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Article

Energy Contribution in Adult Men During Anaerobic Activities

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Abstract: This study aims to explore the contribution of aerobic energy in adult men during anaerobic activity, specifically in the context of the Wingate Anaerobic Test (WAnT) test. The study involved 30 healthy men in their late teens who had no previous sports experience. The methods used include VO2 peak measurements and oxygen uptake during anaerobic tests. The results showed that oxygen use during WAnT reached 69% of peak VO2, with aerobic energy contribution ranging from 16% to 45%, depending on the assumed mechanical efficiency values. These findings confirm that although anaerobic activity is usually dominated by non-oxidative metabolism, the aerobic contribution remains significant and cannot be ignored. The study also noted that the oxygen uptake response in adult men was faster compared to other age groups, suggesting the important role of oxidative metabolism in meeting energy needs during high-intensity exercise. Thus, the results of this study provide new insights into the interaction between aerobic and anaerobic metabolism, as well as its implications for future training and fitness programs. This research is expected to be a reference for the development of more effective training strategies to improve athletes' performance.

Keywords: Male energy; Metabolism; Oxidative; Anaerobic

1. Introduction

Gesture activity is produced by the performance of muscles that require energy (Swartawan, 2019), Not only during physical activity, at rest the body also performs a so-called energy expenditure (REE), derived from biochemical reactions at the subcellular and cellular levels that are expressed in the energy expended by the body's 78 organs and tissues. These organs and tissues, and the 11 systems in which they are located (Heymsfield et al., 2021). Muscles can contract and relax due to the availability of energy from the body's energy system (Sarifin G, 2010) Muscles function to convert chemical energy into mechanical energy, where their activities are controlled by the nervous system so that they can work optimally (Putra, 2020). The series of movements that continue to increase in physical exercise requires a large amount of energy, Glucose is a compound that is the main source of energy for the body in aerobic and anaerobic activities (Lesmana & Broto, 2019), Carbohydrates can be processed by the body into glucose which is the main source of energy for the human body, providing 4 calories (kilojoules) of food energy per gram (Fitri & Fitriana, 2020). In addition, oxygen plays a role as one of the sources of energy for the body in addition to nutrients (Nugroho et al., 2020). The impact of unused energy is the risk of obesity caused by the amount of energy released by the body is less than the amount of food ingested (Annurullah et al., 2021). Immune cells also play an important role in muscle repair, in part by interacting with local stem cell populations to regulate muscle regeneration so that it also affects energy consumption (Tobin et al., 2021). In the context of anaerobic activity, the role of aerobic metabolism is often overlooked. However, recent research shows that aerobic contributions remain significant even though the activity is dominated by non-oxidative metabolism. For example, a study by (Doria et al., 2020) found that "changes in energy system contributions during anaerobic testing may provide new insights into the interaction between aerobic and anaerobic metabolism." These findings suggest that the use of oxygen during the Wingate test indicates that aerobic contribution depends on the value of mechanical efficiency. The relative aerobic and anaerobic energy contribution during short-duration exercise remains almost constant at various exercise intensities (Shiraki et al., 2020), however, energy can be calculated after doing aerobic or anaerobic exercise (Vasava & Vyas, 2022). By adding these quotes, your introduction to your research will be stronger and provide better context about the importance of understanding the interaction between aerobic and anaerobic metabolism in physical activity.

2. Materials and Methods

1) Sample

Participants consisted of 30 men in their late teens approaching healthy and physically active adulthood in one of the cities in Indonesia. The participant has not previously participated in any sports or sports training. All participants give consent to participate in the study. Institutional permission to conduct this research was also obtained.

2) Preparation

All participants were trained in laboratory and testing procedures using sub-maximum and maximum intensity cycle ergometers, covering two sessions that lasted seven days before the main testing session. In the first session, participants learned to ride with a fixed pedal rhythm and an increased load every two minutes for two to three stages while breathing through the funnel. In the second session, participants completed a shorter WAnT while breathing through a funnel

3) Implementation flow

Participants reported to the laboratory twice differently each morning for two weeks. On the first occasion, participants performed a peak VO2 test, on the second occasion they collected basal oxygen absorption for three minutes and oxygen absorption for 30 seconds WAnT. All participants were tested at the same time.

4) VO2 peak determination

To measure willpower fatigue, participants performed continuous incremental exercise tests on a calibrated cycle ergometer (Monark 834E). Every two minutes, the resistance is increased until the participant is unable to maintain the proper pedal rhythm. During the cycle test, a short-range telemetric system (Polar Advantage) is used to monitor the heart rate. When the participant breathes through a funnel with a low-resistance valve, an analysis of the expired air can be performed. During the cycle test, oxygen uptake is measured through one breath at a time using an on-line gas device known as Sensormedics, which takes an average of more than fifteen seconds. During the final stage of the test, when the respiratory exchange ratio was greater than 1.10 and the heart rate was at least 95% of the maximum anticipated heart rate for the participants, peak VO2 was recorded.

