

**31 - HEART RATE BEHAVIOR DURING A BRAZILIAN JIU-JITSU TRAINING SESSION**

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**INTRODUCTION**

Better knowledge regarding physiologic demands during the Brazilian Jiu Jitsu (BJJ) practice could help coaches and physical trainers in prescription of training programs, both for reaching the high sportive performance and for developing physical fitness focused to health. Researches have investigated heart rate behavior in simulations of BJJ combats and its results presented average values around 80% of Maximum HR (HRmax) (SILVA et al., 2011; FRANCHINI, TAKITO, PEREIRA, 2003) with peak values of  $\approx 97\%$ HRmax (SILVA et al., 2011). Prado and Lopes (2003) indicated average of cardiovascular effort ( $\approx 74\%$ HRmax) a little bit lower than the value of the studies mentioned above. Upon these findings, we could consider a moderate cardiovascular demand in simulations of BJJ combats. This suggestion gains strength with results of researches that presented moderate values of aerobic capacity ( $VO_{2max} \approx 49\text{ml/kg/min}$ ) to BJJ elite athletes (ANDREATO et al., 2011; BORGES et al., 2012).

The researches regarding the cardiovascular demand in the BJJ have analyzed the HR behavior in combat context, taking in consideration the sportive rules (SILVA et al., 2011; FRANCHINI et al., 2003; ANDREATO et al., 2012; BORGES et al., 2012; PRADO, LOPES, 2009; DEL VECHIO et al., 2007). However, there are a significant number of people who are looking for this martial art as a way to improve their physical fitness, self-defense, and self-esteem, several times, without the intention to have sportive performance (SILVA, TAHARA, 2003; TAVARES, SILVA, DRIGO, 2003).

The assessment of HR behavior in a typical BJJ training session with high ecological validity will allow the authors to analyze whether cardiovascular effort during BJJ practice is suitable to improve and maintaining a cardiovascular fitness in according with the American College Sport Medicine (ACSM) guidelines (HASKELL et al., 2007). Thus, the aim of this study was to analyze the HR behavior during a traditional BJJ training session.

**METHODS**

**Participants:** Twelve male adult BJJ athletes (age =  $23 \pm 4.1$  yrs; weight =  $75.7 \pm 11$  kg; height =  $176 \pm 4$  cm) with BJJ graduation from blue to black belt participated in this study as volunteers. The athletes were training regularly at least for two years with training frequency of 3 times per week. This research was approved by Ethic Committee of State University of Santa Cruz – Brazil, and the participants needed to sign the Agreement Term to participate in this research. It was adopted the following exclusion criteria: the reported use of illicit ergogenic, the use of medicaments that could interfere in the HR behavior during the training session, and pre-injury/diseases or injury/diseases that could happen during the experimental period.

**Procedures:** We asked to the athletes do not perform high intensity effort or take in alcohol drink 24h before the experimental procedures. Also, they were oriented not consuming food or caffeine drink 3h before of the training session. The athletes carried out the training session, in which the HR was continuously monitored during the whole training.

**Training session (BJJ-TS):** The BJJ-TS was structured by two BJJ coaches with more than 10 years of teaching experience of this martial art. The time duration of the BJJ-TS was estimated for 60 min, with the following phases: 1) Warm up (WU) - Running, stretching, specific coordination movements of BJJ, sit-ups and push-ups; 2) Technical (TEC) - Practice of BJJ techniques (sweeps and pass guard); 3) Combats (COM) - Each athlete participated of 3 BJJ combats with duration of about 5 min each, followed with the same time recovery to the next fight.

**Anthropometric Assessment:** The body mass was determined by Welmy® with 0.1 kg precision, while the height was measured by Seca® stadiometer with 0.1 cm precision.

**Monitoring of the HR and determination of the HRmax:** The HR was captured by heart rate monitor Polar® S610i (Polar Electro, Finland). The band transmitter of the heart rate monitor was fixed around the chest of the athlete, under the gi, and the watch of the heart rate monitor was strategically put in a wooden stick and it was sustained by the researcher who followed the movements of the athlete during the whole training session. An interface allowed the transmission of the data from equipment to computer to be analyzed by Polar Precision Program (version 4.0). The HRmax was estimated using the standard equation  $220 - \text{age}$  (TANAKA, MONAHAN, SEALS, 2001).

