RBCDH Revista Brasileira de CINEANTROPOMETRIA e Desempenho Humano

DOI: http://dx.doi.org/10.5007/1980-0037.2014v16n6p638

original article

Internal training load: perception of volleyball coaches and athletes

Carga interna de treinamento: percepção de técnicos e atletas de voleibol

Francine Caetano de Andrade Nogueira[1]
Ruan Alves Nogueira[1]
Danilo Reis Coimbra[1]
Bernardo Miloski[2]
Victor Hugo de Freitas[3]
Maurício Bara Filho[1]

Abstract – The aim of this study was to evaluate the correspondence between perceived internal load of volleyball players of different positions with perceived internal load planned by the coach, as well as to compare the perceptions of internal training load between different positions in volleyball. The sample was composed of 15 professional volleyball players who were members of a 2012/2013 team in the Brazilian first division league. The athletes answered the Borg CR-10 scale after training, while the coach answered before the training, as was planned for this study. Data analysis was performed Kappa (K), one-way and two-way ANOVA with Tukey post-hoc using the statistical packages SPSS 19.0 and Statistica 8.0. The results indicated that all positions showed good agreement with the perception of the coach and no significant differences in perceptions of internal training load. However, when analysing the percentage of athletes' perceptions of intensity proposed by the coach, it was observed that athletes overestimate the sessions of easy training, while they underestimate the intensity of heavy training. The results indicate that there may be differences between the perceptions of coaches and athletes and reinforce the importance of adopting strategies for monitoring/control of daily training loads.

Key words: Athletes; Monitoring; Volleyball.

Resumo – *Este estudo pretendeu avaliar a correspondência entre a percepção da carga interna de atletas de voleibol de diferentes posições com a percepção da carga planejada pelo treinador e comparar as percepções da carga interna de treinamento entre as diferentes posições no voleibol. A amostra foi composta por 15 atletas profissionais de voleibol integrantes de uma equipe da Superliga 2012/2013. Os atletas responderam à escala CR-10 de Borg, após o treinamento, enquanto o técnico a respondeu antes, conforme o planejou. Para análise dos dados, foi realizado o índice Kappa (K), ANOVA one-way e two-way com post-hoc de Tukey, utilizando os pacotes estatísticos SPSS 19,0 e Statistica 8.0. Os resultados indicaram que todas as posições apresentaram bons níveis de concordância com a percepção do treinador e não apresentaram diferenças significativas nas percepções da carga interna de treinamento. No entanto, ao analisar o percentual das percepções dos atletas por intensidade proposta pelo treinador, foi observado que, em treinamentos leves, os atletas superestimam as sessões, enquanto que, em treinamentos pesados, os atletas subestimam a intensidade. Os resultados permitem concluir que pode haver diferenças entre as percepções de técnicos e atletas e reforçam a importância da adoção de estratégias para o monitoramento/controle diário das cargas de treinamento.*

Palavras-chave: *Atletas; Monitoramento; Voleibol.*

1 Universidade Federal de Juiz de Fora. Faculdade de Educação Física e Desportos. Grupo de Estudos de Psicofisiologia do Esporte e das Atividades Físicas. Juiz de Fora, MG. Brasil

2 Universidade de São Paulo. Escola de Educação Física e Esporte. Grupo de Estudos de Pesquisa em Planejamento e Monitoramento do Treinamento Físico e Esportivo. São Paulo, SP. Brasil.

3 Universidade Estadual de Londrina. Departamento de Educação Física. Grupo de Estudo das Adaptações Fisiológicas ao Treinamento. Londrina, PR. Brasil.

Received: 29 July 2013
Accepted: 26 May 2014

INTRODUCTION

Volleyball is a sport of intermittent actions where athletes make efforts of short length and extremely high intensity, of high neuromuscular demand, and a significant number of jumps[1-3]. These specific characteristics demand a precise application and control of training load to improve athletes' performance.

Historically, training load monitoring has been made from the external load, where coaches use parameters such as total training duration, the number of actions performed, the duration of burst and recovery intervals during the session, as well as the number of series, repetitions and quantity of weights lifted in kilos in the resisted activities[4]. However, the boost for the adaptations resulting from the training is directly related to the physiological stress (internal load) imposed on athletes, which suffers not only from the influence of the external load, but also from the levels of physical fitness and genetic potential[4-7]. Monitoring the internal load training is thus vital for the success of the process, as it is measured through hormonal response to the exercise, metabolites concentration, physiological and psychological parameters[8].

