International Journal of Wrestling Science

ISSN: 2161-5667 (Print) 2161-3524 (Online) Journal homepage: http://www.tandfonline.com/loi/uijw20

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To cite this article: Kentaro Chino, Shingo Matsumoto, Tatsuaki Ikeda & Yoshimaro Yanagawa (2014) Comparison of Perceived Exercise Intensity and Objective Exercise Intensity During A Freestyle Wrestling Match, International Journal of Wrestling Science, 4:1, 131-136, DOI: 10.1080/21615667.2014.10879005

To link to this article: https://doi.org/10.1080/21615667.2014.10879005

COMPARISON OF PERCEIVED EXERCISE INTENSITY AND OBJECTIVE EXERCISE INTENSITY DURING A FREESTYLE WRESTLING MATCH

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ABSTRACT
This study compared perceived exercise intensity and objective exercise intensity during a freestyle wrestling match. Twelve elite collegiate male wrestlers performed freestyle wrestling matches with three 2-min periods. Perceived exercise intensity and objective exercise intensity were evaluated by the 6–20 point Borg rating of perceived exertion (RPE) scale and heart rate (HR), respectively. To compare these values directly, three methods were used: (1) comparison of RPE increased by 10 times and HR (method-1); (2) classification of five exercise intensities (very light, 1; near-maximal to maximal, 5) (method-2); and (3) classification of seven exercise intensities (very light, 1; near-maximal to maximal, 7) by subdividing scales in method-2 (method-3). Perceived exercise intensity was significantly lower than objective exercise intensity in each period (all $P < 0.05$, method-1), in the first period ($P = 0.007$, method-2), or in the first and second periods (all $P < 0.01$, method-3). Perceived exercise intensity of the winners was significantly lower than that of the losers ($P = 0.04$, method-1; $P = 0.03$, method-2), but objective exercise intensity was not significantly different between them. These results suggest that wrestlers, especially winners, feel lower exercise intensity compared with actual exercise intensity during a wrestling match.
KEY WORDS: perceived exertion, rating of perceived exertion (RPE), heart rate

INTRODUCTION

Exercise intensity is classified into two types: (1) perceived exercise intensity that is affected by physiological mediators, and by psychological mediators; and (2) objective exercise intensity that is affected only by physiological mediators. When perceived exercise intensity is higher than objective exercise intensity (i.e., wrestlers feel higher exercise intensity than actual exercise intensity), it is possible that they are not giving their best performance in a wrestling match. However, when perceived exercise intensity is lower than objective exercise intensity (i.e., wrestlers feel lower exercise intensity than actual exercise intensity), there is the possibility that they have an advantage in a wrestling match. Therefore, it is important for wrestlers and their coaches to understand the relation between perceived exercise intensity and objective exercise intensity during wrestling matches.

Perceived exercise intensity can be evaluated by the 6–20 point Borg's rating of perceived exertion (RPE) (very, very light, 7; very light, 9; fairly light, 11; somewhat hard, 13; hard, 15; very hard, 17; very, very hard, 19) (2). Heart rate (HR) is used to assess the cardiovascular strain associated with a Taekwondo competition (3), and to determine the exercise intensity of wrestling matches (1). Therefore, objective exercise intensity can be evaluated by HR. Borg (2) reported that points of the RPE are as close as one tenth of the corresponding HR, which enables investigation of the relation between perceived exercise intensity and objective exercise intensity.

The American College of Sports Medicine (ACSM) has devised a method that classifies RPE and HR into common exercise intensity (Table 1) (4). This method classifies the numerical values of RPE and HR into five exercise intensities, which reflect perceived exertion. Therefore, this method also enables investigation of the relation between perceived exercise intensity and objective exercise intensity. The purpose of this study was to compare perceived exercise intensity and objective exercise intensity during a freestyle wrestling match by using various evaluation methods.

Table 1: Classification of exercise intensity devised by the American College of Sports Medicine (method-2).

Ordinal scale	Intensity	%HRmax	RPE
1	Very light	< 57	< 9
2	Light	57-63	9-11
3	Moderate	64-76	12-13
4	Vigorous	77-95	14-17
5	Near-maximal to maximal	≧ 96	≧ 18

Maximal heart rate (HR_{max}) was estimated from the following equation: 207 − 0.7 × age. The rating of perceived exertion (RPE) was evaluated by the 6–20 point Borg scale (very, very light, 7; very light, 9; fairly light, 11; somewhat hard, 13; hard, 15; very hard, 17; very, very hard, 19).