**Effort Zone:** We determined four cardiovascular zones effort with the objective to verify the dwell time in the different intensity levels during the BJJ-TS, namely: Zone 1 ( $<60\%$ HRmax); Zone 2 ( $60-80\%$ HRmax); Zone 3 ( $80-90\%$ HRmax); and Zone 4 ( $90-100\%$ HRmax).

**Statistical Analysis:** The HR behavior was represented by mean of the HR (HRmean) and peak of the HR (HRpeak), expressed in both absolute (bpm) and relative ( $\%HRmax$ ) values. The data were presented as means and standard deviations (SD). Comparisons between specific phases regarding HRmean and HRpeak were performed by one-way ANOVA for repeated measures followed by Tukey's post hoc test with  $p < 0.05$ .

**RESULTS**

The result from ANOVA having the HRmean as dependent variable indicated there was significant difference among the phases of the BJJ-TS ( $F(2) = 19.1588$ ,  $P < 0.01$ ). The post hoc test showed that the value of the HRmean in COM was higher than those values observed in WU and TEC ( $P < 0.05$ ). In the same way, the result from ANOVA with HRpeak as dependent variable indicated significant difference among the means ( $F(2) = 26.2044$ ,  $P < 0.01$ ), being that the HRpeak in WU and TEC phases were significantly lower than that observed in COM ( $P < 0.05$ ). The Table 1 presents the mean and SD values of these variables analyzed.

Table 1. Cardiovascular responses in traditional BJJ training session (n=12)

Phase	Duration(min)	HR <sub>mean</sub> (bpm)	%HR <sub>max</sub>	HR <sub>peak</sub> (bpm)	%HR
GTS	62 ± 1.2	134 ± 12	69 ± 6.8	189 ± 9	96 ± 5
WU	12 ± 1.1	119 ± 17	63 ± 8	157 ± 16	80 ± 8
TEC	21 ± 1.6	119 ± 14	63 ± 5	149 ± 14	76 ± 5
COM	29 ± 0.8	151 ± 12 <sup>#</sup>	81 ± 3	189 ± 9 <sup>#</sup>	96 ± 5

GTS = General Training Session; values relative of whole training session; # p < 0.05 compared with the values from WU and TEC.

PhaseDuration(min)HRmean(bpm)%HRmaxHRpeak (bpm)%HRmaxGTS62 ± 1.2134 ± 1269 ± 6.8189 ± 996 ± 5WU12 ± 1.1119 ± 1763 ± 8157 ± 1680 ± 8TEC21 ± 1.6119 ± 1463 ± 5149 ± 1476 ± 5COM29 ± 0.8151 ± 12<sup>#</sup>81 ± 3189 ± 9<sup>#</sup>96 ± 5

## DISCUSSION

According to ACSM, 30 min of aerobic moderate intensity physical activity with weekly frequency of 5 days can promote and maintain a healthy cardiovascular fitness to healthy adults with age between 18 and 65 yrs (HASKELL et al., 2007). Our results showed that the structure of the BJJ-TS analyzed comply with the ACSM guideline regarding the intensity and duration of physical activity to promote healthy aerobic fitness to healthy adults. However, these results need to be analyzed with caution because the BJJ-TS presented intermittent effort. The ACSM guidelines also states that 30 min of physical activity can be split in sessions of 10 min over the day (HASKELL et al., 2007). The results showed that the participants remained approximately 54 min in cardiovascular effort above 60%HRmax. Despite to intermittent effort characteristics, the BJJ-TS proved to be capable to promote an appropriate cardiovascular fitness to healthy adults in according to ACSM guidelines.

