ORIGINAL ARTICLE

Blood lactate concentrations after losing or winning a boxing match in junior athletes

Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
D Manuscript Preparation
E Funds Collection

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Abstract

Bacground and Study Aim: A three-round, refereed boxing bout (3 x 3 min.) with one-minute breaks is an exercise with a high proportion of anaerobic metabolism. Weight category-dependent differences in the concentration of the metabolite studied have been reported (the highest intensity of the fight is in the medium categories). There are few studies of the metabolic response in athletes who won and lost their first or subsequent bouts. There is a lack of publications reporting on the exercise metabolism of both opponents of a fought bout with respect to different weight categories. The aim of this study is to know the post-exercise blood lactate concentrations in pairs of opponents, one of whom wins and the other loses the same three-round fight.

Material and Methods: The study was conducted during the Polish Junior Boxing Championships in different categories: 49kg, n = 4; 52kg- 2; 56kg- 4; 60kg- 4; 64kg- 2; 69kg- 2; 69kg- 2; 75kg- 4; 81kg, 4; 91kg- 4. In the fifth minute after the end of the first fight, capillary blood was collected under aseptic conditions from both fighters from the earlobe using disposable automatic lancets into heparinised glass capillaries, from where the material was transferred directly to the DR-LANGE analyser, Germany. A total of 60 athletes were tested (30 who won and 30 who lost bouts). The normal distribution of results in both sub-groups mandated the use of parametric statistical tests.

Results: There was not a single fight interrupted by the ring judge, as none of the fighters tested were knocked out. The mean La concentration expressed in mmol/L (mM) was 12.9 ±3.4 with a range of 7.1 to 21.4 in the winners, and 12.4 ±2.8 with a range of 6.0 to 17.8. There were no significant differences between these averages. A significant correlation coefficient, r = 0.408, was noted between La and body weight in the losers' and winners' groups.

Conclusions: Post-fight lactate (La) concentrations in junior boxers fall within a fairly wide concentration range, which may indicate significant variation in physical activity throughout the fight between the two opponents and differences in their aerobic capacity. There are no differences in mean La between the winners and losers. The positive correlation of La in the blood and body weight of the losing and winning boxers is evidence of a similar intensity of exertion of the two opponents at identical times, so this indicator cannot serve as an argument to explain the reason for the outcome of the boxing fight (losing ÷ winning).

Key words: combat sports • metabolic response • three-round in boxing

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Combat sports – *noun* a sport in which one person fights another, e.g. wrestling, boxing and the martial arts [21].

Technique – *noun* a way of performing an action [21].

Tactics – *plural noun* the art of finding and implementing means to achieve immediate or short-term aims [21].

Blood lactate (La - mmol) – level raises with exercise of increasing intensity. Increased lactate production coincides with cellular acidosis and remains a good indirect marker for cell metabolic conditions that induce metabolic acidosis. If muscle did not produce lactate, acidosis and muscle fatigue would occur more quickly and exercise performance would be severely impaired.

Loosing – succumbing to an opponent, suffering defeat.

Winning – triumphant.

Three-round fight – a three-round fight in boxing consisting of a direct fistfight between two competitors according to specific rules with a limited field of punches.

INTRODUCTION

A boxing bout in amateur sport consists of three three-minute rounds separated by one-minute breaks. The rounds are characterised by repeated, short but intense attacks with the fists aimed at the opponent's body or head, while defence against the blows consists of using the upper limbs to shield and dodge, mainly the head, from the blows. There are a number of factors whose appropriate level is conducive to victory [1]. These include short reaction times to visual stimuli in attack and defence. It has been shown that fighters who won fights were characterised by significantly shorter reaction times measured immediately before the first round [2]. This indicator is included in the so-called cognitive functions such as speed of information processing, planning and others involving the central nervous system. These qualities are particularly required in combat sports and sports games, where there is a need to quickly and accurately select decisions and perform tasks in a changing situation during competition. Such requirements are placed on athletes in combat sports and sports games, i.e. sports with an open task structure [3, 4]. Another important factor is the appropriate technical training and tactics used during combat [5, 6].

Boxing bouts cause significant blood acidification, indicating the involvement of anaerobic processes in exercise metabolism, but the relatively long work duration requires good aerobic capacity. This has been shown by measurements of the maximum relative rate of oxygen uptake during standard exercise showed a very large individual variation in VO2max (53.6-66.2 ml × kg/min) [7]. In boxing bouts, oxygen uptake increases slightly in subsequent rounds [8], but other researchers have reported a decrease in this indicator [9].

