can be measured by the volume of oxygen they can consume. A person's maximum oxygen consumption in minutes per kilogram of body weight is known as VO_2 max. The more fit the individual, the higher the VO_2 max value and the more intense the exercise can be. For at least 20 minutes three to five times a week, work out at a heart rate of 65 to 85% of your maximum heart rate to increase your VO_2 max. In male athletes, the VO_2 max is about 3.5 litres/minute; in female athletes, it is about 2.7 liters/minute [24].

An increase in the maximum aerobic capacity and ability to perform prolonged sub-maximum exercises was observed after aerobic training by Helgerud and Hoydal [25]. Individuals having a low level of fitness will have more change in aerobic power than those having a high level of fitness. Muscle mitochondria increase in size and number after aerobic activity and they burn oxygen more efficiently. Endurance is increased as a result of these changes occurring in muscles and adaptations in the oxygen transport system.

Prediction of VO_2 max, while runs of varying duration and distance carried out in the field have been used to predict VO_2 max.

AN shete and coworkers [26] stated that the VO_2 max is lower for women. This is partly related to differences in body fat (body composition) although the VO_2 max for males is still higher when expressed as a function of lean body mass. Other possible differences include reduced muscle mass, blood volume, hemoglobin level or stroke volume in females (Booth FW, Roberts) and, particularly for non-athletes, reduced activity levels among females for social reasons.

The data on body mass index and aerobic fitness risk factors for cardiovascular diseases in an adolescent was provided by JC Eisenmann [27]. PWC And BMI Markedly affected several cardiovascular disease risk factors. There were no statistically significant differences between the level of fitness and the level of blood lipid and glucose. The overweight fit/ low BMI group had a most favorable CVD risk factors profile than the high fit /normal BMI group. An independent association with adolescents was shown by aerobic fitness and BMI. The body fat percentage, free fat mass and basal metabolic rate were measured by bioelectric impedance to determine the relationship between maximum oxygen uptake capacity and body composition in 13 boys and girls by [28]. 12-minute walk run and multi-stage running tests were used to determine VO_2 max. The results demonstrated that fat percentage and free fat mass were inversely related to aerobic fitness and lower fat percentage and higher free fatty mass contribute to VO_2 max.

CH Kim *et al.* [29] evaluated 11 young rowers (27 ± 4 yrs) and eleven older rowers (58 ± 5 yrs). All subjects underwent a dual-energy X-ray absorptiometry scan to estimate total lean body mass before the testing of VO_2 max. A maximal exercise test on a rowing ergometer and a semi-recumbent cycle ergometer was used to quantify the VO_2 max. The test protocol included a pre-exercise sage followed by incremental exercise until the VO_2 max was reached. Randomized exercise mode was used in the study and there was a washout period between the tests. Breath-by-Breath metabolic cart (VmaxTM Encore, San Diego, CA) was used to obtain the oxygen uptake. Rowing VO_2 max was significant as compared to cycling VO_2 max in both groups ($P < 0.05$). Older subjects showed less improvement in VO_2 max from cycling to rowing ($P < 0.05$). The difference in cycling VO_2 max between groups disappeared after correction in muscle mass ($P < 0.05$), however older subjects still showed a lower rowing VO_2 max relative to younger subjects. VO_2 max is related to muscle mass so it is less influenced in older subjects as compared to Youngers.

Rokowski R and all coworkers [30] found the difference in aerobic capacity and energy expenditure among male and female folk dancers. The study included 8 male and female dancers. The scientific protocol to test the aerobic capacity by the introduction of incremental treadmill testing and energy expenditure by the indirect calorimeter. The result facilitated better aerobic capacity and energy expenditure in men as compared to women dancers but the heart rate during folk dancing was observed more in females. The threshold of decompensated metabolic acidosis was very close to exercise intensity of form during folk dancing. The difficult nature of dance should be physically well prepared and trend for these two to perform at their best.

