Revista Brasileira de Obesidade, Nutrição e Emagrecimento
ISSN 1981-9919 *versão eletrônica*

Periódico do Instituto Brasileiro de Pesquisa e Ensino em Fisiologia do Exercício

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EXCESS OF WEIGHT AND INGESTION OF LOW DIET QUALITY IN PATIENTS WITH PULMONARY HYPERTENSION: A DIFFERENT PROFILE OF LUNG DISEASE PATIENT

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ABSTRACT

Background: Pulmonary hypertension (PH) is characterized by elevated blood pressure in the pulmonary artery. The literature is still scarce about nutritional approaches to this disease. However, is well known that high diet quality has a beneficial impact on quality of life, progression, and mortality of patients with chronic lung diseases, and this may apply to PH as well. Aims: To evaluate diet quality in patients with PH and characterize their comorbidities. Materials and Methods: Cross-sectional study with 35 patients. Body mass index, body fat, food intake, blood biochemical parameters were assessed. Diet quality was evaluated with the Healthy Eating Index (HEI) instrument. Results: The sample consisted predominantly of women (77.2%); 57.1% of the subjects were overweight or obese. Systemic arterial hypertension was the most prevalent comorbidity (28.6%), and one-third of the sample had glycemic changes and hypertriglyceridemia. Most subjects (82.9%) had low diet quality, and none had diet quality classified as good. Intake of fiber, calcium, and monounsaturated fatty acids was below current recommendations, while intake of protein and saturated fatty acids exceeded recommendations ($p<0.05$). Discussion and Conclusion: This sample of patients with PH was predominantly overweight/obese and had poor diet quality. The presence of chronic non-communicable diseases, altered glucose levels, and hyperlipidemia is consistent with these findings, possibly because of poor diet quality.

Key words: Healthy diet. Pulmonary hypertension. Lung diseases. Nutrition assessment.

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RESUMO

Excesso de peso e ingestão de baixa qualidade da dieta em pacientes com hipertensão pulmonar: um perfil diferente de paciente com doença pulmonar

Introdução: A Hipertensão Pulmonar (HP) é caracterizada pela elevação da pressão sanguínea na artéria pulmonar. Em relação à nutrição nesta doença a literatura ainda é escassa, porém sabe-se que a dieta de alta qualidade em nutrientes desempenha papel importante na qualidade de vida, progressão e mortalidade de pneumopatias, podendo se aplicar para HP da mesma forma. Objetivos: Avaliar o Índice de alimentação saudável (IAS) de pacientes com HP e conhecer suas comorbidades. Materiais e Métodos: Estudo transversal, realizado com 35 pacientes portadores de HP. Foram avaliados índice de massa corporal, percentual de gordura corporal, exames bioquímicos, além do índice da qualidade da dieta por meio do instrumento IAS. Resultados: A amostra foi composta por 77% indivíduos do sexo feminino e 57,1% eram sobrepesos ou obesos. Hipertensão arterial sistêmica foi a principal comorbidade apresentada (28,6%), além de que 1/3 dos indivíduos possuírem alterações glicêmicas e hipertrigliceridemia. De todos os avaliados, 82,9% apresentaram alimentação de baixa qualidade. A ingestão de fibras, cálcio e ácidos graxos monoinsaturados (AGM) estavam aquém das recomendações vigentes ($p<0,05$), enquanto a de proteínase ácidos graxos saturados excederam estas mesmas recomendações ($p<0,05$). Discussão e Conclusão: A amostra avaliada foram predominantemente de obesos e sobrepesos e tem baixa qualidade da dieta. A presença de doenças crônicas não-transmissíveis, alterações glicêmicas e de triglicerídeos complementam esses achados, possivelmente como consequências deles.

Palavras-chave: Dieta saudável. Hipertensão pulmonar. Pneumopatias. Avaliação nutricional.

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ISSN 1981-9919 *versão eletrônica*
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INTRODUCTION

Pulmonary hypertension (PH) is defined as an increase in mean pulmonary arterial pressure ≥25 mmHg at rest, as assessed by right cardiac catheterization (Hoeper, et al., 2013; Galiè et al., 2016).