The results showed statistical difference regarding the cardiovascular effort among the phases of the BJJ-TS. The WU presented light to moderate cardiovascular effort (HRmean = 119 ± 17 bpm, 63 ± 8 %HRmax) with peak values around of 80 ± 8 %HRmax. The intensity was suitable to promote required cardiovascular adaptation to perform the activities of the BJJ-TS, attending the recommendations of literature (CERVANTES, SNYDER, 2011; SHELLOCK, PRENTICE, 1985). Also, the intensity level was appropriate even to who is starting a physical activity program (HASKELL et al., 2007).

Andreato et al. (2012) performed study to determine physiological parameters of BJJ athletes during combat simulations. They requested to athletes carry out their usual routine of warm up before the combats. Thus, the athletes performed 10 min of activities including stretching, run, push-up, jump and BJJ specific movements. After the warm up were observed values of HRmean = 122 ± 25 bpm, corresponding cardiovascular effort around 63.4%HRmax. The HR values of the warm up routine at Andreato's research corroborates with our results.

The results showed that the intensity of the cardiovascular demand was considered light to moderate during the TEC phase of the BJJ-TS. Thus, regarding the cardiovascular effort, there isn't contraindication in prescribe this activity to healthy adults, even to beginners in physical activity program (HASKELL et al., 2007). Bridge et al. (2007) evaluated cardiovascular effort of different activities from taekwondo training, being observed smaller values of HR in technical training when compared to other activities such as sparring training. The authors explained these results due to the goal of each activity because the technical training has the goal of technical improvement rather than improving aerobic fitness. Despite of different features between taekwondo and BJJ, we believe that the smaller values of HR observed in the TEC phase could be explained in the same direction of the Bridge's study.

The COM phase presented the biggest cardiovascular effort of the BJJ-TS that could be considered high (81 ± 3 %HRmax) with submaximal peaks efforts (96 ± 5 %HRmax). Prado and Lopes (2009) analyzed the HR behavior of the 8 male BJJ athletes after the BJJ training session involving WU and COM. The results from Prado's research showed values of HR mean (HRmean= 145 ± 10bpm) lower than our results regarding of the effort during the COM. The difference in the experimental protocol seems to be the reason of this discrepancy because in Prado's research the HR was measured only after the combat session.

Silva et al. (2011) performed a study to analyze the HR behavior of 5 male BJJ athletes during BJJ training session involving WU and COM. The study of Silva et al (2011) presented the highest similarity of experimental protocol with the present research concerning the format of the COM session and the procedure of measurement of HR. The results from Silva's study corroborate with our results in both for HR mean (HRmean= 153 ± 14 bpm) and for HR peak (HRpeak= 192 ± 8 bpm).

In summary, differences in the experimental protocols adopted among the researches hampers a generalization of the results regarding the HR behavior in BJJ combats. But despite that, it is evident the cardiovascular demand from moderate to high during BJJ combats in all studies presented.

## CONCLUSIONS

The results showed that the BJJ-TS analyzed has a moderate cardiovascular demand what could be considered appropriate to promote and maintain the healthy aerobic fitness to general people. However, the different activities of the BJJ-TS stressed the cardiovascular system to different degrees, with combat phase eliciting the highest cardiovascular effort among them, which could be considered moderate to high, with peak submaximal efforts. So, we recommend to the BJJ coaches must do a screening regarding cardiovascular risk in their new BJJ students before they start the BJJ training session that include combats in its structure.

Key words: martial art; cardiovascular fitness; intermittent exercise.

## REFERENCES

- ANDREATO, L.V., MORAES, S.M.F., ESTEVES, J.V.D.C., PEREIRA, R.R.A., GOMES, T.L.M., ANDREATO, T.V., FRANCHINI, E.. Physiological responses and rate of perceived exertion in Brazilian jiu-jitsu athletes. *Kinesiology*, 44(2), 173-181. 2012.
- ANDREATO, L.V., MORAES, S.M.F., GOMES, T.L.M., ESTEVES, J.V.D., ANDREATO, T.V., FRANCHINI, E.. Estimated aerobic power, muscular strength and flexibility in elite Brazilian Jiu-Jitsu athletes. *Science & Sports*, 26(6), 329-337. 2011.
- BORGES, C.C., OLIVEIRA, R.A., DE OLIVEIRA, R.A., SILVA, R.F.S., PERFEITO, P.J.C. Physiological responses in acute jiu-jitsu and correlation with the aerobic capacity. *Fiep Bulletin*, 82 – Special Edition. 2012.