HB Sharma and al [31] investigated Gender Differences in Aerobic Capacity and the Contribution of Body Composition and Hemoglobin Concentration in 30 young Indian National Hockey Players by measuring and analyzing Body Weight, BMI, Lean Body Mass, restring Heart Rate, Heart Rate Recovery, Hb, VO_2 max, Physical Work Capacity and Resting Metabolic Rate. There was a significant gender difference in the measured parameters due to Differences in BMI & BF were one of the main reasons. The difference in Resting Metabolic Rate was mainly related to Lean Body Mass, BF and BMI. The study provided an understanding of the gender gap in aerobic capacity.

Anaerobic Capacity: Relation between anthropometric variations and anaerobic capacity (Figure 3)

During anaerobic exercise, Murray and Rosenbloom [32] reported that the body metabolizes muscle glycogen as a source of energy, rather than oxygen, to generate power. As a result of dietary amino acids and carbohydrates, blood sugar supplies glycogen to the body. During anaerobic exercise, glycogen replaces oxygen since there is no time for oxygen to be consumed. Anaerobic exercise makes your body capable of delivering powerful performance in response to demand. As a result of anaerobic training, muscles develop differently, enhancing their performance during high-intensity activities. Strengthened bones, reduced muscle atrophy with age, improved speed and power, and stronger muscles.

A study by Sahlin K [33] shows that increasing creatine in muscle fibres can improve anaerobic lactate power through the training of the ATP-CP system. Intensive exercises can be applied through brief activities (2-8 seconds/sprints up to 80 meters) of max/near max intensity. As repetitions (2-4) increase, ATP-CP (creatine phosphate) energy consumption should decrease in the working muscles. To maintain an execution rate of high quality, the total volume stress should be broken down into sets. Generally, this occurs after 2-4 sets. In a given sports discipline, anaerobic capacity parameters are largely genetically conditioned and are influenced by training characteristics and specificity

Redkva, P.E., Miyagi and all [34] verified the effects of caffeine on anaerobic capacity. He evaluated the sum of estimated glycolytic and phosphagen metabolism based on blood lactate and excess post-oxygen consumption. For this purpose, 14 male cyclists were included in the study. The graded exercises were introduced to determine the maximum oxygen uptake and intensity associated with VO_2 max. The anaerobic capacity was determined with a protocol of performance by participants for two supra maximal efforts at 115% of VO_2 marks but after the previous supplementation with caffeine or a placebo (dextrose). The result interpreted the positive effect role of acute ingestion of caffeine facilitates the exhaustion delay but does not significant effect on the estimation of anaerobic capacity.

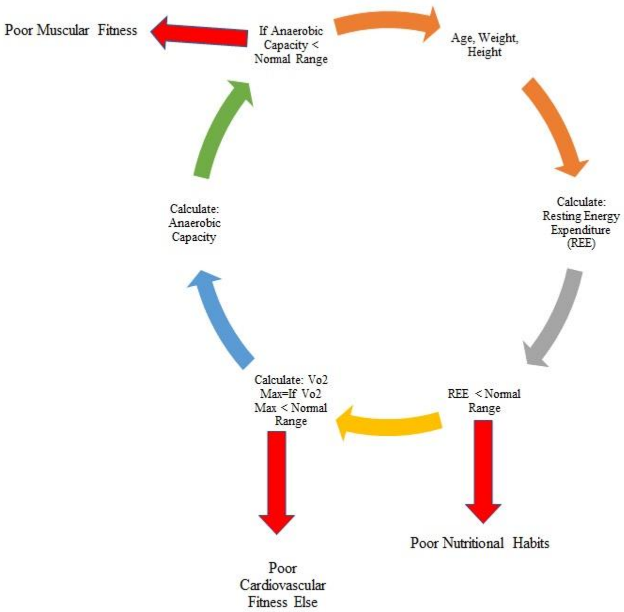

Figure 3 Flowchart for a relationship between resting energy expenditure, VO_2 max and anaerobic capacity