It is a rare and multifactorial disease, which may involve clinical manifestations and result in complications, especially cardiovascular and respiratory disease (Galiè et al., 2016).

Its symptoms are nonspecific; dyspnea on minimal exertion is the most frequent initial manifestation (SBPT, 2005).

Fatigue, pre-syncope, syncope, peripheral edema, palpitations, and chest pain may also occur (Montani et al., 2013).

Conventional treatment, specific targeted therapy, invasive approaches, and general supportive care are all part of PH management (Galiè et al., 2013).

Although nutrition is poorly studied in the context of PH, it is well known that diet is an important factor of protection or risk for numerous chronic diseases. Recent studies show the importance of diet in the management of pulmonary diseases (Hanson et al., 2014; Sorlí-Aguilar et al., 2015).

In this sense, it is suggested that a high-quality diet in terms of nutrient intake plays an important role in improving the quality of life of patients with lung diseases, in addition to the prevention and control of chronic noncommunicable diseases (NCDs) in general (Hanson et al., 2014).

However, there are still few studies in the literature about dietary habits, dietary assessment, and diet quality in individuals with PH (Hanson et al., 2014).

A recent study carried out by our group (Zanella et al., 2018) investigated nutritional status in patients with PH and its relationship with parameters of pulmonary circulation and functional performance. We found a negative correlation between regular physical activity and body fat percentage (Zanella et al., 2018).

Considering the importance of bridging this research gap, we investigated the eating habits of patients with PH to obtain information about diet quality and, consequently, a better understanding of nutritional status, which we believe may influenced the findings of our previous study.

For that purpose, we used the Healthy Eating Index (HEI) (Kennedy et al., 1995), an instrument that evaluates overall diet quality and is used to understand the relationship between food, nutrients, eating habits, and correlating these with individual health (Kennedy et al., 1995; Guenther et al., 2013).

MATERIALS AND METHODS

Study design and sample

This cross-sectional study was conducted with individuals with PH, of both sexes, who are treated at the Hospital de Clínicas de Porto Alegre (HCPA).

As PH is a relatively rare disease, the sample was recruited by convenience, through an invitation during outpatient care, and consisted of 35 individuals.

The study was designed in accordance with the Directives and Norms Regulating Research Involving Human Beings (National Health Council Resolution 466/12) and was evaluated and approved by the HCPA Research Ethics Committee under opinion number 150127.

The inclusion criteria consisted of: PH confirmed by right cardiac catheterization (pulmonary arterial pressure at least 25 mm Hg), stable for the 3 previous months under drug treatment, and group 1 or 4 in the ESC/ERS Joint Task Force classification of PH (Galiè et al., 2016).

Patients were excluded from the sample if they had left-sided heart failure, required continuous oxygen supplementation, had had a myocardial infarction or neuromuscular disease in the last 3 months, had a previous history of pulmonary disease, and/or exhibited cognitive or functional impairments that would limit completion of the study instrument. All patients included in the sample provided written informed consent for participation.

Measures and procedures

Anthropometric and subjective evaluation

The anthropometric evaluation consisted of weight, measured on an anthropometric scale with a maximum capacity of 150 kg and a resolution of 50 g (Filizola, São Paulo, Brazil); height, measured with a wall-mounted stadiometer (length 2 m); waist circumference (WC), over the umbilical scar with a nonelastic tape measure; and body fat mass, measured by a Biodynamics 450

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bioelectric impedance system (Biodynamics Corp. Seattle, Washington, USA).

All measurements were performed by a previously trained researcher. The cutoff points for body mass index (BMI), obtained by measured weight and height, were those proposed by World Health Organization (ABESO, 2016).

The cutoff points proposed by Morrow et al., (2003) were used for the classification of body fat percentage (% BF), while the cutoff points established in the Brazilian Obesity Guidelines were used for the classification of WC (ABESO, 2016).

Blood biochemical parameters

Fasting glycemia, total cholesterol, HDL cholesterol, triglycerides, and liver function tests (alanine aminotransferase [ALT] and aspartate aminotransferase [AST]) were determined by the enzymatic method, using commercially available kits (Roche Diagnostic, Mannheim, Germany).