The method of session-Rating of Perceived Exertion (RPE) proposed by Foster et al.[9] quantifies the internal training load by multiplying the intensity of the session obtained through the adapted CR-10 Borg scale[10], with its duration in minutes. This method allows coaches to monitor the training individually by verifying the athlete's response to the proposed training, as well as to allow the planning elaboration for the load intended by the coach to maximize performance and prevent negative effects of training[6,11].

Considering that training adaptations are directly linked to the magnitude of internal load, the planning created by coaches must take into consideration not only the activities to be executed, but also the internal load desired for each training session. Some studies have investigated differences between the load planned by coaches and perceived by athletes[9,11-14], noting that the lack of correspondence between the perceptions may cause an undesirable impact on the effectiveness of the planning[9,15,16].

Other studies have investigated differences between the perception of the load of coaches and athletes with conflicting results between the perceptions of both[11-14,16]. Viveiros et al.[13] have compared the perception of athletes in the Brazilian National Judo Team and their coaches during a training camp and noticed that the intensity perceived by the athletes was superior to the one predicted by the coaches in every training session. Specifically in volleyball, Borin et al.[15] have concluded, unlike Viveiros et al.[13], that the coaches overestimated the perception of the athletes in 9.76%.

To date, all such studies have evaluated the differences between the perceptions of coaches and athletes through analysis of variance and correlation. However, these statistical tests alone do not seem to fully answer the question raised, which may be one reason for the lack of consensus in the literature. Thus, conducting an agreement analysis to evaluate the

correlation between perceptions of coach and athletes may constitute an effective method to evaluate these differences, and should be investigated. So, this study aims to assess the level of agreement between the perceptions of internal load of volleyball players with the coach's perceived planned load, and to examine the relationship between the variables. Another aim of this study is to compare the perceptions of internal training load between different positions in volleyball.

METHODOLOGICAL PROCEDURES

Participants

Fifteen high-level volleyball athletes and their coach took part in this study. The athletes were all male (body weight: 84.6 ± 11.14 kg; height: 189.3 ± 9.7 cm; age: 24 ± 2.8 years old; % body fat: 8.8 ± 3.04), and included two setters, five middle blockers, four outside hitters, two liberos and two opposites. The criteria for the athletes' participation in the research were that they were in the middle of the training season and competed on a national level as part of the team for the state and national championships of the 2012/2013 season.

After the study proposal and an explanation of the possible risks involved were presented to the athletes and the coaching staff, the athletes signed a free and conscious consent form authorising the collection and disclosure of the data. The study procedures respected the international norms for human experiments (Helsinki Declaration, 1975), and was approved by the "Universidade Federal de Juiz de Fora", filed under protocol n º 278/2010.

Experimental design

Data was collected over a period of two months of training for the 2012/2013 national championship season. This pre-season training was comprised of 34 sessions, and resulted in a total of 510 data perceptions of athletes and coach. The athletes trained every day, and only on-the-court sessions were monitored. The weight training sessions and games were not considered.

During data collection for this study, all training sessions were planned by the coach and implemented by him and his assistants. This method was used to compare the intensity of the load planned by the coach and the intensity perceived by the athletes, following the methodology of Foster et al.[9]. All volleyball players were familiarised with the session-RPE method before the beginning of the research for at least one year. The athletes completed all of the studied training sessions, with different exercises and intensities.

Training load monitoring

The session-RPE method was measured for each athlete during the study period. The measurements were calculated by multiplying the duration of the training session in minutes with the intensity value of the training indicated by the RPE through the adapted scale as proposed by Foster et al.[9].

To ensure that the information obtained from the RPE average referred to the training in its total, the athletes were asked, "How was your training today?" thirty minutes after the training session. In order to compare the perception of the coach and the athletes, the RPE of the coach was collected before each training session using the same scale. This indicated only one intensity for all the athletes, without specifying the internal load for each position.

Description of the training sessions' intensity

The training sessions were divided according to the intensity intended by the coach, based on what was proposed by Foster et al.[9]: RPE < 3, easy training; RPE 3-5, moderate training; RPE > 5, hard training. Of the 34 sessions analysed, 5.9% were classified as easy, 67.6% as moderate and 26.5% as hard. Box 1 describes a complete session for each of the intensities intended by the coach.