5) Oxygen absorption

Before the test was conducted, participants sat in a chair and were asked to collect basic oxygen absorption. They measured the number of breaths per breath on average for fifteen seconds. Next, oxygen absorption was collected for three minutes by asking participants to wear a nose clip and breathe through a mouthpiece for thirty seconds. The same oxygen absorption collection technique is also used during the WanT for thirty seconds.

6) Anaerobic Tests

After the standard warm-up, participants completed a WAnT30 seconds. This includes four minutes of constant pedaling at 70 revolutions per minute (rpm), interspersed with three maximum sprints for 2-3 seconds at resistance applied at 0.74N/kg body mass. Followed by static stretching for the groin, hamstrings, and quadriceps for two minutes.

The height of the seat and handlebars is adjusted according to the participant by using a toe clip to fasten the foot to the pedal. After the "3,2,1, go" countdown, the test begins with a rolling start at 70 rpm with minimal force. Data collection began and participants were verbally encouraged to pedal as fast as possible while remaining seated until they were told to stop after pressing the "Go" button. The variables of interest are the peak power, peak power, and average power achieved in WAnT30 s corrected for the inertia of the ergometer for one second. The method of correcting the inertia of the flywheel and the internal resistance of the ergometer is described elsewhere (Armstrong et al., 2019).

7) Aerobic contribution

There are two different ways to calculate the contribution of aerobic energy to WAnT30s. The first calculates the rate of net oxygen uptake during WAnT30 s as a percentage of the VO2 peak. The net oxygen uptake rate is calculated by taking the VOnT rate and subtracting the basal VO2 rate. For the second method, the absorption of clean oxygen during WAnT30 s is converted into a unit of work (i.e. joules) with a conversion factor of 20.92 KJ/L of oxygen, assuming carbohydrate metabolism is 100% (C. Doria et al., 2020), because WAnT30 s respiratory exchange ratio is 0.99 (Luminescence, 2012). Assuming extreme gross mechanical efficiency values of 15 and 35%, WAnT30 s VO2, shown in units of work, divided by the total work in WAnT30 s, shown in percentages, makes an aerobic contribution to the test (Tortu & Deliceoglu, 2024).

8) Analysis

The Windows Program Statistics Package for Social Sciences (SPSS 11.0) is used to collect and store data. For the variable of interest, descriptive statistics are created. One-way variance analysis (OW-ANOVA) was used to study the differences between boys and girls. The significance level was measured at a value of 0.05.

3. Results

Participant characteristics: Participant characteristics of 30 adult males are presented in Table 1.

Table 1 Participant characteristics and performance of adult male sports

Variable	Men (n=30)
Age (y)	20.3 ± 0.2
Figure (m)	1.69 ± 0.05
Body mass (kg)	68.9 ± 3.5
Absolute peak VO_2 ($l \cdot min^{-1}$)	1.72 ± 0.31
Relative peaks VO_2 ($ml \cdot kg^{-1} \cdot min^{-1}$)	53 ± 7
RER (Respiratory exchange rate) atpeak VO_2	1.02 ± 0.05
Max HR at peak VO_2 ($beats \cdot min^{-1}$)	195 ± 10
VE (Ventilation) at the top ($l \cdot min^{-1}$)	72.60 ± 12.5

PP (peak power) (W)	352 ± 35
PP·kg^{-1} BM (W·kg^{-1})	9.1 ± 1.4
MP (power rate) (W)	247 ± 35
MP·kg^{-1} BM (W·kg^{-1})	6.7 ± 1.2

Grades are a means of ± elementary school. *shows significant differences in $p<0.05$ Adult males have similar characteristics based on their age, height, and body mass.

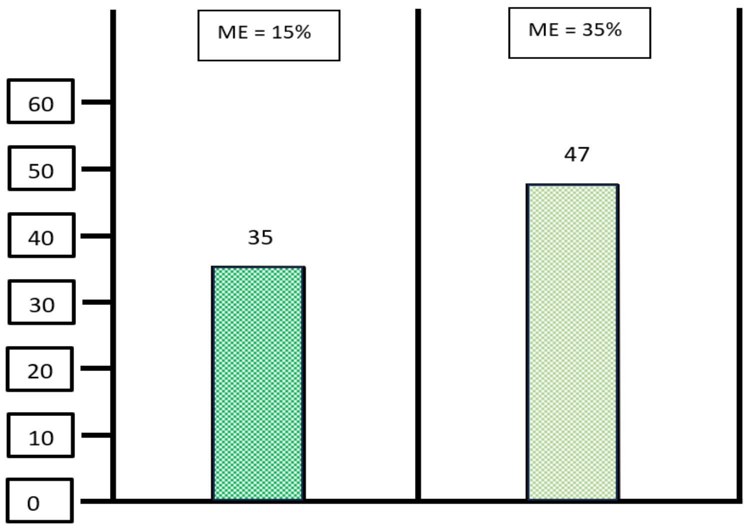
Workout performance

Table 1 contains data on the characteristics of VO2 peak training and the power generated in WAnT30 adult males.

