DOI: 10.4025/jphyseduc.v31i1.3103

Original Article

DERMATOGLYPHIC TRAITS OF BRAZILIAN GOLFERS

TRAÇOS DERMATOGLÍFICOS DOS GOLFISTAS BRASILEIROS

Rudy José Nodari Júnior[1], **Rodrigo Gomes de Souza Vale**[2], **Adriano Alberti**[1,3], **Renan Souza**[1], **Gracielle Fin**[1] and **Estélio Henrique Martin Dantas**[4]

[1]Universidade do Oeste de Santa Catarina, Joaçaba-SC, Brasil.
[2]Universidade Estácio de Sá, Rio de Janeiro-RJ, Brasil.
[3]Universidade do Sul de Santa Catarina, Palhoça-SC, Brasil.
[4]Universidade Federal do Rio de Janeiro, Rio de Janeiro-RJ, Brasil.

RESUMO
Jogado em todo o mundo, o golfe está ganhando popularidade, sendo um esporte que depende das habilidades individuais, tornando-se importante a busca por ferramentas que visem buscar e orientar seus respectivos talentos. O presente estudo teve por objetivo comparar a distribuição dos indicadores dermatoglíficos de golfistas de alto rendimento e de um grupo controle de não atletas. A amostra foi composta por 46 indivíduos com idade e sexo pareados, divididos em dois grupos: o Grupo Golf (GG), composto por 23 golfistas e o Grupo Controle (GC), composto por 23 indivíduos controle aleatoriamente selecionados. Os golfistas, parte do Projeto Golf Brasil da Confederação Brasileira de Golfe, tinham idade entre 11 e 21 anos. Os resultados demonstram que o número de linhas no padrão de seis possíveis variáveis de impressão digital (MESQL1, MESQL2, MESQL4, MESQL5, SQTLE, SQTL) é maior nos golfistas (GG) quando comparado ao grupo controle (GC). Quando observadas as variáveis qualitativas, ou seja, o tipo de figura, observaram-se diferenças significativas entre os grupos, visto que os Golfistas (GG) apresentaram maior quantidade de Presilha Radial (LR) no MDT5 quando comparados ao grupo controle (GC). Os resultados encontrados neste estudo demonstraram que o perfil dermatoglífico de golfistas de alto rendimento difere da população não atleta.
Palavras-chave: Dermatoglifia. Golf. Alto rendimento.

ABSTRACT
Played all over the world, golf has gained popularity, for it is a sport that depends on individual abilities. For this reason the search for tools that aim to seek and guide its respective talented players has become very important. Therefore, this study had the objective of comparing the distribution of the dermatoglyphic indicators of high performance golfers and of a group control of non-athletes. The sample was composed of 46 individuals with paired age and gender, divided into two groups: the Group Golf (GG), composed of 23 golfers, and the Group Control (GC), composed of 23 individuals control randomly selected. The golfers, part of the Project Golf Brazil of the Brazilian Golf Confederation, were between 11 and 21 years old. The results demonstrated that the number of lines in the pattern was of six possible variables of fingerprint (MESQL1, MESQL2, MESQL4, MESQL5, SQTLE, SQTL) is significantly higher in the golfers (GG) when compared to the group control (GC). When observed the qualitative variables, i. e., the pattern type, significant diferences where observed between the groups, since the golfers (GG) presented more Radial Loops (RL) in MDT5 when compared to the group control (GC). The results found in this study demonstrated that the dermatoglyphic profile of high performance golfers differ from the non-athlete population.
Keywords: Dermatoglyphics. Golf. High performance.

Introduction

Played all over the world, golf is gaining popularity. There are no sex, age or training level restrictions, and motor ability is an important variable[1]. The general objective of golfers is to make the fewest strokes between the starting area, known as the tee, and the hole located on the green, an area of closely trimmed grass surrounding it. To that end, golfers' performance depends on their individual skills, the course being the only direct adversary, since there is nothing a player can do to hinder the performance of others[2].

Despite being golf is more popular among older individuals, because they have more free time and the aerobic demand is low and there has been a significant increase in the sport among different age groups and economic classes[3]. Part of this growth and trend toward massification is related to its inclusion in the 2016 Olympic Games in Rio de Janeiro, Brazil.

In this respect, the search for tools to improve the performance of golfers has intensified. In all sports, training involves a set of complex activities aimed at achieving maximum output, for a certain period of time. This output depends on improved performance, achieved through periodized training, better techniques and tactics, and psychological control[4].