The reference values adopted were according to the cutoff points established in the Brazilian Society of Diabetes Guidelines (SBD, 2017) and 5th Brazilian Guideline on Dyslipidemia and Prevention of Atherosclerosis (Faludi et al., 2017).

Dietary intake

All subjects completed a 3-day dietary recall, including two weekdays and one weekend day. The total energy intake (TEI) in calories (kcal), in addition to carbohydrates (CHO, expressed as percent of TEI), proteins (g), lipids (expressed as percent of TEI), cholesterol (mg), fibers (g), calcium (mg), iron (mg), and sodium (mg), were analyzed.

The ratio of ω-6:ω-3 fatty acids ingested in the diet was also calculated, following the recommendations established by the WHO and the United Nations Food and Agriculture Organization (WHO, 1995).

All food analyses were performed in ADS Nutri® software (Universidade Federal de Pelotas, Pelotas, Brazil), supplemented as necessary with label-provided nutrition data for industrialized foods not included in the software.

The reference values followed the Dietary Reference Intake (USDA, 2015) recommendations, more specifically the estimated average requirements (EARs) for groups of people.

Healthy Eating Index (HEI)

Dietary evaluation was based on the Healthy Eating Index (HEI-2010) (Guenther et al., 2013) proposed by the United States Department of Agriculture (USDA).

The HEI-2010 includes 12 components: nine of them measure dietary adequacy (fruits + fruit juices, fresh fruits, total vegetables, greens and grains, whole grains, dairy products, total proteins, seafood, and plant proteins and fatty acids), and three evaluate components that should be consumed in moderation (refined grains, sodium, and empty calories). For all components, higher scores reflect better adherence to the evaluated component.

The minimum global score is 0 and the maximum is 100, which is given by the sum of the scores of each component. Scores are classified as: <51 = low diet quality; 51-79 = diet requiring improvement; and > 80 = good diet quality.

Statistical analysis

Data were tested for normality by the Shapiro-Wilk method. Energy intake was compared between the sexes by Student's t test for independent samples.

Dietary intake of protein (g/kg), fiber, cholesterol, calcium, iron, sodium, fatty acid ratio, and HEI score, as well as blood sugar, cholesterol (total and fractions), triglycerides, ALT, and AST were compared by the one-sample t-test, where the reference or cutoff values of these parameters were used as the test value.

Statistical analysis was performed in SPSS software. The level of statistical significance was set at 5% ($p \leq .05$) for all analyses, and the results are expressed as percentage, mean and standard deviation, and median (minimum - maximum).

RESULTS

Of the 35 individuals included, 77.2% were female.

Most of the patients belonged to PH group 1 (68.6%), divided into the following functional classes: I, 28.6%; II, 48.6%; III, 20%; and IV, 2.8%.

Age ranged from 17 to 71 years, with a mean of 47 ± 15 years. According to BMI, most of the sample (54.3%) was overweight or obese individuals ($p<0.05$).

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Measurement of waist circumference indicated that 74.3% of the patients were at increased risk for metabolic complications. However, stratified by sex, these values were only significant in women, which is consistent with the observed sex distribution.

Likewise, mean %BF was significantly elevated enough to increase risk of obesity-associated disorders, but only in women (Table 1).

The most common comorbidities among patients were systemic arterial hypertension (28.6%), followed by HIV/AIDS (14.3%), depression (11.4%), dyslipidemia (8.6%), and diabetes mellitus (5.7%). Five participants met criteria for the metabolic syndrome.

Table 1 - Characterization of patients with Pulmonary Hypertension (n=35).