Acaröz Candan and all [35] investigated the effects of aerobic and anaerobic training methods on aerobic and anaerobic capacity by participating in this study's eight females and eight males. The Aerobic training had 24 training seasons of treadmill workouts at 60-70% Max HR for 1 hour. The anaerobic training program included running in the range of maxHR 80-90% on the treadmill for 1 hour. A bicycle ergometer determined the aerobic performance with a portable gas analyzer. To determine the anaerobic performance, a bicycle ergometer was connected to a computer modified for the Wingate Anaerobic Power Test (WAnT) and compatible with an appropriate piece of software, was used. The results showed that anaerobic training caused a high level of difference in aerobic capacity values, thus increasing aerobic capacity. It was observed that aerobic training positively affected anaerobic capacity, power, and fatigue index. Although aerobic training increases aerobic capacity by approximately 4%, this increase was insignificant.

The effect of high-altitude training camps on an athlete's aerobic capacity was explored by Janbowska Lukanova [36] at the PyeongChang 2018 Winter Olympic Games, when she had a body weight of 59.6 kg, a height of 161.0 cm, a fat mass of 10.9 kg and 18.3% fat tissue, a fat-free mass of 48.7 kg, a muscle mass of 46.3 kg, and a body mass index of 23.0 kg/m^2. Tests for aerobic and anaerobic capacity were conducted from April 2018 to September 2018 and April 2019 to September 2019 (periods of general and special preparation). Anaerobic and cardiopulmonary graded exercise tests on a cycle ergometer were used in the laboratory. The study found that participating in the Olympic Winter Games in Korea in February 2018 improved the skater's exercise capacity as a result of training under hypobaric conditions. A significant improvement in aerobic fitness parameters was observed during the study period (2018–2019). As a result of four altitude training camps held over two seasons, the athlete showed the results of high-exercise-induced adaptations and improvements in aerobic metabolism.

Kusnanik, N., Azmi Sekolah and all coworkers [37] evaluated the effect of speed agility and quickness (SAQ) training in improving anaerobic capacity by conducting quantitative with matching only design research on 26 male soccer sub-elite players for 6 weeks 3 times per week. Data was collected from quantitative parameters of anaerobic testing like vertical jump, standing broad jump, and 40m sprints. The result after statical reactions showed that SAQ training had a significant effect in improving anaerobic capacity. It can be determined that anaerobic capacity can be improved by the SAQ training program.

Wax B. and scientists [38] established the effect of creatine supplementation for 7 days on anaerobic performance in 30 resistance-trained subjects. The study originated that by a 7-days creatine loading regimen, there can be a significant improvement in anaerobic capacity test performance in the selected study population.

Using the maximal accumulated oxygen deficit method and the gross energy cost method, Andersson and his colleagues [39] compared four different models for estimating anaerobic energy supply during treadmill running exercise at ~55–80% of peak oxygen uptake for a duration of 4-minutes time with the maximal accumulated oxygen deficit method and the gross energy cost method in Fifteen endurance-trained recreational athletes. Two linear speed regression models were used to estimate the instantaneous required metabolic rate during the trial. Also, the average gross energy cost based on all five submaximal stages or the gross energy cost based on the last submaximal stage gross energy cost was used to estimate the instantaneous required metabolic rate. The anaerobic capacity was computed as the difference between the instantaneous required metabolic rate and the aerobic integrated over time. These results proved a generally high alteration in estimated anaerobic capacities between models and show that the incidence of a measured Y-intercept in the linear regression is likely to underestimate the instantaneous required metabolic rate and the gross energy cost associated with the trial, and hence the anaerobic capacities during maximal 4-min treadmill running.

The randomized, double-blind, placebo-controlled, parallel clinical study of 92 moderately trained healthy men and women was conducted Van Iersel, L.E *et al.* [40] They found that supplementing CFE in 400 and 500 mg daily for 4 and 8 weeks improved anaerobic exercise capacity. The Wingate anaerobic test was used to measure anaerobic exercise capacity and power output. The 400 mg group showed significant improvement in power output after supplementation for 4 weeks. During high-intensity exercise, CFE supplementation increased anaerobic capacity and peak power in moderately trained individuals. CFE supplementation induces underlying mechanisms that need to be identified further.

