Estimating Energy Expenditure in Weightlifting Workouts Using MET Values

Rafael Sansana Ataide

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Abstract

This paper presents a discussion on estimating energy expenditure during weightlifting workouts using Metabolic Equivalent of Task (MET) values. We provide an overview of the factors that contribute to calorie expenditure in weightlifting and propose a revised formula to estimate the MET intensity of a workout based on the amount of weight lifted, number of repetitions, distance, and resistance. The limitations of this formula and the challenges in accurately estimating MET values for weightlifting are also discussed. An example section illustrates the application of the proposed formula using hypothetical weightlifting workouts.

1 Introduction

Estimating energy expenditure during weightlifting workouts is essential for individuals to monitor their progress and tailor their training programs to meet specific goals. One widely-used method to estimate energy expenditure in various physical activities is the use of MET values [1]. In this paper, we discuss the factors influencing calorie expenditure in weightlifting and present a revised formula for estimating the MET intensity of a workout. We also discuss the limitations of this approach and the challenges in accurately estimating MET values for weightlifting.

2 Calorie Expenditure in Weightlifting

Calorie expenditure during weightlifting is influenced by various factors, such as an individual's weight, workout intensity, duration, and type of exercises performed [2]. A general formula for estimating calories burned during weightlifting is:

Calories burned = METs · body weight (kg) · duration (hours)

MET values for weightlifting typically range from 3 to 6, depending on workout intensity [1]. Higher MET values correspond to more intense workouts.

3 Revised Formula for Estimating MET Intensity of Weightlifting Workouts

To develop a revised formula to estimate the MET intensity of a weightlifting workout, we consider the following factors: amount of weight lifted (W), number of repetitions (R), distance (D), and resistance (Res). The proposed formula is as follows:

$\text{MET} = \text{BMR}_{m}ultiplier + ((\text{W}_{\overline{W_c}}) \cdot (\frac{R}{R_c}) \cdot (\frac{D}{D_c}) \cdot \text{Res})$

In this formula, the BMR_multiplier is the base MET value for weightlifting, typically ranging from 3 to 6 depending on the intensity of the exercise. The distance (D) is the distance traveled by the weight during each repetition, and resistance (Res) accounts for the external forces acting against the movement, such as gravity. The weight constant (W_c), repetitions constant (R_c), and distance constant (D_c) are normalization factors, which can be set as 100 kg, 10, and 1 m, respectively.

This formula provides only a rough estimate of the MET intensity and does not account for factors such as exercise selection, training technique, or muscle groups involved. Furthermore, this formula has not been scientifically validated, and its accuracy in real-world weightlifting workouts is uncertain.

4 Example Application of the Revised Formula

To illustrate the application of the revised formula and the general formula for estimating calories burned during weightlifting, consider the following

hypothetical weightlifting workouts, each taking 30 seconds:

- Workout A: Squats with 60 kg for 5 sets of 5 repetitions, individual's leg length as distance, gravity as resistance.
- Workout B: Bicep curls with 15 kg for 3 sets of 10 repetitions, individual's forearm length as distance, gravity as resistance.

Applying the revised MET formula for each workout:

- Workout A: $MET = 3 + ((60/100) \cdot (25/10) \cdot (1/1) \cdot 9.81)$
- Workout B: $MET = 3 + ((15/100) \cdot (30/10) \cdot (1/1) \cdot 9.81)$

Calculating the MET values:

- Workout A: $MET = 3 + (0.6 \cdot 2.5 \cdot 9.81) = 3 + 14.715 = 17.715$
- Workout B: $MET = 3 + (0.15 \cdot 3 \cdot 9.81) = 3 + 4.4135 = 7.4135$

Now, let's assume an individual weighing 70 kg performs each workout for a duration of 0.083 hours (5 minutes). Using the general formula for estimating calories burned, we can calculate the calories burned during each workout:

- Workout A: $Caloriesburned = 17.715 \cdot 70 \cdot 0.083 = 102.70025$
- Workout B: $Caloriesburned = 7.4135 \cdot 70 \cdot 0.083 = 42.989725$

Please note that 5 minutes doing an resistance exercise is rather a long time. These results provide a rough estimate of the calories burned during each workout. Keep in mind that individual factors and the limitations of the formulas can affect the accuracy of these estimates.

5 Conclusion

Estimating the MET intensity of weightlifting workouts is a complex task due to the various factors influencing energy expenditure. The revised formula provides a rough estimate based on the amount of weight lifted, number of repetitions, distance, and resistance. However, this formula has limitations and does not account for all factors affecting energy expenditure during weightlifting. It is recommended to use this formula in combination with other methods, such as heart rate monitoring or fitness trackers, to obtain a more accurate estimate of energy expenditure during weightlifting workouts. Future research should focus on validating this formula and improving its accuracy for practical applications.

References

[1] Ainsworth BE, Haskell WL, Herrmann SD, et al. *The Compendium of Physical Activities Tracking Guide*. Healthy Lifestyles Research Center, College of Nursing Health Innovation, Arizona State University. [Online]. Available: `https://sites.google.com/site/compendiumofphysicalactivities/` [Accessed: April 26, 2023].

[2] McArdle, W. D., Katch, F. I., Katch, V. L. (2010). *Exercise Physiology: Nutrition, Energy, and Human Performance* (7th ed.). Lippincott Williams Wilkins.