	Female (n=27)	Male (n=8)	Reference range
Age (years)	47.5 ± 15	45.4 ± 13.5	-
Weight (kg)	69.5 ± 16.3	88.2 ± 31.9	-
Height (cm)	160.0 ± 0.1	170 ± 0.1	-
BMI (kg/m²)	27.9 ± 6.3*	29.6 ± 9.5*	< 25 kg/m²
WC (cm)	96.0 ± 13.9**	104.5 ± 24.4	M < 94 cm F < 80 cm
%BF	33.7 ± 5.3*	25.2 ± 7.7	M (ideal) < 25% F (ideal) < 31%

Legend: BMI: body mass index; WC: waist circumference; %BF: fat mass; M: male; F: female. Data expressed as mean ± standard deviation. * = significantly different from the reference range for this variable (p<0.05); ** = significantly different from the reference range for this variable (p<0.01).

Table 2 - Macronutrient and micronutrient intake and overall diet quality in patients with Pulmonary Hypertension (n=35).

	Female (n=27)	Male (n=8)	Reference range/cutoff point
Energy (kcal)	1727.4 ± 471.5[a]	2478.1 ± 748.2 [b]	--
Carbohydrates (%)	54.3 ± 6.4[a]	48.2 ± 8.6[b]	45-65% of TEI
Protein (g/kg)	1.2 ± 0.5*	1.6 ± 0.7*	0.66 g/kg
Lipids (%)	24.9 ± 5.5	28.0 ± 5.7	20-35% of TEI
Fibers (g)	16.3 ± 7.2*	20.7 ± 5.6*	M: 38 F: 25
Calcium (mg)	410.9 ± 184.6*	453.9 ± 286.1*	M:800 F:800
Iron (mg)	6.6 ± 2.5[a]	9.9 ± 4.7[b]	M: 6.0 F: 8.1
Sodium (mg)	1504.7 ± 654.1*	1780.3 ± 1084.6*	<2000
Cholesterol (mg)	228.2 ± 99.3[a]	430.8 ± 162.0[b]	<300
SFA (%)	11.6 ± 3.5*	12.6 ± 3.5*	<10% of TEI
MFA (%)	8.1 ± 2.9	10.1 ± 2.9	15% of TEI
AGP (%)	6.2 ± 2.6	4.5 ± 2.3	5-10% of TEI
Ratio ω- 6:3	11:1	10:1	5:1
HEI (%)	47.1 ± 7.8*	40.5 ± 5.0*	<51 = poor quality 51-79 = requires improvement >80 = good quality

Legend: SFA: saturated fatty acids; MFA: monounsaturated fatty acids; PFA: polyunsaturated fatty acids; HEI: Healthy Eating Index; F: female; M: male; TEI: total energy intake. Data expressed as mean ± standard deviation. a,b = significantly different between the sexes. * = intake significantly different from the reference values for daily intake according to sex and age.

Table 2 presents the dietary variables and the HEI score. Comparing by sex, calories, iron, and cholesterol intake were higher in men, while carbohydrate intake was higher in women (p<0.05). No differences were found for other nutrients. The ratio of ω-6 to ω-3 dietary fatty acids was not different between the sexes, although well above recommended levels in both.

Analysis of nutrient intake by the groups in relation to current sex-specific recommendations indicated significantly lower intake of fiber, calcium, and monounsaturated fatty acids (MFA) (p<0.05) in both sexes, and

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above-recommended intake of protein and saturated fatty acids (SFA) ($p<0.05$).

Reflecting this, HEI assessment showed that most of the sample had a low diet quality score (82.9%); only six participants (17%) had a diet classified as "requiring improvement", and none reached scores indicative of good diet quality.

Overall, 100% of males and 75% of women presented low diet quality. This was particularly influenced by low intake of whole grains (any such intake was reported by only 26% of the participants) and low intake of seafood (37%), most of which was consumed fried. Furthermore, intake of fruits and vegetables was recorded in insignificant quantities, on average two servings per day.

Conversely, intake of refined grains, processed foods, empty calories (from alcoholic beverages, added sugar, and trans fatty acids), and foods with high sodium content appeared frequently in all filled records. In quantitative terms, the average number of daily meals of most participants was three or four.

Blood biochemical parameters are shown in Table 3.

One-third of the sample exhibited glycemic changes and hypertriglyceridemia, although the overall mean was not significantly outside reference range ($p>0.05$).

However, in both sexes the HDL-cholesterol was below desirable values ($p<0.05$), while total cholesterol and LDL-cholesterol were within the normal range.

