

Metabolic and energetics characterization and gender comparison in prepubertal karate practitioners

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8th IMACSSS International Conference Abstracts, Viseu (Portugal), October 10-12, 2019

Type: Poster presentation

Abstract

The number of children practicing karate is constantly increasing. It is necessary to provide correct information to the karate masters/coaches about this specific population, so they can properly develop karate training processes without causing any harm to practitioners but, on the contrary, contribute to the harmonious development of children and youths. This study was carried out with twenty-one prepubertal karate practitioners, male and female. They were analyzed on their maturational development, metabolic and energetic behavior in an incremental test until exhaustion. Only the energetic variables presented significant differences between gender, so it seems that the karate practice has a similar metabolic impact in the development of the prepubertal karate practitioners of both genders.

Keywords: Martial arts; combat sports; children; metabolism; energetics; karate.

1. Introduction

Today it's normal to see young children practice karate with high intensity and competing in tournaments. So it is necessary to understand the effects of karate practice in young children, namely in what is concerned to their metabolic and energetic responses and adaptations and specialization to the karate practice. We must understand that children are not adults in miniature, and, as such, their physiological and metabolic responses to effort vary according to age and gender, as reported in several studies performed with population with and without developing sport practice (Eliakim et al., 2019; Malik, Williams, Weston, & Barker, 2019). However, studies about this topic are quite scarce in the field of karate, especially in the evaluation of children, which makes this study relevant to the karate coaches and to all karate practitioners, in what it is concerned to the optimization of the training methodologies according with the correct level of effort required, the practitioners ages and genders, or the metabolic and energetics specific capacities.

2. Objectives

The main purpose of this study was to characterize the metabolic and energetics responses during effort in prepubertal children with ages between 8 and 11 years old that practice karate. The second aim was to verify the existence of differences between genders in the metabolic and energetics variables analyzed.

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3. Methodology

The sample was recruited in Karate clubs and associations affiliated to the Portuguese Karate Federation (FNK-P). Before the data collection, the study was explained to the parents and to the children and informed consent was obtained from them. The study was approved by the Ethics Committee of the Research Unit of the Polytechnic Institute of Santarém.

Twenty-one prepubertal karate practitioners participated in the study, fifteen males and six females (age: M - 9 yr. \pm 1, F - 9 yr. \pm 2; height: M - 135 cm \pm 9,2, F - 136 cm \pm 10,7; weight: M - 30.2 kg \pm 5.8, F - 31.3 kg \pm 5.3; Tanner's stage: M - 2, F - 2; IMC: M - 16.2, F - 16,7; karate level: M - 7^o to 5^o kyu, F - 7^o to 4^o kyu; hours of karate weekly training: M - 4 h \pm 1, F - 3 h \pm 1; hours of school physical education: M - 2 h, F - 2 h).

Protocols proposed by the International Society for the Advancement of Kinanthropometry (ISAK), and the assessment of biological maturation through self-rating, (Malina & Beunen, 2008; Tanner, 1962) were used to assess the children's maturational and biological state.

Regarding metabolic indicators in effort, we used an incremental treadmill protocol, modified Balke test (Heyward, 2006), applied until exhaustion (volitional fatigue or maximum criterion was achieved), on the Technogym Runrace Treadmill HC1200 (Italy), with the use of COSMED K4 b2 portable metabolic measurement system, and acknowledge software to collect and analyze data on respiratory frequency (RF), carbon dioxide production (VCO_2), oxygen uptake (VO_2), heart rate (HR), in the total exercise time. The final three minutes of exercise were considered the active recovery after exhaustion. It was also analyzed the energy expenditure (EEm) and the metabolic equivalents (METS) in the exercise.

To examine the study data, it was first performed a simple descriptive statistical analysis (mean and stander deviation values), then, after verified the normality and homogeneity of the sample, a comparison was made between genders with the *U* Mann-Whitney test with the Statistical Package for Social Sciences, version 20 (SPSS Inc, USA). The significance level was set at $p < 0.05$ for all comparisons.

4. Results

Considering the mean and standard-deviation values, in the male (M) karate children the total exercise time was of 12 minutes, and in the female (F) was of 11.45 minutes, wherein the last three minutes of recovery that occurs after exhaustion, are included in the total time. During the exercise the RF was of 42 breaths $\text{min}^{-1} \pm 13$ in both genders, but the HR was of 141 bpm ± 30 in M and 140 bpm ± 28 in F. In the recovery the HR decrease 69 bpm ± 14 in M and 56 bpm ± 20 in F.