- BRIDGE, C.A., JONES, M.A., HITCHEN, P., SANCHEZ, X. Heart rate responses to Taekwondo training in experienced practitioners. *J Strength Cond Res*, 21(3), 718-723. 2007.
- CERVANTES, S.J., SNYDER, A.R. The Effectiveness of a Dynamic Warm-Up in Improving Performance in College Athletes. *Journal of Sport Rehabilitation*, 20, 487-493. 2011.
- DEL VECCHIO, F.B., BIANCHO, S., HIRATA, S.M., CHACON-MIKAHIL, M.P.T. Análise morfo-funcional de praticantes de Brazilian Jiu-Jitsu e estudo da temporalidade e da quantificação das ações motoras na modalidade. *Movimento & Percepção*, 7(10), 263-281. 2007.
- FRANCHINI, E., TAKITO, M.Y., PEREIRA, J.N.C. Frequência cardíaca e força de preensão manual durante a luta de jiu-jitsu. *Revista Digital Efedportes*. 2003.
- HASKELL, W.L., LEE, I., PATE, R.R., POWELL, K.E., BLAIR, S.N., FRANKLIN, B.A., MACERA, C.A., HEATH, G.W., THOMPSON, P.D., BAUMAN, A. Physical Activity and Public Health: Updated Recommendation for Adults from the American College of Sports Medicine and the American Heart Association. *Med Sci Sports Exerc.*; 39(8), 1423-34. 2007.
- PRADO, E.J., LOPES, M.V.C. Resposta aguda da frequência cardíaca e da pressão arterial em esportes de luta (Jiu-Jitsu). *Revista Brasileira de Ciências da Saúde*, 7(22), 63-67. 2009.
- SHELLOCK, F.G., PRENTICE, W.E. Warning-Up and Stretching for Improved Physical Performance and Prevention of Sports-Related Injuries. *Sports Medicine*, 2(4), 267-278. 1985.
- SILVA, K.A., TAHARA, A.K. Fatores de adesão à prática do jiu jitsu. *Motriz*, 9(Suppl.), S186. 2003.
- SILVA, L.H., MARSHAL, R., RIBEIRO, L.F.P., MAURINO JR, D., DRIGO, A.J. Correlation between methods of quantifying of training load in a session of combats of jiu-jitsu. *Fiep Bulletin*, 81 - Special Edition. 2011.
- TANAKA, H., MONAHAN, K.D., SEALS, D.R. Age-Predicted maximal heart rate revised. *Journal of the American College of Cardiology*, 37(1), 153-6. 2001.
- TAVARES JR, A.C., SILVA, L.H., DRIGO, A.J. Os motivos da adesão da prática do jiu-jitsu na cidade de Rio Claro. *Motriz*, 9(Suppl.), S180. 2003.

#### HEART RATE BEHAVIOR DURING A BRAZILIAN JIU-JITSU TRAINING SESSION

Many people have practiced martial arts as a way to keep themselves physically active. So, better understanding regarding physiological responses on this kind of physical activity might help the professionals of physical education for a safe and precise prescription. Then, the aim of this study was to analyze heart rate (HR) behavior during an ordinary Brazilian Jiu-Jitsu (BJJ) training session. To achieve this goal, twelve male BJJ athletes ( $23.0 \pm 4.1$  yrs) volunteered to this study and carried out a training session of ~ 1h. Firstly, the participants performed a general warm-up, which was followed by technical exercises and, for the last, the combats. HR was continuously monitored during the session. Considering the results from average HR values ( $HR_{\text{average}} = 68 \% HR_{\text{max}}$ ) the BJJ training session analyzed could be considered of moderate intensity. The results from one-way ANOVA for repeated measures followed by Tukey's post hoc test revealed that the average ( $HR_{\text{average}} = 81 \pm 3 \% HR_{\text{max}}$ ) and peak HR ( $HR_{\text{peak}} = 96 \pm 5 \% HR_{\text{max}}$ ) in combats were higher than those observed in warm-up ( $HR_{\text{average}} = 63 \pm 8 \% HR_{\text{max}}$ ;  $HR_{\text{peak}} = 80 \pm 8 \% HR_{\text{max}}$ ) and technical exercises ( $HR_{\text{average}} = 63 \pm 8 \% HR_{\text{max}}$ ;  $HR_{\text{peak}} = 76 \pm 8 \% HR_{\text{max}}$ ). The BJJ training session could be considered appropriate to promote and maintain the healthy aerobic fitness to general people. However, due the high  $HR_{\text{peak}}$  values in combats, the BJJ coaches must do a screening regarding cardiovascular risk in their new BJJ students, in specific those who are sedentary.