Table 3 - Biochemical parameters in patients with Pulmonary Hypertension (n=35).

	Mean ± SD	Reference range
Fasting glucose	97.5 ± 19.1	<100 mg/dL
Total cholesterol	173.8 ± 45.3	<200 mg/dL
HDL cholesterol	41.1 ± 12.9*	> 60 mg/dL
LDL cholesterol	107.1 ± 38.7	<130 mg/dL
Triglycerides	129.4 ± 52.0	<150 mg/dL
AST	23.3 ± 7.2	≤32 U/L
ALT	22.8 ± 11.0	≤33 U/L

Legend: HDL: high-density lipoprotein; LDL: low-density lipoprotein; AST: aspartate aminotransferase; ALT: alanine aminotransferase. Data expressed as mean ± standard deviation. * = mean value significantly below the reference range.

DISCUSSION

In this study, we evaluated the HEI of patients with PH. More than half were found to be overweight or obese, with WC and %BF more than proposed cutoff points.

High blood pressure was the most prevalent comorbidity; abnormal blood glucose, hypertriglyceridemia, and low HDL cholesterol were also common.

Together, these results reflect the dietary intake pattern of the sample, as indicated by low diet quality scores. Notably, no participant achieved a "good" diet quality score.

The anthropometric profile found in this sample is different from that classically reported in patients with respiratory disease, who are commonly malnourished (Schols, 2015).

Burger et al., (2011) corroborate our findings, suggesting that one of the possible factors for overweight in these individuals is their decreased ability to exercise.

This hypothesis is reinforced by Ng et al., (2014), who reported that BMI is negatively associated with forced expiratory volume in the first second (FEV_1).

In addition, the nutritional profile of our sample is like that of general population, which presents increasing rates of overweight and noncommunicable diseases (NCDs). Recent studies with other samples of patients with pulmonary disease showed results consistent with this nutritional profile shift.

Lambert et al., (2017) reported that 34% of participants in their study of COPD patients were obese, and Wei et al., (2017) observed that overweight and obese patients represented 41.2% of patients with COPD in their study.

Dietary analysis indicated adequate intake of some nutrients and inadequacy of others. Intake of fibers, calcium, and MFA was below the reference daily intake, while protein and SFA intake significantly exceeded recommendations.

In a prospective study by Kaluza et al., (2016), who found that high intake of

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ISSN 1981-9919 ***versão eletrônica***

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processed red meat is associated with increased risk of COPD among smokers, the authors suggest that this finding is related to the high nitrite content of processed meats and its role in oxidative stress and inflammatory processes in lung cells.

This hypothesis was reinforced by Jiang et al., (2008) and Varraso et al., (2007), who also showed that frequent intake of processed meat is associated with an increased risk of COPD.

Although not all protein consumed by the sample evaluated in this study was composed or processed meat, local food habits indicate that is one of the most common foods in their routine diet.

On the other hand, the inadequacy of SFA, MFA, and ω-6:3 ratio predisposed these patients to a more inflammatory profile, given the eicosanoid precursor role of the latter two and the stimulus for production or inhibition of inflammatory or anti-inflammatory cytokines of SFA and MFA, respectively (Roos et al., 2009; FAO/OMS, 2008).

In this line, Ng and coworkers (2014) reported that vitamin supplementation and fish intake (three times a week) in individuals with a history of asthma or COPD were individually positively associated with FEV_1, just as supplementation of ω-3 fatty acids was positively associated with forced vital capacity (FVC).

According to the results of HEI application, most participants had a low diet quality, while some had a diet that requires improvement.

To the best of our knowledge, no other studies have used dietary indices in the evaluation of patients with PH, which hinders comparison of our findings. However, similar studies have been conducted in other lung diseases.

Anic et al., (2016) who evaluated the association of diet quality with lung cancer risk in 460,770 adults and concluded that high intake of whole grains and fruits was inversely associated with risk of lung cancer.

They also proposed that diet may play a role in reducing this risk, especially among former smokers. However, poor diet quality among all evaluated individuals was also found in this study (Anic et al., 2016).