Acute effects on circadian rhythm and anaerobic performance parameters were studied by Cheikh M and his co-workers [41] 15 male kickboxers ranging in age from 18 to 25 participated in the study. Data were collected at different times using multimodal HIFT exercises to measure T-line agility, vertical jump and baseline peak power. It was found that vertical jump peak power values and T-line agility average power values differed statistically significantly. The effect of high-intensity functional exercises in the evening was found to be greater than its effect in the morning. Based on anaerobic power and anaerobic capacity test scores, P J Maud *et al.* [42] compared the performance of 102 young active men and women aged 21.4 years. Three performance measures were used in the study. According to the results, men and women had no significant differences in anaerobic power or anaerobic capacity when measured relative to fat-free mass.

Limitations

1) Age: The sample population should be limited to young adults aged 18-35. This is because the physiological responses to anthropometric variations may vary across different age groups.
2) Gender: The sample population should be limited to one gender, as physiological responses to anthropometric variations may differ between men and women.
3) Health Status: The sample population should also be limited to

individuals who are healthy and free from any medical conditions that may affect the outcome of the study.

4) Anthropometric Measurements: The anthropometric measurements should be limited to BMI, waist-to-hip ratio (WHR), body fat percentage, and skinfold measurements. Any other anthropometric measurements should not be considered in the study.

5) Physical Activity Level: The sample population should have a similar physical activity level, as physical activity can affect the resting energy expenditure, VO_2 max, and anaerobic capacity of an individual.

Result and Discussion

The anthropometric variation of young, healthy individuals can affect their resting energy expenditure, their VO_2 max, and their anaerobic capacity. Exercise energy expenditure (EE) may not be the only factor that influences energy balance, and VO_2 max may also affect resting metabolic rate (RMR) or trigger a common mechanism associated with diet-induced thermogenesis. VO_2 max-associated research shows that taller individuals tend to have higher VO_2 max levels compared to shorter individuals. A taller individual may have a larger lung capacity and a higher oxygen delivery to their muscles as a result. In addition to weight, VO_2 max can also be affected by weight, with heavier individuals generally having higher VO_2 max levels than lighter individuals. In addition to weight, resting energy expenditure is also influenced by weight, as heavier individuals tend to have higher resting energy expenditures than lighter individuals. There are two main factors affecting cardiorespiratory fitness, the gold standard measuring tool, VO_2 max, which is used to predict mortality and morbidity. Physical activity levels are not associated with cardiorespiratory fitness when weight increases. VO_2 max may have a different effect on energy balance apart from physical activity's energy expenditure (EE), possibly by affecting the RMR or triggering a common mechanism associated with diet-induced thermogenesis. Weight change is predicted by sedentary energy expenditure, but directly measured VO_2 max does not appear to be correlated with weight change. The relationship between resting energy expenditure, VO_2 max, and anaerobic capacity in individuals is complex. Resting energy expenditure is directly related to anaerobic capacity, as it is an indicator of the body's ability to work anaerobically. VO_2 max is also related to anaerobic capacity, as it reflects the body's maximal aerobic power. However, the strength of this relationship is not known. Overall, both resting energy expenditure and VO_2 max are important determinants of anaerobic capacity in individuals and are worth considering when evaluating an individual's anaerobic potential.

Conclusion

Anthropometric variations can significantly affect resting energy expenditure, VO_2 max, and anaerobic capacity. It is important to consider individual differences in body composition when assessing physical performance. This means that the higher the resting energy expenditure, the higher the VO_2 max and the greater the anaerobic capacity. This suggests that higher resting energy expenditure is associated with higher levels of aerobic and anaerobic performance. This could be because resting energy expenditure is a measure of the body's metabolic rate and is an indicator of the amount of energy that can be used for physical activity. Additionally, higher levels of resting energy expenditure may indicate a better fitness level and therefore a higher VO_2 max and anaerobic capacity. Additionally, comprehensive assessments should include measurements of both energy expenditure and physical performance to gain a better understanding of an individual's overall health.

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