In addition to the concern of sports trainers regarding the morphological and functional aspects of athletes, genetic factors are also viewed as determinants of individual athletic performance[5]. Greater allele frequency in genes associated with the physical performance of athletes, compared to the general population, added to findings of rare genotypic combinations in athletes, substantiate the idea that genetics is an indispensable factor for high-performance sport excellence[6].

Despite the scientific advances in methods and assessment of body components[7], Sports Science still faces difficulties in devising appropriate methodologies to detect the genetic potential of an individual[8]. A feasible method for the analysis of the genetic potential and fetal development is dermatogliphics, since fingerprints are understood as dermic representation of these characteristics[9-11].

Studies based on dermatoglyphics found that the complexity of fingerprint patterns could determine the genotypic traits of physical aptitude[12,13]. Dermatoglyphic characteristics could therefore be used in athletic assessment, with respect to both physical performance and morphofunctional understanding of the athlete.

The increased number of studies that have focused on genetic factors for predisposition to sport[8,14] and identifying the possible use of dermatoglyphics, related to basic physical qualities, suggests that this method be thoroughly and reliably investigated, allowing its correct use in Sports Science.

The assessment of elite athletes outlines parameters related to physical and anthropometric abilities as well as the genetic profile of individuals who display specific traits in each modality. Tools and methods that help assess and guide high-performance athletes are essential in the search for better sport performance[15]. Mainly golf, as there are a few scientific investigations in this area. This demonstrates the importance of this study, which aims to compare the distribution of the dermatogliphic indicators of high performance golfers and of a group control composed of non-athletes.

Methods

Participants

The sample consisted of 46 age and sex-matched individuals, divided into two groups: the GG, composed of 23 golfers and the CG, consisting of 23 randomly selected control individuals. The golfers, part of the Brazilian Golf Confederation's Project Golf Brazil, were aged between 11 and 21 years (average age of 15.5± 2.09) and two years of practice time.

Procedures

The study was approved by the Human Research Ethics Committee of UNOESC/HUST (University of Western Santa Catarina/Santa Teresa University Hospital, under protocol number 292.868, in accordance with ethical standards of regulatory guidelines and research directives involving human beings and in compliance with National Health Council Resolution 466/12[16] and the Declaration of Helsinki[17].

The antropometrical evaluation prodecures were performed as follows: assessment of height and body mass to identify BMI. For this purpose, a Filizola® clinical scale (Brazil), equipped with a stadiometer that was accurate to 0.1 kg with a capacity range between 0 and

150 kg was used. The stadiometer was accurate to 0.5 cm, and its scale ranged from 0 to 190 cm.

Dermatoglyphics was the protocol selected to analyze genetic potential and embryonic development via fingerprint collection.[9] For capture, processing and analysis of the fingerprints, we used a dermatoglyphic reader, consisting of an optical fingerprint scanner that collects and interprets the image and constructs a pattern in binary code that is captured by specific software to reconstruct real black and white binary images, using the Dermatoglyphic Reader®[18].

After all the images are collected, the user of the device selects them one by one to define the (core and delta) points, automatically tracing Galton's line of analysis, so that the software, using specific algorithms, intersects the traced line with the digital lines, thereby determining the number of lines and pattern type of each finger. The software performs qualitative identification of the image and quantitative of the lines, creating a computerized spreadsheet resulting from the processed data[18]. The evaluations were performed by the same researcher, in a single day. Cronbach's alpha was 0.88.

Statistical analysis

Statistical analyses were processed by the Statistical Package for the Social Sciences (SPSS) 20 for Windows. The Kolmogorov-Smirnov test was used to compare the two groups and their quantitative variables, in order to check the normality of distribution. In the event of non-normal distribution, the Mann-Whitney nonparametric test for comparisons between numerical variables was applied, as follows: left hand, number of lines on finger 1 – thumb (MESQL1), left hand, number of lines on finger 2 – index (MESQL2), left hand, number of lines on finger 3 – middle (MESQL3), left hand, number of lines on finger 4 – ring (MESQL4) and left hand, number of lines on finger 5 – little (MESQL5); number of lines on the left hand (SQTLE); right hand, number of lines on finger 1– thumb (MDSQL1), right hand, number of lines on finger 2 – index (MDSQL2), right hand, number of lines on finger 3 – middle (MDSQL3), right hand, number of lines on finger 4 – ring (MDSQL4) and right hand, number of lines on finger 5 – little (MDSQL5); number of lines on the right hand (SQTLD); number of lines on the right and left hand (SQTL).