METHODS

Participants: Twelve Japanese elite collegiate male wrestlers (mean ± SD; age, 20.6 ± 2.0 years old; wrestling history, 7.8 ± 3.3 years; height, 166.1 ± 4.8 cm; weight, 65.8 ± 4.9 kg) participated in the present study. They were freestyle wrestlers belonging to the 55-, 60-, or 66-kg weight category. This study was approved by the Ethics Committee of the Japan Institute of Sports Sciences.

Instruments-Tests: HR was recorded with a telemetry heart rate monitor (RS800; Polar Electro, Kempele, Finland) at 5-s intervals during the wrestling matches. A HR transmitter was attached across the subject's chest under a singlet, and the receiver was attached at the ankle joint of the hind leg.

Procedures: Comparison of perceived exercise intensity and objective exercise intensity was carried out by the following three methods. The first method (method-1) was based on Borg's study (2), where RPE was increased by 10 times, and the value was compared with HR. The second method (method-2) was based on Bridge et al.'s study (3), where HR was expressed as a percentage of subjects' maximal HR (% HR_{max}), which was calculated using a previously published equation (5): 207 − 0.7 × age. The % HR_{max} was classified into five exercise intensities devised by the ACSM (4) (Table 1). For the third method (method-3), the scales of "moderate" and "vigorous" of method-2 were each subdivided into two categories (Table 2).

Table 2: Classification of exercise intensity subdivided by the American College of Sports Medicine (method-3).

Ordinal scale	Intensity	%HRmax	RPE
1	Very light	< 57	< 9
2	Light	57-63	9-11
3	Moderate-1	64-70	12
4	Moderate-2	71-76	13
5	Vigorous-1	77-86	14-15
6	Vigorous-2	87-95	16-17
7	Near-maximal to maximal	≧ 96	≧ 18

"Moderate" and "vigorous" scales devised by the American College of Sports Medicine (method-2) were each subdivided into two categories.

Research design: Freestyle wrestling matches were carried out under the official rules specified by the International Federation of Associated Wrestling Styles in 2010. One wrestling match included three periods of 2 min with 30-s breaks between each period. To generate a demanding competitive environment, the subjects were divided into pairs of the same weight category and similar competition level. To ensure that the duration of one match was uniform (6 min), all three periods were performed in full for all matches, even if one subject won two periods or won by a fall or technical superiority. RPE was measured using the 6–20 point Borg's RPE (2) immediately after each period. HR of each period was determined by the mean value for 30 s immediately after the period.

Statistical analysis: Data obtained from method-1, which were ratio scales, were analyzed by two-way ANOVA (three periods × two types of exercise intensity) followed by Tukey's post hoc tests. Statistical significance between the winners and losers of each period was analyzed by the two-sided unpaired t test. Data obtained from method-2 and method-3, which were ordinal scales, were analyzed by the Wilcoxon rank-sum test. $P < 0.05$ was considered statistically significant. Statistical analyses were performed using SPSS 12.0J for Windows (SPSS Japan, Tokyo, Japan).

RESULTS

The relationship between perceived exercise intensity and objective exercise intensity evaluated by method-1 is shown in Figure 1. In all of the three periods, the perceived exercise intensity was significantly lower than the objective exercise intensity (mean ± SD; first period, 132 ± 15 vs. 169 ± 7 bpm; second period, 151 ± 14 vs. 174 ± 7 bpm; third period, 163 ± 20 vs. 176 ± 9 bpm) (all $P < 0.05$). The perceived exercise intensity of the winners (143 ± 20 bpm) was significantly lower than that of the losers (158 ± 19 bpm, $P = 0.04$), but the objective exercise intensity was not significantly different between the winners (174 ± 7 bpm) and the losers (173 ± 10 bpm, $P = 0.72$).