An analysis of the contribution of different sources of energy processes in a semi-contact boxing effort indicates a 77% contribution of aerobic work [10], which is why endurance-type efforts [11] or hypoxia training [12] are part of the conditioning training programme. The athlete's body weight is controlled before the fight. Slight overweight above the limit recorded 24 h before the start requires restriction of beverage intake or a combination of this procedure with active dehydration (running) [13].

Biomechanical studies of juniors and elite seniors have shown significant differences in the relative power of blows executed with different techniques with the dominant and non-dominant hand and a greater contribution of the other body segments in the execution of the blow in the elite [14].

La concentration after exercise is considered a measure of intensity. In boxers, measurements were taken after various anaerobic repetitive efforts simulating a boxing bout (sparring) The range of concentrations recorded was quite wide and depended on the number of rounds and their duration, averaging from 8.4 mM for 3min × 3 rounds to13.6 mM for 4 × 2min [8]. Another study for a 4 × 2 min regimen showed an average La for juniors of 14.1mM and significant dispersion in the data, from 10 to 18.1 mM [13]. The accumulation of lactate after successive rounds results in a monotonic increasing La, 6.7mM after Round 1 to 9.5mM after Round 3 with very similar activity in each round expressed by the number of attacks and defensive actions [10].

Under the conditions of an official sports bout, post-exercise La are higher than during a semi-contact pad-work exercise. In the high-level athletes participating in the international tournament, the mean La fell within a fairly wide range and depended on the weight category. The lowest mean values were recorded in the 48 and 91 kg categories, 11.4 and 11.6 mM, respectively, and the highest for the 57 and 64 kg limits, 15.4 and17.0 mM, respectively [15].

Taking into account a number of different factors determining the outcome of competition, researchers have attempted to identify the primary predictors of success in boxing by analysing physical and physiological characteristics in winners and losers. It can be assumed that, in addition to the level of training, greater activity during a bout and more effective use of physical echoes is a pathway to success. Assuming that post-fight La is a measure of physical activity, it can be expected that this physiological indicator differentiates winners and losers of boxers, however, there are no such studies in the available literature.

The aim of this study is to know the post-exercise blood lactate concentrations in pairs of opponents, one of whom wins and the other loses the same three-round fight.

MATERIAL AND METHODS

Participants

The study was conducted during the Polish Junior Boxing Championships in different categories: 49kg, n = 4; 52kg- 2; 56kg- 4; 60kg- 4; 64kg- 2; 69kg- 2; 69kg- 2; 75kg- 4; 81kg, 4; 91kg- 4. A total of 60 athletes were tested (30 who won and 30 who lost bouts).

Procedures

The post-fight results (La) in mM for for the winners and losers group were measured. In the fifth minute after the end of the first fight, capillary blood was collected under aseptic conditions from both fighters from the earlobe using disposable automatic lancets into heparinised glass capillaries, from where the material was transferred directly to the DR-LANGE analyser, Germany.

Statistical analysis

The estimation of the results is based on the following indicators: frequency (N, n); mean (M); median (Me); range (minimum ÷ maximum); standard deviation (SD or ±); coefficient of variation (CV in %); skewness and kurtosis. The normal distribution of results in both sub-groups mandated the use of parametric statistical tests (the Shapiro-Wilk). Calculations made on 30 absolute individual differences. Pearson correlation coefficient between La and body weight was determined.

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RESUTS

All the boxing bouts ended in regulation time, i.e. lasted a full 3 rounds of 3 minutes each. The Shapiro-Wilk test (indicator W) showed normality of distribution for the losers' group (W = 0.985, p = 0.942) and the winners' group (W = 0.976, p = 0.710).

The mean La concentration expressed in mmol/L (mM) was 12.9 ±3.4 with a range of 7.1 to 21.4 in the winners, and 12.4 ±2.8 with a range of 6.0 to 17.8 (Table 1). A mean value of differences 2.5 ±2.1 with a very large dispersion. From 0.3 to 10.7 mM. opponents, and in the remaining 10 winners lower than losers, by an average of 2.8 ±2.1 mM. Testing for differences showed no intergroup statistical differences in La means (t = 0.727, p = 0.470).

Sportsman's in the 60-69 kg category of subgroup show slightly higher La values and slightly less inter-individual variability as can be seen from the CV values (Table 2).