The chi-squared test was used to compare the following categorical variables: Arch (A), Radial Loop (LR), Ulnar Loop (LU), Whorl (W), left hand fingerprint patterns, finger 1 (MET1), finger 2 (MET2), finger 3 (MET3), finger 4 (MET4) and finger 5 (MET5) and right hand, finger 1 (MDT1), finger 2 (MDT2), finger 3 (MDT3), finger 4 (MDT4) and finger 5 (MDT5), and adjusted residual analysis was applied when significant differences were found. The study adopted a level of $p \leq 0.05$ for significance statistic.

Results

After the Kolmogorov-Smirnov test revealed non-normal distribution of the quantitative variables, the Mann-Whitney nonparametric test was applied to compare numerical variables. The result demonstrates that the number of lines on the pattern of six possible fingerprint variables (MESQL1, MESQL2, MESQL4, MESQL5, SQTLE, SQTL) is significantly higher in the golfers (GG) when compared to the control group (CG), as shown in Table 1.

Table 1. Antropometrical data

	Corporal mass		Stature		BMI	
	Average	DP	Average	DP	Average	DP
Masc. Golfers	64,81	13,71	1,73	0,08	21,67	4,38
Masc. Control	62,09	9,74	1,70	0,17	21,48	9,92
Fem. Golfers	56,77	10,67	1,61	0,55	21,76	3,82
Fem. Control	57,89	9,87	1,62	0,72	21,10	8,23

Source: The authors

Table 2. Mean number of lines on the fingerprints of the left and right hand, SQTLE, SQTLD, SQTL and the significant difference found between the GG and CG

	$\bar{x}$ GG	$\bar{x}$ CG	p	Cohen D Effect Size	Effect Size (r)
MESQL1	16.00 ± 3.63	11.62 ± 6.10	0.01*	0.87	0.39
MESQL2	11.16 ± 4.91	8.10 ± 4.92	0.05*	0.62	0.29
MESQL3	12.26 ± 6.23	9.76 ± 4.83	0.10	0.44	0.21
MESQL4	14.79 ± 5.40	11.52 ± 4.98	0.05*	0.62	0.30
MESQL5	13.16 ± 4.67	9.10 ± 5.94	0.01*	0.75	0.35
SQTLE	67.37 ± 18.44	50.05 ± 21.70	0.01*	0.86	0.39
MDSQL1	15.89 ± 4.54	13.67 ± 5.13	0.24	0.45	0.22
MDSQL2	10.63 ± 5.63	7.95 ± 5.62	0.20	0.47	0.23
MDSQL3	11.37 ± 5.26	9.00 ± 4.37	0.12	0.49	0.23
MDSQL4	13.95 ± 5.61	12.24 ± 4.49	0.17	0.33	0.16
MDSQL5	12.79 ± 5.11	10.24 ± 4.08	0.07	0.55	0.26
SQTLD	64.63 ± 17.74	53.10 ± 18.33	0.06	0.63	0.30
SQTL	132.00 ± 35.03	103.14 ± 38.51	0.03*	0.78	0.36

Note: *$p \leq 0.05$. Mann-Whitney test
Source: The authors

The characteristics of the GG, when compared to the CG, show a larger number of lines, which may be related to the higher number of complex patterns, since the greater the distance between the core and the delta, the larger the space identified by Galton's line of analysis.

For categorical variables, the chi-squared test demonstrated a significant difference in one of the fingerprint variables (MDT5), as depicted in Table 3.

Table 3. Significant difference found between the fingerprint patterns on the right and left hand when the GG and CG were compared.

MET1	MET2	MET3	MET4	MET5	MDT1	MDT2	MDT3	MDT4	MDT5
0.56	0.30	0.93	0.65	0.20	0.75	0.25	0.87	0.56	0.00*

Note: *$p \leq 0.05$
Source: The authors

When a significant difference in the categorical variables between the GG and CG was identified, adjusted residual analysis was conducted to determine which pattern exhibits a significant value in the groups, thereby establishing the predominant and different fingerprint pattern in the GG, when compared to the CG. When the chi-squared test showed a significant difference between the patterns of the groups, adjusted residual analysis was carried out, as recommended by Pereira[19]. In this case, the data were compared to determine whether the standard value of 1.96, that is, all the results above the standard demonstrate a significant intergroup difference and which fingerprint patterns is more frequent in the GG (Table 4).