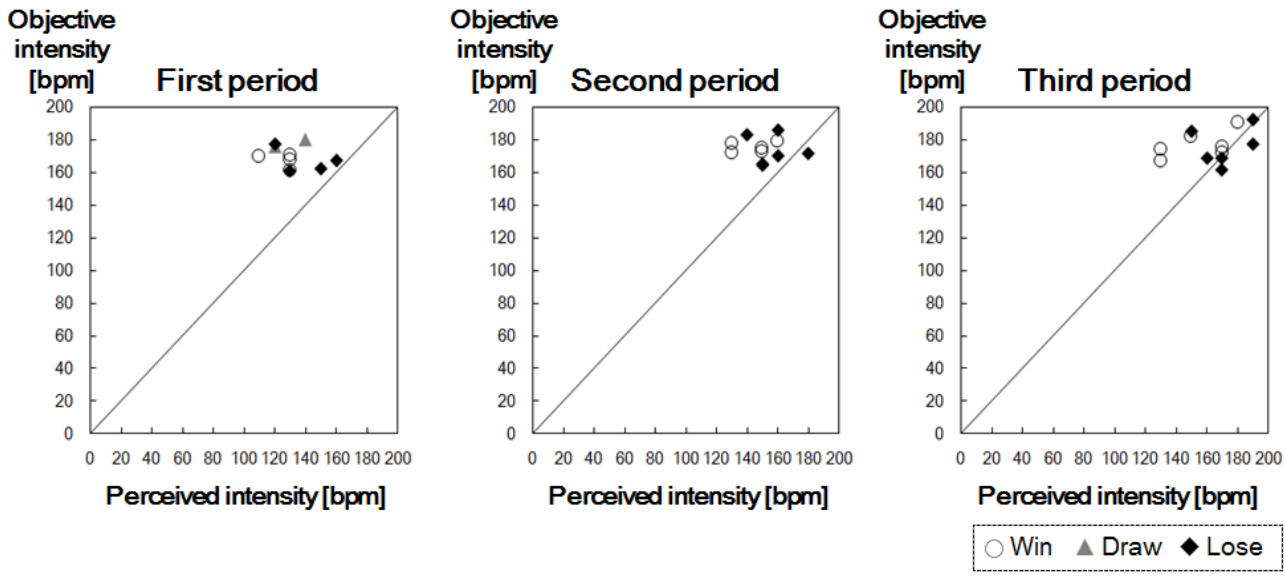

Figure 1: Relationship between perceived exercise intensity and objective exercise intensity obtained from method-1. Perceived exercise intensity was obtained from multiplying the 6–20 point Borg scale by 10. Objective exercise intensity was obtained from heart rate (HR).

Fig. 2 shows the relationship between perceived exercise intensity and objective exercise intensity evaluated by method-2. In the first period, the perceived exercise intensity (median: 3; min-max: 2–4) was significantly lower than the objective exercise intensity (median: 4; min-max: 4–4) ($P = 0.007$). There were no significant differences between the perceived exercise intensity and the objective exercise intensity in the second period (median: 4; min-max: 3–5 vs. median: 4; min-max: 4–5) ($P = 0.52$) and the third period (median: 4; min-max: 3–5 vs. median: 4; min-max: 4–5) ($P = 0.84$). The perceived exercise intensity of the winners (median: 3; min-max: 2–5) was significantly lower than that of the losers (median: 4; min-max: 3–5) ($P = 0.03$), but the objective exercise intensity was not significantly different between the winners (median: 4; min-max: 4–5) and the losers (median: 4; min-max: 4–5) ($P = 0.80$).