Regarding to the gas analysis, the absolute VCO_2 production was 746 ml $\text{min}^{-1} \pm 377$ and the VO_2 uptake was 786.9 ml $\text{min}^{-1} \pm 355$ corresponding to a relative value of 27.2 ml $\text{kg}^{-1} \text{min}^{-1} \pm 11.7$ in male; in female VCO_2 was 777 ml $\text{min}^{-1} \pm 417$, the VO_2 uptake was 779.4 ml $\text{min}^{-1} \pm 335$ corresponding to a relative value of 24.9 ml $\text{kg}^{-1} \text{min}^{-1} \pm 10.2$.

In the male group, on three minutes of recovery, the absolute VCO_2 production was 822.6 ml $\text{min}^{-1} \pm 177.6$ with a VO_2 uptake of 751.1 ml $\text{min}^{-1} \pm 156.5$ corresponding to a relative value of 25.4 ml $\text{kg}^{-1} \text{min}^{-1} \pm 4.03$, and in female the VCO_2 was 861.8 ml $\text{min}^{-1} \pm 239.4$, the VO_2 uptake was 748 ml $\text{min}^{-1} \pm 166.84$ corresponding to a relative value of 24.05 ml $\text{kg}^{-1} \text{min}^{-1} \pm 4.1$. The energy cost of the test in male, presented energy expenditure of 1454.4 Kcal $\text{min}^{-1} \pm 116.4$ and 7.7 METS ± 3.4 , while the female has 884.8 Kcal $\text{min}^{-1} \pm 137.7$ and 8.6 METS ± 3.8 during all the exercise time.

Gender comparison showed significant differences in EEm ($p = 0.044$) and METS ($p = 0.002$). The variable relative VO_2 ($p = 0.066$) showed a tendency to statistical difference.

5. Discussion

Although children participating in this study presented similar anthropometrical and maturational characteristics, and in cardiorespiratory variables, it seems to exist a different behavior in the energetic field when they perform a maximal physical effort, as usually happens in karate practice. Male children supported a little more time of maximal effort than female children

before reaching exhaustion, however, this did not have significant consequences in the RF or in the HR during the exercise fulfilment or in the recovery time, even though the male karate children tended to recover better they HR, returning faster to an initial HR state than the females.

Despite the inexistence of significant differences on VCO_2 and VO_2 variables, it seems that the male karate group tended to have more efficiency in the gas exchanges, and this may be associated with a better adapted metabolism to the high intensity effort, induced by the karate practice. This is reflected by the higher values of VO_2 and the lower production of VCO_2 in male karate children. However, this study was limited to just one karate children sample, so it is not possible, at this moment, to state that these results would not be different in children who do not practice karate, or in those who practice other sports than karate.

6. Conclusion

The prepubertal karate practitioners reached to exhaustion in a high intensity exercise after 12 min, with relative VO_2 intakes between 25 and 27 $ml\ kg^{-1}\ min^{-1}$, and an energetic expenditure between 884 and 1454 $Kcal\ min^{-1}$. In general, there were no significant differences between genders on the assessed metabolic or maturational characteristics, although differences were found in energy expenditure and the metabolic equivalents during exercise.

Acknowledgements

The authors are grateful for the availability of athletes and coaches from: Associação AMICALE Karate; AKDS - Clube Atlético do Montijo; AKWK - Associação de Karaté-Do Wado-Kai.

References

- Heyward, V. (2006). *Advanced Fitness Assessment and Exercise Prescription* (6 ed.). Champaign: Human Kinetics
- Malina, R. M., & Beunen, G. (2008). Growth and Maturation: Methods of Monitoring. In H. Hebestreit & O. Bar-Or (Eds.), *The Young Athlete* (pp. 430-42). Oxford: Blackwell Publishing.
- Malik, A., Williams, C., Weston, K., & Barker, A. (2019). Perceptual and Cardiorespiratory Responses to High-Intensity Interval Exercise in Adolescents: Does Work Intensity Matter? *Journal of Sports Science & Medecine*, 18, 1-12.
- Tanner JM (1962). *Growth at adolescence* (2 ed.). Oxford: Blackwell.
- Eliakim, A., Falk, B., Armstrong, N., Baptista, F., Behm, D. G., Dror, N., . . . Rowlands, A. V. (2019). Expert`s choice: 2018`s most exciting research in the field of pediatric exercise science. *Pediatric Exercise Science*, 31(1), 1-27. doi: [10.1123/pes.2019-0010](https://doi.org/10.1123/pes.2019-0010)