Table 4. Adjusted residual analysis, with a standard value of 1.96, using the chi-squared test of categorical variables with a significant difference between the GG and CG

		Finger print patterns			
		A	LR	LU	W
MDT5	Golfer Group	1.1	5.2	-5.4	0.1
	Control Group	-1.1	-5.2	5.4	0.1

Source: The authors

In the fingerprints exhibiting significant differences, there is a predominant pattern in the GG when compared to the CG, that is, Table 4 shows that the fingerprint pattern in the GG displays a larger number of LR on MDT5, while the CG shows a larger number of LU on the same finger.

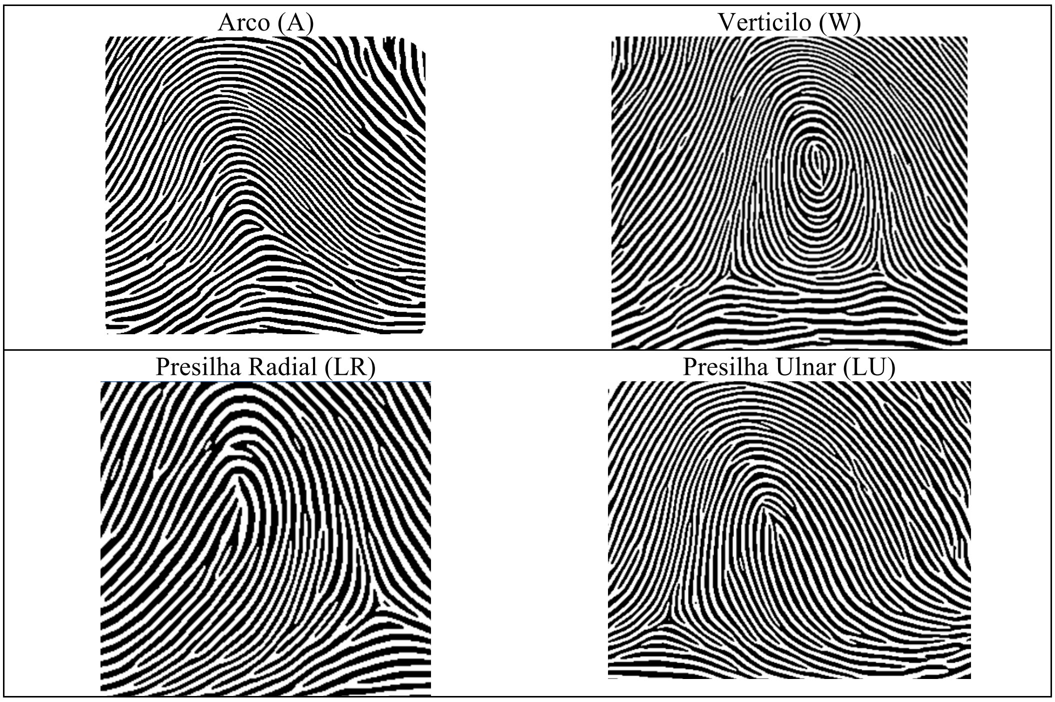

Figure 1. Patterns found by Dermatoglyphics
Source: Nodari and Fin[20]

Discussion

This study showed significant differences in high-performance golfers in terms of quantitative (number of lines) and qualitative (pattern types) dermatoglyphics, when compared to the control group of non-athletes. The golfers exhibited a larger number of lines and predominance of radial loops (LR).

After a review study, Del Vecchio and Gonçalves[21] reported that dermatoglyphics may contribute to detecting, guiding and promoting sport talent, suggesting that athletes displaying strength and coordination show a higher number of lines, scarcity of arches (A) and large number of whorls (W). They also found that athletes in sports requiring speed, power and brief periods of high exertion, show a high frequency of arches (A) and loops (L) and a low number of whorls (W) and total number of fingerprints. The results in the present study demonstrate a difference for the sport of golf, when the traditional paper and ink method was replaced by the computerized method validated by Nodari Júnior et al.[18] given that it is statistically four times more accurate. The contradictions between dermatoglyphic findings may be associated with the different methods used to analyze fingerprints.

Borin et al.[8] reported that information on dermatoglyphics applied to Sport Science in Brazil only describes the distribution of pattern frequencies, which limits possible contributions. This study brings more reliable results in researches about dermatoglyphics, because it uses a group control, and a validated equipment, more precise than the traditional method, found significant intergroup differences and identified differences in dermatoglyphic patterns.