Box 1. Description of the three sessions by intensity

Easy training (RPE < 3)	Moderate training (3 – 5)	Hard training (> 5)
18′ Warm up. 20′ Technical Training of passing for the outside hitters and liberos and service for the others. 10′ only for the outside hitters and liberos. 5′ of setting with attack. Total time: 53 minutes.	20′ Warm up. 24′ Technical Training of passing for the outside hitters and liberos and service for the others. 28′ of Tactical Training consisting of work with different attacking combinations on the six court positions. Total Time: 72 minutes.	20′ Warm up (dynamic stretching, general movement, short runs, sit-ups). 41′ Blocking Technical Training. 51′ of Tactical Training consisting of work with different attacking combinations on the six court positions. Total Time: 112 minutes.

Statistical analysis

For the data analysis, the statistic packages SPSS version 19.0 and Statistica version 8.0 were used. The parametric hypothesis was evaluated by the Shapiro-Wilk test and the Levene test. Data analysis was based on 510 data perceptions collected from 15 athletes for their 34 training sessions. The perceptions of the coach and the athletes were transformed in intensity categories as proposed by Foster et al.[9] as follows: RPE<3, easy training; RPE 3-5, moderate training; RPE>5, hard training. This was to evaluate the level of agreement between the perceptions of the coach and the athletes of each position through the Kappa (K) index. The strength of agreement varies from 0 to 1 and presents six classification levels proposed by Landis[17]: K=0, poor; 0.01<K>0.20, slight; 0.21<K>0.40, fair; 0.41<K>0.60, moderate; 0.61<K>0.80, substantial; 0.81<K>1, almost perfect. This analysis was chosen because the perceptions must agree in intensity levels, but not necessarily be completely equal. However, the ANOVA two-way statistical analysis with Tukey's post-hoc was also used as in previous studies,[9,11,12] in order to verify possible differences in the results. In order to compare the perception of the athletes in the three intensities, the ANOVA one-way along with Tukey's post-hoc was also used. To compare internal load between players of different positions, the one way analysis of variance (ANOVA one-way) for independent measures was again used along with

Tukey's post-hoc to verify possible differences. The level of significance adopted was p<0,05 for the analysis.

RESULTS

Table 1 shows the Kappa agreement index between the perceptions of coach and players of different positions. When adopting the classification of the level of agreement proposed by Landis[16], it is noticed that all the players, despite their position, presented the same level of agreement as the coach, considered very good. The levels of agreement were statistically significant (p<0,05).

Table 1. Agreement index of players by position

Position	Kappa index
Setter	0.78**
Liberos	0.79**
Outside hitters	0.75**
Middle blockers	0.74**
Opposites	0.75**
Total	0.64**

**p<0.01, n=15

Figure 1 shows the percentage of perceptions of the athletes by the intensity proposed by the coach. It is possible to observe that when the coach intended an easy training, only 3.4% of the athletes perceived it as such. The vast majority of athletes (90%) overestimated the practice, seeing it as moderate. In the sessions proposed as moderate, 67.8% of the athletes had the same perception as the coach. However, when classifying the practice as hard, only 37.1% of the athletes agreed with the coach, while 53.3% underestimated the session, classifying it as moderate.

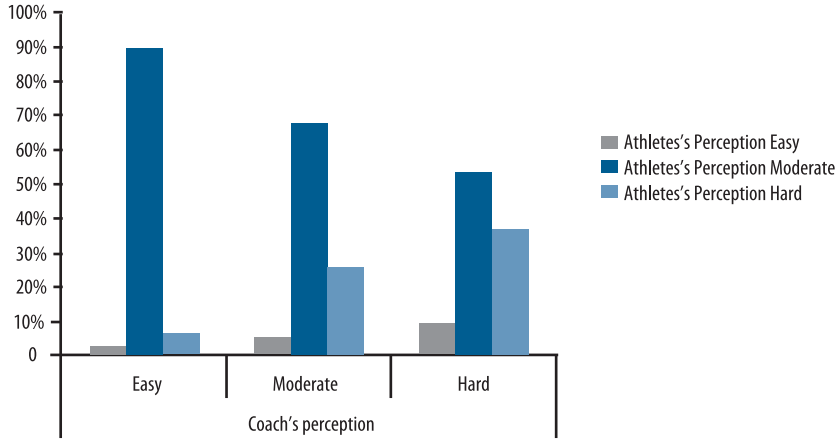

Figure 1. Percentage of the perception of the athletes by intensity proposed by the coach.