Oxygen uptake during WAnT30 seconds:

In adult males, oxygen uptake during WAnT30s is 69 ± 7% of VO2 peak. The age of the participants did not affect the percentage of oxygen uptake. Figure 1 shows that the contribution of aerobic energy to WAnT30 in adult males ranges between 15% and 35% of the gross mechanical efficiency (ME) value, with a core value of 16% to 45%. In addition, the percentage of aerobic contribution to WAnT30 to the assumed ME value was proportional to their age.

% Aerobic contribution to WAnT $_{30\ s}$



Extreme assumed ME values

Fig. 1 In adult males, the aerobic energy contribution of WAnT30 is 15% and 35%, respectively, being mean values. For ME, there is no difference in age types that are considered equal.

4. Discussion

The main result of this study is that, taking into account the assumed extreme ME values, the contribution of aerobic energy to the WanT 30s cannot be negligible, whether it is indicated in units of work or as a percentage of peak VO2. Oxygen uptake in adult males reaches 69% VO2 peak during WAnT30 s. During the WAnT30s, 63 healthy male adolescents aged 15.40 ± 0.34 years correspond to the range of 60-70% of the VO2 peak reported by Sheridan et al. (Sheridan et al., 2021).

Whether in liters per minute or milliliters per kilogram of body mass per minute, the results show that men have very high peak VO2. This corresponds to the results (Faíl et al., 2022) They found 20 adult male samples with a matching VO2 max (66.7%) and 10 samples with an inappropriate VO2 max (33.3%).

When VO2 WAnT was expressed in relation to peak VO2, there was no age-type difference in aerobic contribution to WAnT30, although adult males had higher peak VO2 (i.e. 69±7%; p>0.05). This suggests that the oxidative metabolism of adult males serves to meet the energy demands of WAnT30, and aerobic fitness does not affect aerobic contribution to maximum exercise.

It is very difficult to determine the gross mechanical efficiency of a maximum-intensity exercise such as the one in the WAnT30s, but by being optimistic and pessimistic about ME during maximum-intensity exercise, you can accommodate individual gross efficiency differences. taking into account the extreme values of ME of 15% and 35% (Wackwitz et al., 2021), In the case of adult males, the aerobic contribution to WAnT30 ranges between 16% (ME = 15%) and 45% (ME = 35%) (Fig. 1). The grade range for female physical education students is higher than 10% (ME = 15%) and 17% (ME = 25%), according to Volkov V. and Tambovtseva R. (Volkov & Tambovtseva, 2023), for five men, and also higher than 10% (ME = 15%) and 17% (ME = 25%) for female physical education students, according to Soylu Ç (Soylu et al., 2020).

It appears that adult males use oxidative metabolism more to meet WAnT30 than adults. This does not necessarily indicate that adult males do not have the ability to produce energy from non-oxidative metabolism; Conversely, it may indicate that non-oxidative metabolism is more dependent on meeting the highest demands of exercise. The results showed that oxygen uptake in WAnT30 reached 69% of the VO2 peak. This may be because adult males show a faster oxygen uptake response than older adults to maximum-intensity exercise (Wang et al., 2017).

WAnT30 produces more power in adult males, even though the body mass of boys and girls is the same. Prepubescent boys have PP and MP 20% and 11% greater in body mass W/kg than girls. MP is also 16% greater, which is shown in the body mass ratio in boys than in prepubescent girls (Cho Eun-hyung & Chae Jin-seok, 2010). Recent results support sex differences in the strength of WAnT30 before puberty, although the evidence for sex differences before sexual maturity in children is unclear (Paškevičė & Požėrienė, 2020).

5. Conclusions

In adult males, the contribution of aerobic energy to WAnT30 cannot be ignored. In terms of VO2 peak, net oxygen uptake during WAnT30 is 69% in adult males. On the other hand, with the extreme assumed ME values of 15% and 35%, the contribution of aerobic energy to WAnT30 is 16% to 45% in adult males. VO2 values peak high in adult males, so the contribution of aerobic energy is essential for WAnT30 in adult males. A plausible explanation for the contribution of aerobic energy to WAnT30 is the faster oxygen uptake response to maximum-intensity exercise and the lack of dependence on non-oxidative metabolism in adult males.

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