Key words: martial art; cardiovascular fitness; intermittent exercise.

#### COMPORTEMENT DE LA FRÉQUENCE CARDIAQUE DURANT UNE SESSION D'ENTRAÎNEMENT DE JIU-JITSU BRÉSILIEN.

Beaucoup de personnes pratiquent les arts matiaux comme un moyen de se maintenir physiquement active. Dans ce contexte, une meilleure compréhension des réponses physiologiques dans ce genre d'activité peut aider les professionnels d'éducation physique à des prescriptions plus sûres et précises. Ainsi, l'objectif de cette étude a été d'analyser le comportement de la fréquence cardiaque (FC) durant une session d'entraînement traditionnelle de Jiu-Jitsu brésilien (JJB). Pour atteindre cet objectif, douze athlètes de JJB du sexe masculin ( $23,0 \pm 4,1$  ans) se sont volontairement proposés pour participer de cette étude et ont réalisé une session d'entraînement de ~ 1h. Les participants ont d'abord effectué un échauffement général qui a été suivi par des exercices techniques et, finalement, par les combats. La FC a constamment été mesurée durant la session d'entraînement. Compte tenu des résultats des indices moyens de la FC ( $FC_{\text{moyenne}} = 68\% FC_{\text{max}}$ ), la session d'entraînement de JJB analysée peut être considérée d'intensité modérée. Les résultats du one-way ANOVA pour des mesures répétées, suivi du test de Tukey, ont révélé que la moyenne ( $FC_{\text{moyenne}} = 81 \pm 3 \% FC_{\text{max}}$ ) et le pic de la FC ( $FC_{\text{pic}} = 95.9 \pm 5.1 \% FC_{\text{max}}$ ) durant les combats ont été plus importants si comparés aux valeurs relevées durant l'échauffement ( $FC_{\text{moyenne}} = 63 \pm 8 \% FC_{\text{max}}$ ;  $FC_{\text{pic}} = 80 \pm 8 \% FC_{\text{max}}$ ) et durant les exercices techniques ( $FC_{\text{moyenne}} = 63 \pm 8 \% FC_{\text{max}}$ ;  $FC_{\text{pic}} = 76 \pm 8 \% FC_{\text{max}}$ ). La session d'entraînement de JJB peut être considérée appropriée pour promouvoir et maintenir un niveau de conditionnement aérobie sain pour les personnes en général. Toutefois, dû au mesures élevées de la  $FC_{\text{pic}}$  pendant les combats les entraîneurs de JJB doivent prêter attention au rapport aux risques cardiovasculaires pour les nouveaux élèves de JJB, surtout pour ceux qui sont sédentaires.

Mots-clés: Art martial, conditionnement cardiovasculaire, exercice intermittent.