Since the intensity zones are established by the coach[9], a comparison was made between the perception of athletes in each category. The analysis of variance showed that there was a difference in the perception of the

athletes between the easy and moderate intensities (p=0.01), easy and hard intensities (p<0.01) and moderate and hard intensities (p=0.05). Despite the athletes' perceiving all the training inside the moderate category, the perceptions are different and increase with the rise of the intensity.

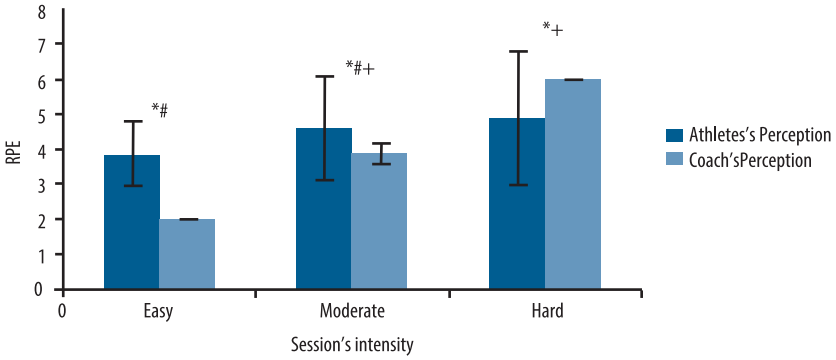

Figure 2. Comparison of the perception of the coach and the athletes in different intensities.
* Difference between coach and athletes (p<0,01) #Differences between RPE athletes easy and moderate (p<0,05) +Differences between RPE athletes moderate and hard (p<0,05)

When comparing the internal load between players of different positions, the analysis of variance (ANOVA one-way) for independent measures shows that there were no statistically significant differences between the training load perception (p=0.86). However, when observing Figure 3, it is possible to see descriptively that the opposites perceived the sessions as more intense than the others.

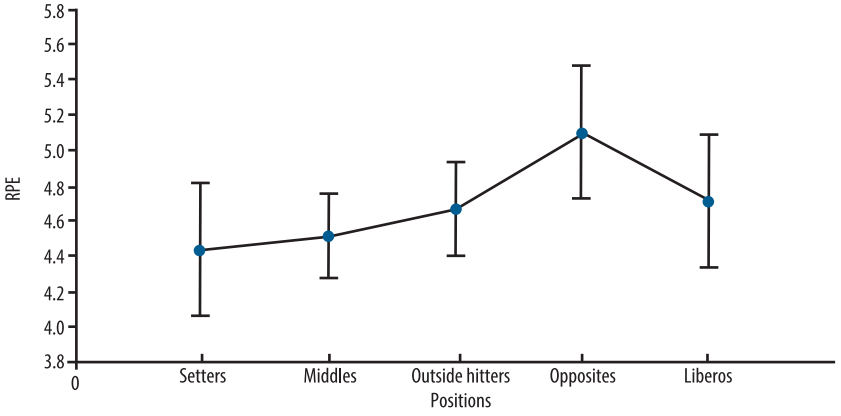

Figure 3. Internal load by position

DISCUSSION

This study aimed 1) to evaluate the correspondence between internal load perception of volleyball athletes of different positions and the perception of load planned by the coach, and 2) to compare the internal load perception of training in all different volleyball positions. The results showed that athletes of all positions presented good levels of agreement with the perception of the coach, even though the coach did not specify the intensity

of the sessions for each position. It was also verified that players, despite their position, did not present significant differences in the perceptions of internal training load.

Using the classification suggested by Foster et al.[9], it was possible to conclude that athletes tend to overestimate sessions classified as easy and tend to underestimate sessions classified as hard. However, in moderate sessions, there was a greater agreement between athletes and coach (65.3%), despite the analysis of variance indicating that there were significant differences inside this intensity ($p<0.01$). These findings agree with the studies of Foster et al.[9] on runners, Delattre et al.[11] on cyclists, Wallace et al.[12] on swimmers, and Reyes et al.[13] with handball athletes, which showed that athletes in team sports overestimate the training load specified by the coach, regardless of the magnitude.