This study corroborates Nodari Júnior et al.[22] findings, in which it was verified that male high performance soccer athletes have a different dermatogliphic mark in relation to the rest of the population, showing quantitative difference (greater number of lines) in fingers MESQL1, MESQL3, MESQL5, and MDSQL1, sum of total number of lines of left hand (SQTLE) and sum of total number of lines (SQTL), and also qualitative difference (types of patterns), with significance in the patterns Whorl (W) and Radial Loop (RL). It shows that high performance athletes have a specific dermatogliphic mark.

In another research performed by Alberti et al.[23] with female high performance soccer players in Brazil, significant differences were obtained, showing the Radial Loop as a characteristic mark of high performance athletes, the same found in this study, what supports the results found in this research, because in this study it was used the computerized method validated by Nodari Júnior et al.,[18] which is more precise and reliable in the results obtained.

In another study about dermatogliphics and high performance atlhetes[24], with female volleyball players, a group of 50 volleyball players aged between 20 and 29 was compared to a group control of 50 non-athlete women, with the same age range, and the result was the absence of the pattern Arch (A) and the predominance of the pattern whorl (W) in the group of athletes and increase of the number of lines in four fingers, left finger 1 (MET1), right finger 2 (MDT2), and right finger 3 (MDT3) and sum of total number of lines (SQTL).

In another study about dermatoglyphics and high performance athletes[25], there was the predominance of the loop pattern in a group of paracanoe athletes in Brazil, however using the traditional method, without performing the differentiation between Ulnar and Radial Loop and without the comparison with the control group, which was different from this study because, besides the computerized collection, this study performed a comparison between high performance golfers and the group control composed of non-athletes, enabling a more reliable data analysis.

The results found in this study demonstrated that the dermatoglyphic profile of golfers differ significantly from the non-athlete population. It is therefore suggested that a predictive equation be devised to guide golfers, since the presence of radial loops (LR) on MDT5 is significantly higher than in the control group. The number of lines was also significantly different and, in this case the MESQL1, MESQL2, MESQL4, MESQL5, SQTLE and SQTL of golfers were always greater than in the control group.

As limitations of this study, it is worth highlighting that investigations on larger samples of both sexes with different ethnicities and performance levels are needed in order to identify traits in different groups of golfers.

Conclusion

It is concluded that the distribution of the dermatogliphic indicators of high performance golfers differ from a group control composed of non-atlhetes. The results presented in this study show that dermatogliphics contributes in the orientation of talented people and in the performance of high performance sports, and that it is a method that strenghens the evaluation of people who show talent, enabling the identification of genetic and fetal development characteristics, which are particular of athletes. Based on these premises, this is one more tool that can help the seek of talented people on sports.