Likewise, Yazdanpanah et al., (2016) evaluated diet quality in patients with COPD and found 37.2% low diet quality, 60.3% needing improvement, and only 2.5% with good diet quality; HEI score decreased as disease severity increased.

Finally, a study conducted in China (Yan et al., 2017) with 42,000 participants evaluated healthy lifestyle behaviors in participants with COPD and found that only 31.2% of the sample had high diet quality.

Among HEI components, the worst results observed were related to low intake of fruits and vegetables, whole grains, and seafood, in parallel with high intake of sodium, refined grains, processed foods, and empty calories. Altogether, these findings justify the inadequacies in macro and micronutrient intake observed in this sample.

It is well known that fruits and vegetables are main sources of antioxidant compounds in the diet (Benzie and Choi, 2014).

In this sense, a study of patients with asthma (Wood, 2017) found that low intake of antioxidants generates a proinflammatory environment, suggesting that this may contribute to the development of airway inflammation, worse pulmonary function, and poor asthma control.

Furthermore, the balance between toxic substances and antioxidant defenses seems to play an important role in the loss of lung function over time and in the development of COPD (Yazdanpanah et al., 2016).

These studies clearly show that a relationship exists between antioxidants and lung function.

Since the nutritional profile of this sample reflects that of a substantial portion of the general population, we believe it is valid to compare our findings to those of population-wide studies.

Rehm, Monsivais and Drewnowski (2015) analyzed the relationship between diet cost and HEI score among 11,181 adults in the USA between 2007 and 2010. The mean HEI score was 55.9, and the authors reported a positive association between a high-cost diet and a higher HEI score, especially among females. Higher-cost diets represented elevated intake of total fruits, total vegetables, whole grains, and seafood, as well as lower intake of refined grains and saturated fatty acids.

This suggests that individuals with high incomes may consume higher-quality diets, which may explain the low HEI found in this study, although we did not evaluate the purchasing power of our sample.

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Regarding blood biochemical parameters, elevated glucose and triglyceride levels were expected as consequences of the overweight and poor diet quality found in the sample, just as the presence of high blood pressure.

Likewise, the low levels of HDL are at least partly explained by the fact that these individuals have restrictions on physical activity, which is a factor that influences levels of this lipoprotein (Khammassi et al., 2018).

The limitations of this study include the small sample size, due to the rarity of the disease, and our simplified analysis of micronutrients. As many studies have evaluated these nutrients in an isolated manner, it is impossible to compare them with our global evaluation and reach more robust conclusions.

However, considering all factors evaluated, given the overall inadequacy of our participants' diets and the high prevalence of comorbid NCDs, we emphasize the importance of healthy eating in the context of PH.

HEI analysis provides insight into overall dietary pattern instead of isolated nutrient intakes, which may be useful to analyze various aspects of the diet simultaneously.

Although the role of diet quality specifically in PH has yet to be elucidated, it is well established that diet may be a protective factor for lung function and in other NCDs.

In addition, dietary adjustments based on individual metabolic profile may have a beneficial impact on progression and mortality in chronic lung diseases (Papaioannou et al., 2018).

CONCLUSION

In this sample, patients with PH were predominantly overweight and had consistently poor diet quality. Intake of fiber, calcium, and MFA was below current recommendations, while protein and SFA intake exceeded recommended levels.

The presence of NCDs and altered plasma glucose and serum lipid levels corroborate these findings, and possibly reflect poor diet quality.

ACKNOWLEDGMENTS

We thank the Universidade Federal do Rio Grande do Sul (UFRGS) and the Fundo de Incentivo à Pesquisa e Eventos (FIPE) - Hospital de Clínicas de Porto Alegre (HCPA), for all research and financial support.

CONFLICT OF INTEREST

The authors declare there are no conflicts of interest.

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ISSN 1981-9919 ***versão eletrônica***

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Revista Brasileira de Obesidade, Nutrição e Emagrecimento
ISSN 1981-9919 *versão eletrônica*

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Recebido para publicação em 03/12/2020
Aceito em 20/03/2021