To the best of our knowledge this is the first study, to perform an agreement analysis to evaluate the correspondence between the perceptions of coach and athletes. The changes found by the analysis of variance do not seem to completely answer the question raised. As shown in Figure 2, in moderate training, both the perception of the coach and that of the athletes are in the moderate intensity level (average RPE =3.9 and 4.6 respectively), thus confirming the high level of agreement between the perceptions of coach and athletes ($k=0.64$). This high level of agreement, classified as very good[17], can also be explained by the small number of easy and hard sessions, where there was greater disagreement between coaches and athletes. This constituted a limitation of this study. It is therefore suggested that future research evaluate a greater number of easy and hard sessions. It was not possible in this study to do so because of the decision not to interfere in the coach's planning.

It was also observed that in these two intensities (easy; RPE=2 and hard; RPE=6), the perception of the athletes are in the moderate level (moderate RPE=3.9 and 4.9 respectively). These findings are more worrisome, in view of the fact that coaches and athletes perceive the training in different zones of intensity. However, despite these differences, it was observed that the athletes can distinguish the intensity of the sessions when they present statistically smaller values of perception in the easy category than the ones in the moderate category, which in turn, were statistically smaller than the ones in the hard category.

Since it is statistically impossible to perform the analysis of agreement through the Kappa index separately for each intensity, this study suggests that the two analyses (agreement and variance) be performed when verifying the correspondence between the perceptions of athletes and coaches. When interpreting the results, it is possible to see that both statistical tests provide important information about the data.

This study allows us to infer that when a professional team presents a consistent and carefully planned training program, there are often noticeable differences between the perceptions of coaches and athletes, particularly in sessions of extreme intensities, classified as easy or hard by the coach. Foster et al.[9] indicate from empirical observations, that one

of the potential causes of the high incidence of undesirable results in the training is the lack of correspondence between the program planned by the coach and the one executed by the athletes. Foster et al.[9] and Viveiros et al.[13] also highlight that this method could help modify a common tendency in training: the tendency of loads to be maintained at moderate levels, instead of extreme values. In this study, 67.6% of the training sessions were moderate yet most of the athletes perceived the easy and hard sessions as moderate as well, confirming this tendency. This fact must be analysed in a very selective way by the coach, because the combination of the intensity of the session with full training load (session RPE) may be a trustworthy variable in the evaluation of monotonous stimulation, which predisposes the athletes to sub-average performance or to overtraining[14,18]. However, in volleyball specifically, the intensity classified as moderate may reflect different kinds of training, thus explaining the great number of sessions in this category.

The analysis of the internal load perception of players by position shows that the athletes perceive the training loads in a similar way. It is not essential for the coach to indicate different RPE values for different volleyball positions when all athletes perform the same training, even if they perform different actions due to the specificity of their functions. Sheppard et al.[2] mentioned that many coaches believe that changes in the rules of volleyball along with the evolution of tactical game strategies have led to an increase in the specialisation of the players' position, and will directly influence the physiological profile of each position. This study was limited in that it did not evaluate physiological variables. Therefore additional studies evaluating these differences in more depth should be conducted.

Based on the perceptions of each position it is possible to speculate that the internal load perception of volleyball players is associated with the specific motor actions of the function they perform. Jumps, displacement, and falls can partially explain the similarities between the perceptions of the analysed athletes. Future studies that relate the RPE to the motor action in volleyball are suggested in order to detect which variable has greater influence on the perception of each position. The results of this study reinforce the need for a careful monitoring/control of the training loads in order to avoid differences between the perceptions of training planned by the coach and perceived by the athletes. It is important to investigate the differences between the RPE along with physiological variables to determine whether the athletes are interpreting the scale correctly. Because it is a subjective instrument, the scale can also be associated with the incompatibilities between coach and players found in this study.

CONCLUSION

This is the first study to analyse the level of agreement between volleyball coaches and athletes of different positions. The results found here reinforce the importance of the adoption of strategies for the daily monitoring/control of the training load for the athletes. The incompatibility between

the loads planned and perceived may cause a negative impact on the effectiveness of the planning and on an athlete's performance.