Table 1. Descriptive statistics lactate (La) concentration values for the 30 sub-groups studied, losers and winners (the post-fight results).

Group	M & SD	Me	CV%	Range	Skewness	Kurtosis
Losers	12.3 ±2.8	12.3	22.8	6.0-17.8	0.247	0.024
Winners	12.9 ±3.4	13.1	26.4	7.1-21.4	–0.026	–0.049

Table 2. Lactate (La) concentration values in athletes of different body weights categories subgroups.

Weight categories group	N	M & SD	CV%	Range
49-56 kg	20	12.7 ±3.2	25.2	7.5-21.4
60-69 kg	16	13.0 ±2.9	22.3	8.5-17.8
75-91 kg	24	12.3 ±3.2	26.0	6.0-17.3

A significant correlation coefficient, r = 0.408, was noted between La and body weight in the losers' and winners' groups.

DISCUSSION

In our study, there were no significant intergroup differences in mean La. The range of the observed variable was very wide in both groups. This may indicate a good tolerance of high La values in both losers and winners. Thus, the concentration of a metabolite does not determine the outcome of a fight. This may indicate that high La either does not impair either upper limb exercise capacity and probably does not significantly impair cognitive and executive functions or, if the fight affects psychomotor abilities, to a similar degree in both opponents. Regardless of the level of exercise capacity, an important prerequisite for the effectiveness of the effort is technical-tactical ability and quick decisions on when to take which offensive or defensive actions [16]. Research on the level of physical activity during a fight and its influence on the referee's verdict has been the subject of many studies The authors focused their attention on the work of the shoulder girdle, as the muscles of this part of the body exert the greatest effort. There are six basic punching techniques (punches), jab, cross, lead hook, rear hook, lead uppercut, rear uppercut, and combinations of these actions, with two or three punches each.

Davis and co-authors analysed physical activity and its effectiveness based on video recording and including the number of punches reaching the target (landed punches) and missed punches (air punches) in novice juniors in a 3 × 2min format [17]. This study showed that the winners dealt more accurate punches (landed punches) and the losers more air punches (air punch. The frequency of single punches as well as their combinations was higher in the winners. In this study, the average La for the whole group was 10.8 ±2.2 mM in the fifth minute, and the value of the relative variability expressed by the coefficient of variation CV = 20.3% was slightly lower than that in our study. The slightly higher La obtained in our study may have been due to the longer bout time. On the other hand, the higher La than our results could be explained by the participation of high-class players in an international tournament. high-class athletes in an international tournament [15]. Another study differentiating the activity of winners and losers was conducted in elite seniors in a 3 × 3 min format [18]. The authors noted that out of 29 bouts, in four cases the judges' verdict based on visual observation of the number of landed punches was inconsistent with the video recording. In addition, physical activity based on activity-to-break ratio or frequency of breaks decreased markedly in successive rounds [18]. The reason may have been increasing fatigue. The analysis of the effectiveness of offensive and defensive actions after successive bouts should, according to the researchers, help to develop technical-tactical skills. However, no decrease in activity was recorded in the winners at the Olympics [19]. The negligible weight category-dependent decline noted in our study is consistent with the observations of other authors [15].

In the light of the data from the cited literature and our own results, there is no basis for assuming that the average metabolic responses of winning and losing fighters are significantly different. Nevertheless, in individual cases, very large La differences between two athletes can arise when one of them manifests significantly more physical activity than his rival at the end of the fight. As the results of our study have shown, this applies to both winners and losers. In a study of elite Polish seniors taking part in an international tournament, the four losing fighters showed significantly higher La than the values demonstrated by the winners. Analysis of the course of the fights showed that the losers after two rounds tried with particularly high activity in the 3rd round to make up for lost points, but without success [20]. This behaviour in losing boxers manifested by more attacks with single punches in the last round (n = 16) compared to the first round (n = 13.3) was also noted by other researchers [17].

CONCLUSIONS

Post-fight lactate (La) concentrations in junior boxers fall within a fairly wide concentration range, which may indicate significant variation in physical activity throughout the fight between the two opponents and differences in their aerobic capacity. There are no differences in mean La between the winners and losers. The positive correlation of La in the blood and body weight of the losing and winning boxers is evidence of a similar intensity of exertion of the two opponents at identical times, so this indicator cannot serve as an argument to explain the reason for the outcome of the boxing fight (losing ÷ winning).

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