References

1. McHardy A, Pollard H, Luo K. Golf injuries: A review of the literature. Sports Med 2005;36(2):171-87. Doi:10.1186/1746-1340-13-7.
2. Bernardes J. Golfe: Dicas e segredos. 2.ed. São Paulo: Nobel; 2007.
3. Jorge SR. Estresse em jogadores de golfe profissional. [Dissertação em Educação Física]. Curitiba: Universidade Federal do Paraná; 2010.
4. Dantas EHM. A prática da preparação física. 6.ed. São Paulo: Roca; 2014.
5. Dias RG, Pereira AC, Negrão CE, Krieger JE. Polimorfismos genéticos determinantes da performance física em atletas de elite. Rev Bras Med Esporte 2007;13(3):209-16. Doi: 10.1590/S1517-86922007000300016.
6. Dias GR. Genética, performance física humana e doping genético: O senso comum versus a realidade científica. Rev Bras Med Esporte 2011;17(1):62-70. Doi:10.1590/S1517-86922011000100012.
7. Petroski EL, Pires-Neto CS, Glaner MF. Biometrica. Jundiaí: Fontoura; 2010.
8. Borin, JP, Padovani CR, Araon FF, Gonçalves A. Dermatoglyphics in sports sciences: Understanding the distribution of quantitative indicators in non-athletes and athletes of basketball according to their performance. Rev Andal Med Deporte 2012;5(3):99-104.
9. Cummins H, Midlo CH. Finger prints, palms and soles an introduction to dermatoglyphics. New York: Dover Publications; 1961.
10. Butova OA, Lisova IM. Correlation of certain parameters of human constitution. Gippokraf - Saint Petersburg - Russia. Morfologia 2001;119(2):63-66.
11. Verbov J. Clinical significance and genetics of epidermal ridges – a review of dermatoglyphics. J Invest Dermatol 1970;54(4):261-271. Doi.org/10.1111/1523-1747.ep12258550.
12. Guba VP, Tchernova GP. Meios morfo-biomecânicos baseados na determinação dos talentos e dotes esportivos. Organização da metodologia científica baseada nos sistemas de preparação dos atletas reservas russos e os caminhos do seu aperfeiçoamento. Proceedings of the 15th Congresso Científico da Rússia – prática e conferência: Moscou; 1995, p. 115-6.
13. Nikitjuk BA. Adaptatsiya, konstitutsiya i motorika. / Adaptation, constitution and motorics. Kineziologija 1988;20(1)1-6.
14. Artioli GG, Guilherme JPLF. Testes genéticos no esporte: um novo modelo de predição de talentos? Rev Ciênc em Saúde 2015;5(1):3801-3811.
15. Volkov VM, Filin VP. Seleção desportiva. Moscou: Fizcultura y Sport; 1983.
16. Ministério da Saúde [Internet]. Conselho Nacional de Saúde. Resolução n. 466, de 12 de dezembro de 2012. Aprova diretrizes e normas regulamentadoras de pesquisas envolvendo seres humanos. Diário Oficial da União [acesso em 19 dez 2017]. Disponível em: https://bvsms.saude.gov.br/bvs/saudelegis/cns/2013/res0466_12_12_2012.html
17. The World Medical Association Inc [Internet]. Declaration of Helsinki [acesso em 19 dez 2017] Disponível em: https://www.wma.net/wp-content/uploads/2017/11/DoH-Oct2008.pdf.
18. Nodari RJ Jr., Heberle A, Ferreira-Emygdio R, Irany Knackfuss M. Dermatoglyphics: Correlation between software and traditional method in kineanthropometric application. Rev Andal Med Deporte 2014;7(2):60-65.
19. Pereira JCR. Análise de dados qualitativos: estratégias metodológicas para as ciências da saúde, humanas e sociais. 3.ed. São Paulo: Edusp; 2001.
20. Nodari-Júnior RJ, Fin G. Dermatoglifia: Impressões digitais como marca genética e de desenvolvimento fetal. Joaçaba: Ed. Unoesc; 2016.
21. Del Vecchio FB, Gonçalves A. Dermatoglifos como indicadores biológicos del rendimiento deportivo. Rev Andal Med Deporte 2011;4(1):44-52.
22. Nodari Júnior RJ, Panizzi Jr C, Jesus JA, Alberti A, Souza R, Sartori G, et al. Elite futsal athletes: Dermatoglyphic profil, return to play. London: Basic Sciences and regenerative Medicine; 2016.
23. Alberti A, Fin G, Vale RGS, Soares BH, Nodari RJ. Dermatoglifia: As impressões digitais como marca característica dos atletas de futsal feminino de alto rendimento do Brasil. Revista Brasileira de Futsal e Futebol 2018;10:193-201.
24. Ablikova A, Serhiyenko L. Sports selection of volley-ball players : genetic criteria to define motor endowments. Slobozhanskyi her sci sport 2016;2(52):5-10.
25. Sousa APS, Ferreira HR, Fernandes Filho J. Dermatoglyphic profile and hand grip strength of the finalists athletes in the Brazilian paracanoe championship. J Exerc Physiol 2016;19:50-6.

Acknowledgements: The authors wish to thank all the athletes who participated of this study, also Fundação Carlos Chagas de Amparo à Pesquisa do Estado do Rio de Janeiro (FAPERJ), which helped to fund this research.

Author's **ORCID:**
Rudy José Nodari Júnior: https://orcid.org/0000-0002-8375-657X
Rodrigo Gomes de Souza Vale: https://orcid.org/0000-0002-3049-8773
Adriano Alberti: https://orcid.org/0000-0003-0313-0380
Renan Souza: https://orcid.org/0000-0002-8007-1225
Gracielle Fin: https://orcid.org/0000-0001-7860-4451
Estélio Henrique Martin Dantas: https://orcid.org/0000-0003-0981-8020

Received on Nov, 13, 2018.
Reviewed on Aug, 30, 2019.
Accepted on Sep, 10, 2019.

Author address: Adriano Alberti. R. Benedito Zandona, 1061 - Senhor Bom Jesus, Campos Novos - SC, 89620-000.E-mail: adrialberti90@gmail.com