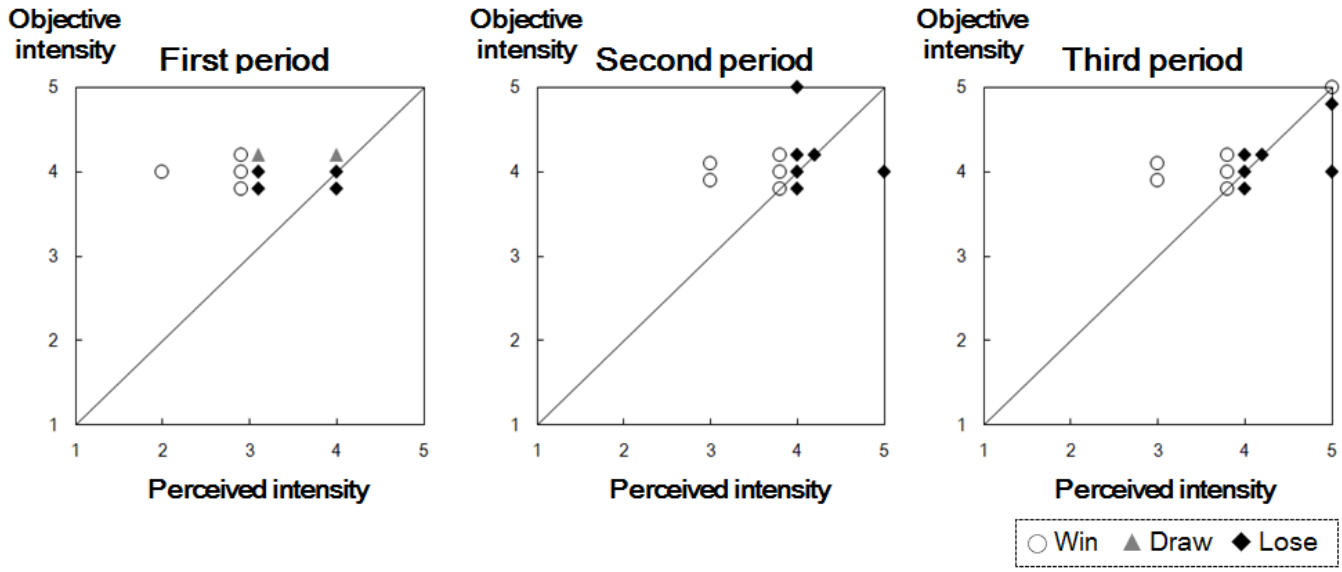

Figure 2: Relationship between perceived exercise intensity and objective exercise intensity evaluated by method-2. Perceived exercise intensity and objective exercise intensity were evaluated by classification into five exercise intensities identified by the American College of Sports Medicine (Table 1). Maximal heart rate (HR_{max}) was estimated from the equation: 207 − 0.7 × age.

The relationship between perceived exercise intensity and objective exercise intensity evaluated by method-3 is shown in Fig. 3. The perceived exercise intensity was significantly lower than the objective exercise intensity in the first period (median: 4; min-max: 2–5 vs. median: 6; min-max: 5–6) ($P < 0.001$) and the second period (median: 5; min-max: 4–7 vs. median: 6; min-max: 5–7) ($P = 0.003$). In the third period, there was no significant difference between the perceived exercise intensity (median: 6; min-max: 4–7) and the objective exercise intensity (median: 6; min-max: 5–7) ($P = 0.63$). For perceived exercise intensity, there was no significant difference between the winners (median: 4; min-max: 2–7) and the losers (median: 5; min-max: 3–7) ($P = 0.12$). Similarly, for objective exercise intensity, there was no significant difference between the winners (median: 6; min-max: 5–7) and the losers (median: 6; min-max: 5–7) ($P = 0.60$).

DISCUSSION

The present study compared perceived exercise intensity and objective exercise intensity during a freestyle wrestling match by three types of evaluation methods. We observed that perceived exercise intensity tended to be lower than objective exercise intensity. Perceived exercise intensity of the winners tended to be lower than that of the losers, but the objective exercise intensity was not significantly different between them.

Perceived exercise intensity was significantly lower than objective exercise intensity in all of the three periods for method-1, in the first period for method-2, and in the first and second periods for method-3 (Figs. 1–3). This result indicates that wrestlers felt lower exercise intensity than actual exercise intensity during these periods. In our study, the perceived exercise intensity was evaluated by RPE, which is affected by physiological mediators and by psychological mediators. The wrestling history of the present subjects was 7.8 ± 3.3 years, and they continued daily training to win wrestling matches. Therefore, it appears that repetition of hard training makes these wrestlers feel lower exercise intensity than the actual intensity. In addition, method-1 and method-2 showed that perceived exercise intensity of the winners of each period was significantly lower than that of the losers (Figs. 1–2). However, all of the three evaluation methods indicated that the objective exercise intensity was not significantly different between winners and losers (Figs. 1–3). These results showed that the winners felt lower exercise intensity compared with the losers, although a similar objective exercise intensity was imposed on them. We speculate that winners can control opponents at their desire, and therefore, they feel lower exercise intensity. We conclude that there is discord between perceived exercise intensity and objective exercise intensity during wrestling matches, which could be caused by the effect of daily training performed by wrestlers and/or development of the wrestling match.