When planning training load through the session-RPE method, coaches must consider not only the training characteristics that will be used, but also the load to which the athlete was submitted on the day before as well as in the previous sessions. These are factors which directly influence the perception of the athletes. Training sessions with the same characteristics may have relatively different perceptions at different moments in time.

In volleyball, although each athlete performs a specific function on the team, there were no observable differences in the load perceptions of players of different positions. It is unnecessary for the coach to propose different intensities for each position when all the athletes undergo the same training, such as tactical training.

The session-RPE method can help members of the technical team change their tendency to maintain loads at moderate levels, rather than at extreme levels, since this tendency can lead to monotonous stimulation, and predisposes the athlete to a decrease in their athletic performance.

REFERENCES

1. Gabbett TJ. Do skill-based conditioning games offer a RPE especific training stimulus for junior elite volleyball players? J Strength Cond Res 2008;22(2):509-17.
2. Sheppard JM, Gabbett TJ, Stanganelli LC. An analysis of playing positions in elite men's volleyball: considerations for competition demands and physiologic characteristics. J Strength Cond Res 2009;23(6):1858-66.
3. Lidor R, Ziv G. Physical and physiological attributes of female volleyball players--a review. J Strength Cond Res 2010;24(7):1963-73.
4. Moreira AF, Nakamura FY, Aoki MS. Percepção de esforço da sessão e a tolerância ao estresse em jovens atletas de voleibol e basquetebol. Rev Bras Cineantropom Desempenho Hum 2010;12(5):7.
5. Impellizzeri FM, Rampinini E, Coutts AJ, Sassi A, Marcora SM. Use of RPE-based training load in soccer. Med Sci Sports Exerc 2004;36(6):1042-7.
6. Manzi V, D'Ottavio S, Impellizzeri FM, Chaouachi A, Chamari K, Castagna C. Profile of weekly training load in elite male professional basketball players. J Strength Cond Res 2010;24(5):1399-406.
7. Nunes JA, Viveiros L, Moreira A, Aoki MS. Monitoramento da carga interna no basquetebol. Rev Bras Cineantropom Desempenho Hum 2011;13(1):67-72.
8. Nakamura FM, Moreira A; Aoki MS. Monitoramento da carga de treinamento: a percepção subjetiva de esforço da sessão é um método confiável? Rev Educ Física/ UEM 2010;21(1):1-11.
9. Foster C, Florhaug JA, Franklin J, Gottschall L, Hrovatin LA, Parker S et al. A new approach to monitoring exercise training. J Strength Cond Res 2001;15(1):109-15.
10. Borg GA. Psychophysical bases of perceived exertion. Med Sci Sports Exerc 1982;14(5):377-81.
11. Delattre E, Garcin M, Mille-Hamard L, Billat V. Objective and subjective analysis of the training content in young cyclists. Appl Physiol Nutr Metab 2006;31(2):118-25.
12. Wallace LK, Slattery KM, Coutts AJ. The ecological validity and application of the session-RPE method for quantifying training loads in swimming. J Strength Cond Res 2009;23(1):33-8.
13. Viveiros LCEC, Moreira A, Nakamra FY, Aoki MS. Monitoramento do treinamento no judô: comparação entre a intensidade da carga planejada pelo técnico e a intensidade percebida pelo atleta. Rev Bras Med Esporte 2011;17(4):266-9

14. Borresen J, Lambert MI. The quantification of training load, the training response and the effect on performance. Sports Med 2009;39(9):779-95.
15. Borin JP, Dias RG, Leite GS, Padovani CPR, Padovani CR. Indicadores de desempenho e percepção subjetiva de esforço entre técnico e atletas de voleibol. Braz J Biomotricity 2010;4(2):123-30.
16. Landis JR, Koch GG. The measurement of observer agreement for categorical data. Biometrics 1977;33(1):159-74.
17. Fry G, Lachenmeier E, Mayrand E, Giusti B, Fisher J, Johnston-Dow L et al. A new approach to template purification for sequencing applications using paramagnetic particles. Biotechniques 1992;13(1):124-31.

Corresponding author

Francine Caetano de Andrade Nogueira
Universidade Federal de Juiz de Fora.
Faculdade de Educação Física e Desportos. Grupo de Estudos de Controle da Carga de Treinamento.
Campus Universitário, Bairro Martelos, s/n. CEP 36036-330 – Juiz de Fora, MG. Brasil.
E-mail: francine_andrade_@hotmail.com