#### COMPORTAMIENTO DE LA FRECUENCIA CARDÍACA DURANTE UNA SESIÓN DE ENTRENAMIENTO DE JIU-JITSU BRASILEÑO.

Muchas personas han practicado artes marciales como un medio para mantenerse físicamente activas. En este contexto, una mejor comprensión de las respuestas fisiológicas en este tipo de actividad física puede ayudar a los profesionales de la educación física en la obtención de una prescripción segura y precisa. De este modo, el objetivo del estudio fue analizar el comportamiento de la frecuencia cardíaca (FC) durante una sesión de entrenamiento tradicional de Jiu-Jitsu brasileño (JJB). Para lograr este objetivo, doce atletas masculinos de JJB ( $23.0 \pm 4.1$  años) se ofrecieron como voluntarios para este estudio y se sometieron a una sesión de entrenamiento de ~ 1h. En primer lugar, los participantes realizaron un calentamiento deportivo general, que fue seguido por ejercicios técnicos y, finalmente, la lucha. La FC fue monitoreada continuamente durante la sesión de entrenamiento. Teniendo en cuenta los resultados de los valores medios de FC ( $FC_{\text{media}} = 68\% FC_{\text{máx}}$ ), la sesión de entrenamiento JJB analizada puede considerarse de intensidad moderada. Los resultados del ANOVA de una vía para mediciones repetidas, seguido de la prueba de Tukey, revelaron que la media ( $FC_{\text{media}} = 81 \pm 3\% FC_{\text{máx}}$ ) y el pico de la FC ( $FC_{\text{pico}} = 95.9 \pm 5.1\% FC_{\text{máx}}$ ) en las luchas fueron mayores en comparación con los valores observados en el calentamiento deportivo ( $FC_{\text{media}} = 63 \pm 8\% FC_{\text{máx}}$ ,  $FC_{\text{pico}} = 80 \pm 8\% FC_{\text{máx}}$ ) y durante los ejercicios técnicos ( $FC_{\text{media}} = 63$

$\pm 8\%$  FCmáx, FCpico =  $76 \pm 8\%$  FCmáx). La sesión de entrenamiento de JJB se puede considerar apropiada para promover y mantener un nivel de capacidad aeróbica saludable para las personas en general. Sin embargo, debido a los altos valores de FCpico en combate, los entrenadores de JJB deben evaluar los riesgos cardiovasculares para los nuevos estudiantes de JJB, específicamente para aquellos que son sedentarios.

Palabras claves: arte marcial; acondicionamiento cardiovascular; ejercicio.

#### COMPORTAMENETO DA FREQUÊNCIA CARDÍACA DURANTE UMA SESSÃO DE TREINO DE JIU-JITSU

Muitas pessoas têm praticado artes marciais como um meio de manter-se fisicamente ativas. Neste contexto, uma melhor compreensão sobre as respostas fisiológicas neste tipo de atividade física pode auxiliar os profissionais em educação física para uma prescrição segura e precisa. Assim, o objetivo deste estudo foi analisar o comportamento da frequência cardíaca (FC) durante uma sessão de treino tradicional de Jiu-Jitsu (JJ). Para alcançar esse objetivo, doze atletas de JJ do sexo masculino ( $23,0 \pm 4,1$  anos) se ofereceram voluntariamente para este estudo e realizaram uma sessão de treinamento de ~ 1h. Primeiramente, os participantes realizaram um aquecimento geral, que foi seguido por exercícios técnicos e, por último, os combates. A FC foi monitorada continuamente durante a sessão de treino. Considerando os resultados dos valores médios da FC (FCmédia =  $68\%$  FCmáx), a sessão de treinamento de JJ analisada pode ser considerada de intensidade moderada. Os resultados da one-way ANOVA para medidas repetidas, seguida pelo teste a posteriori de Tukey, revelaram que a média (FCmédia =  $81 \pm 3\%$  FCmáx) e o pico da FC (FCpico =  $95.9 \pm 5.1\%$  FCmáx) nos combates foram maiores em comparação aos valores observados no aquecimento (FCmédia =  $63 \pm 8\%$  FCmáx; FCpico =  $80 \pm 8\%$  FCmáx) e durante os exercícios técnicos (FCmédia =  $63 \pm 8\%$  FCmáx; FCpico =  $76 \pm 8\%$  FCmáx). A sessão de treino de JJ pode ser considerada apropriada para promover e manter um nível de condicionamento aeróbio saudável para pessoas em geral. Contudo, devido aos altos valores da FCpico nos combates, os técnicos de JJB devem fazer uma triagem a respeito do riscos cardiovascular para os novos alunos de JJB, em específico para aqueles que são sedentários.

Palavras-chaves: arte marcial; condicionamento cardiovascular; exercício intermitente.

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