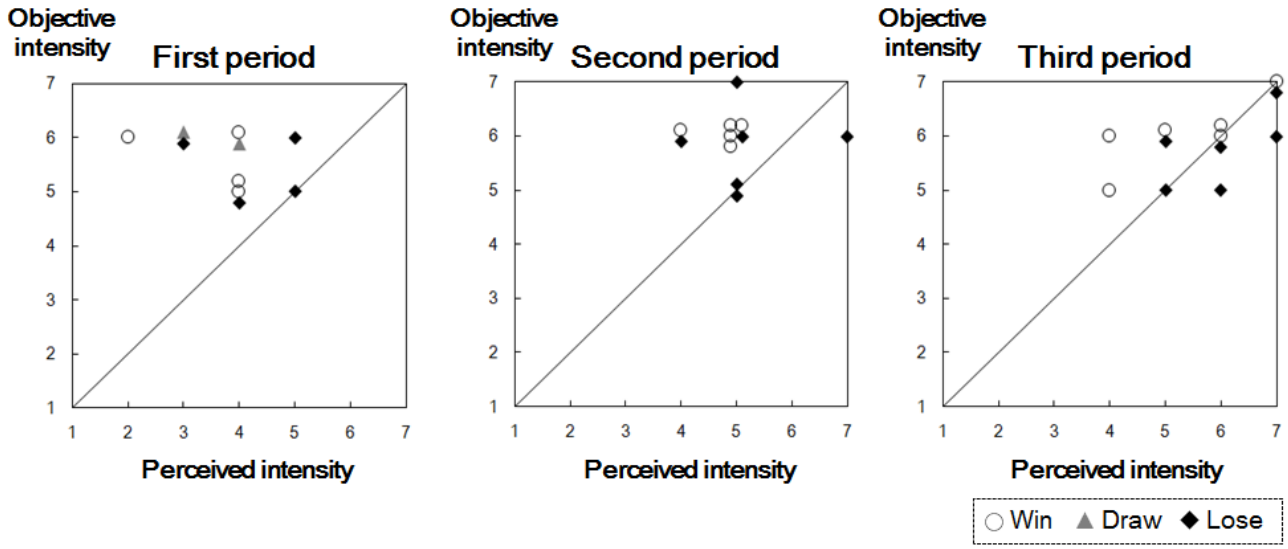

Figure 3: Relationship between perceived exercise intensity and objective exercise intensity acquired from method-3. Perceived exercise intensity and objective exercise intensity were evaluated by seven classifications where the “moderate” and “vigorous” scales of method-2 were subdivided into two categories (Table 2).

There are three limitations in this study. The first limitation is that the results of statistical significance were not completely consistent between the three types of evaluation methods. When exercise intensity during wrestling matches was evaluated by method-2, the perceived exercise intensity was “moderate” or “vigorous”, and objective exercise intensity was almost “vigorous” (Fig. 2). Therefore, we devised method-3, in which we subdivided “moderate” and “vigorous” into two categories (Table 2). As a result, a significant difference between perceived exercise intensity and objective exercise intensity was observed in the first period and in the second period (Fig. 3), which is an outcome caused by subdividing the classification. However, a significant difference between winners and losers was not detected by method-3, although it was detected by method-1 and method-2. We consider that method-3 is the most suitable method for investigating perceived exercise intensity and objective exercise intensity during a wrestling match, but it requires further consideration. The second limitation is that exercise intensity of the winners and losers could not be compared between the three periods, but was compared throughout all of the three periods. Therefore, the influence of the period could not be considered when comparing the exercise intensity of the winners and the losers. The reason for not comparing between the periods was a small sample size in this study (e.g., winners, N = 4; drawers, N = 2; losers, N = 4 for the first period). The third limitation is that HR is affected by psychological mediators. Therefore, HR is not a perfect indicator of objective exercise intensity. Tension and/or excitability of wrestlers is increased during wrestling matches, and therefore, HR will be increased by these psychological mediators. Consequently, objective exercise intensity during wrestling matches evaluated by HR was likely to be overestimated. Further research with a larger sample size is required to determine the most suitable method for evaluating exercise intensity during a wrestling match, and this would enable a more detailed comparison of perceived exercise intensity and objective exercise intensity.

CONCLUSIONS

Wrestlers, especially winners, feel lower exercise intensity compared with actual exercise intensity during a freestyle wrestling match. Such discord between perceived exercise intensity and objective exercise intensity could be the result of the influence of the daily training performed by wrestlers and the development of a wrestling match.

PRACTICAL IMPLICATIONS/ADVICE FOR ATHLETES AND COACHES

The evaluation methods used in this study should be useful for wrestlers and their coaches for improvement of wrestling performance. By using palpation of an artery for measurement of HR, they can easily use our evaluation methods. When they continuously collect data from their daily training, the most suitable evaluation method for each wrestler will be evident.

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