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LETTER TO THE EDITOR

Cardiac response to *Nage no Kata* in judo

Réponse cardiaque au Nage no Kata en judo

1. Case itself

The first world judo *Kata* competition was held in October 2007 in Tokyo, Japan. The *Nage no Kata* was developed in 1884 and 1885 at the Kodokan. by Jigoro Kano, the founder of judo, who developed *Kata* to demonstrate the principles of judo and to provide a type of training which emphasized performing techniques under controlled setting. According to Kano, to fully develop judo skills, it is essential to involve both *Randori* and *Kata* techniques [1]. Most high-grade Japanese judo teachers emphasize the importance of *Kata* performance for judokas' development, in particular *Nage no Kata* [2].

Results of the study conducted by Canestri et al. [3] suggested that session-RPE and HR monitoring is a simple and practical tool to quantify training loads in judo in different conditions. To date, no studies have investigated on possible association between HR and RPE related to *Nage no Kata* in judo athletes. Also, empirical evidence shows no studies that have researched correlation between *Tori* and *Uke* in any segment of judo performance. Thus, the aim of this study was to analyse the changes in HR and RPE of male and female judo athletes who performed *Nage no Kata* in a competitive setting.

Forty-six male judokas (n = 46) (mean body mass 84.06 ± 13.47 kg; mean body height: 179.68 ± 6.89 cm, mean body mass index (BMI) 26.25 ± 3.37 kg/m^2; mean age 21.91 ± 4.07 yrs.) and 40 female judokas (n= 40) (mean body mass 66.50 ± 12.24 kg; mean body height 163.97 ± 6.83 cm; mean BMI 25.07 ± 4.90 kg/m^2, mean age 20.05 ± 2.78 yrs.) were further subdivided into two groups. The first group consisted of judokas who performed the technique (*Tori*), while the other group of judokas presented their partners and had the role to assist them executing the technique (*Uke*). Data were collected during the official Serbian *Kata* judo competition (Novi Sad, Serbia) in January 2020. This *Kata* consists of five sets of three throws. All athletes performed only first three sets of *Nage no Kata*. Heart rate was monitored continuously throughout *Kata* and recovery period using heart rate monitor the Polar Team2 System (PE3000 Heart Rate monitor, Polar Electro Oy, Kempele, Finland) and recorded at 3 time points: prior, during and 1 minute following performance. The subjective perception of *Kata* intensity was measured using a Borg's category ratio 10 RPE scale (CR-10). Two-way ANOVA was applied in order to examine whether there is a statistically significant difference between males and females, and *Tori* and *Uke*, using SPSS version 20.0 for Windows (SPSS, Chicago, IL, USA). The statistical significance was set at $P \leq 0.05$ and the confidence intervals at 95%.

2. Discussion

Heart rate and RPE did not differ between *Tori* and *Uke*, suggesting a similar cardiovascular response during *Kata* performance. Differences occurred only in HR and RPE in female judokas before *Kata*performance and in male judokas after 1 min recovery. However, differences between male and female judokas were noticed in all HR values measured (Table 1).

Previous studies have researched the effect of successive judo matches on variables, such as HR and RPE [4,5]. Studies concerning judo performance have recorded HR during bouts, where increase in cardiovascular stress during contest was detected.

In our study, the HR recorded during *Kata* performance indicates that the judokas who performed *Nage no Kata* reached a HR peak of 183.05 ± 12.27 beats·min-1 for female and 168.34 ± 13.71 beats·min-1 for male judokas. Similar response of HR was noted when *Uke* technique was performed. Furthermore, all HR parameters in male judokas (*Uke*) were slightly higher when compared with those who performed *Tori*. The high HR recorded indicates that judo *Kata* performance poses a high strain on the cardiovascular system when *Uke* and *Tori* techniques are performed. In addition, all female judokas presented higher HR values when compared to male judokas. Nevertheless, our findings show that both physical and mental efforts are related to RPE during fight in judo.

Data found through our study revealed that the value of RPE related to *Nage no Kata* was similar between *Uke* and *Tori*, as well as between male and female judokas. In fact, judo *Kata* presented a similar physiological and

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Table 1 Heart rate and rate of perceived exertion during *Nage no Kata*.

	Entire cohort ($n = 86$)	Female ($n = 40$)	Male ($n = 46$)
Heart rate			
HR start ($b \cdot min^{-1}$)			
Tori	126.86 ± 18.55	135.60 ± 17.17**, ***	119.26 ± 16.36
Uke	126.01 ± 17.69	129.52 ± 17.31	122.95 ± 17.62
HR peak ($b \cdot min^{-1}$)			
Tori	175.18 ± 14.93	183.05 ± 12.27**	168.34 ± 13.71
Uke	176.32 ± 15.44	180.72 ± 16.36*	172.50 ± 13.64
HR end ($b \cdot min^{-1}$)			
Tori	168.34 ± 17.79	178.17 ± 13.26**	159.80 ± 16.87
Uke	168.63 ± 18.24	174.12 ± 19.25*	163.86 ± 16.04
HR after 1 min recovery ($b \cdot min^{-1}$)			
Tori	145.47 ± 19.59	154.50 ± 18.27**	137.63 ± 17.33
Uke	149.19 ± 21.53	155.12 ± 23.79*	144.04 ± 18.07***
Rate of perceived exertion (Borg scale 1—10)			
RPE before			
Tori	$3.27 \pm 1.26^{\ddagger}$	3.55 ± 1.39***	3.04 ± 1.09
Uke	2.83 ± 1.29	2.95 ± 1.21	2.73 ± 1.35
RPE after			
Tori	4.59 ± 1.62	4.97 ± 1.70	4.26 ± 1.49
Uke	4.41 ± 1.56	4.47 ± 1.88*	4.36 ± 1.25
RPE after 1 min recovery			
Tori	3.89 ± 1.68	4.12 ± 1.95	3.69 ± 1.39
Uke	3.94 ± 1.43	4.17 ± 1.70	3.73 ± 1.12
Nage no Kata duration (s)	280.85 ± 73.22	277.43 ± 70.11	283.83 ± 76.47

*$P < 0.005$ between males and females; **$P < 0.001$ between males and females; ***$P < 0.01$ between *Tori* and *Uke*.

psychological response between *Tori* and *Uke*. Therefore, it appears that HR and RPE increased similarly for both *Uke* and *Tori* techniques. However, female judokas presented higher values of RPE when compared to male judokas but statistically insignificant results have been found. Results of the present study show that highest RPE was after *Kata* performance for female (*Tori*) 4.97 ± 1.70 and 4.36 ± 1.25 for male judokas (*Uke*). Thus, it can be concluded that performing these techniques required an exertion of moderate intensity for both male and female judokas.

Kata duration and physical demand of *Kata*, which demands basic judo skills, remained mainly unchanged between judokas. In that sense, RPE was similar in judokas, except for a RPE before *Kata* in the whole group. This observation can be explained by rather demanding nature of *Kata*, which requires perfect technique execution and the mental control during the movement.

In sum, *Nage no Kata* performance is an activity that requires high physiological and psychological demands for both *Uke* and *Tori*. Data acquired through this study might provide a useful insight in understanding the level of effort and the internal energetic and physiological demands. Physiological response in relation to *Kata* performance should provide valuable information regarding physiological adaptations and stimulate further investigations regarding *Kata* as an important and integral part of judo.

Disclosure of interest

The authors declare that they have no competing interest.

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