The influence of the No Syphilis Project on congenital syphilis admissions between 2018 and 2019

A influência do Projeto Sífilis Não nos internamentos por Sífilis congênita entre 2018 e 2019

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ABSTRACT

Introduction: The syphilis epidemic in Brazil, as evidenced by the Indicators and Basic Data on Syphilis in Brazilian Municipalities, published and updated annually by the Ministry of Health, shows that the growing number of cases dates back to 2010 and 2019 was the first in the long series of ten years to show a retreat. Over the years 2017 and 2018, from an agreement signed between the Brazilian Ministry of Health, the *Universidade Federal do Rio Grande do Norte* (UFRN), and the Pan American Health Organization (PAHO), policies to fight syphilis related to diagnosis, treatment, prevention and management are being implemented. **Objective:** The objective of the work was to test the hypothesis that the No Syphilis Project has influenced the decline of Congenital Syphilis hospitalizations in Brazilian municipalities since May 2018. **Methods:** This is an ecological study that compared time series of Congenital Syphilis hospitalizations before and after the implementation of the No Syphilis Project in the *Priority municipalities* for the project and in *Other municipalities*. The variables were analyzed by the Chi-square test to rule out the randomness of the results. The series were also analyzed by Linear Regression to measure the degrees of correlation between them. **Results:** Significance was identified for the reduction of admissions by congenital syphilis occurred after the implementation of the project ($p<0.00001$). The coefficient of determination R2 among the variables that measured admissions for congenital syphilis in the *Priority municipalities* and in the *Other municipalities* fell in the period from 0.884 to 0.261 attesting to the disassociation of the series from the project's performance. **Conclusion:** The results obtained in the work are compatible with the effectiveness of the actions developed by the No Syphilis Project in the fight against congenital syphilis in Brazil.

Keywords: syphilis, congenital; public policy; health services research; epidemiology.

RESUMO

Introdução: A epidemia de sífilis no Brasil, como atestam os *Indicadores e Dados Básicos da Sífilis nos Municípios Brasileiros*, publicados e atualizados anualmente pelo Ministério da Saúde, apresentou crescente número de casos em 2010, sendo o ano de 2019 o primeiro da longa série de dez anos a apresentar recuo. Ao longo dos anos de 2017 e 2018, a partir de um convênio firmado entre o Ministério da Saúde do Brasil, a Universidade Federal do Rio Grande do Norte (UFRN) e a Organização Pan-americana da Saúde (OPAS), foram implantadas políticas de enfrentamento da sífilis relacionadas ao diagnóstico, ao tratamento, à prevenção e à gestão. **Objetivo:** O objetivo do trabalho foi testar a hipótese de que o Projeto Sífilis Não tenha influenciado o declínio das hospitalizações por sífilis congênita nos municípios brasileiros a partir de maio de 2018. **Métodos:** Trata-se de estudo ecológico que comparou séries temporais de internamentos por sífilis congênita anteriores e posteriores à implantação do Projeto Sífilis Não nos *Municípios prioritários* e nos *Demais municípios*. As variáveis foram analisadas pelo teste do χ^2, para descartar a aleatoriedade dos resultados. As séries foram também analisadas por regressão linear, para medir os graus de correlação entre elas. **Resultados:** Foi identificada significância para a redução dos internamentos por sífilis congênita ocorrida após a implantação do projeto ($p<0,00001$). O coeficiente de determinação R^2 entre as variáveis que mediram os internamentos por sífilis congênita nos *Municípios Prioritários* e nos *Demais municípios* caiu no período de 0,884 para 0,261, atestando a desassociação das séries a partir da atuação do projeto. **Conclusão:** Os resultados obtidos no trabalho são compatíveis com a efetividade das ações desenvolvidas pelo Projeto Sífilis Não no enfrentamento da sífilis congênita no Brasil.

Palavras-chave: sífilis congênita; política pública; pesquisa sobre serviços de saúde; epidemiologia.

INTRODUCTION

Syphilis is an easily treatable sexually transmitted disease exclusive to humans. Regardless, it has been growing worldwide in a worrying manner for several years[1]. The World Health Organization (WHO) estimates that 930,000 pregnant women a year have active and transmissible syphilis during pregnancy, resulting in 350,000 adverse problems at birth, of which half are stillborn and neonatal deaths[1].

The Epidemiological Bulletin of Syphilis, from 2020[2], from the Ministry of Health (MH), shows that the rates related to acquired and congenital syphilis, and in pregnant women, dropped between 2018 and 2019. The syphilis epidemic in Brazil, as evidenced by the Indicators and Basic Data on Syphilis in Brazilian Municipalities, published and updated annually by the MH[3], presented an increasing number of cases in 2010, with 2019 being the first year of the ten-year-long series to show a setback.

Epidemiological Bulletin No. 42, from 2020[4], from the Health Surveillance Secretariat (*Secretaria de Vigilância à Saúde* – SVS) presents the operational details for the implementation of the No Syphilis Project (*Projeto Sífilis Não*) and emphasizes two important dates, that of the invitation, by the MH, to the municipal and state managers to the adherence to the "national syphilis coping strategy", through the aforementioned project that took place in 2017, and the implementation of the syphilis coping policy, territorially integrated by a decentralized network of institutional supporters operating in municipalities classified as priority[4] in the five macro-regions of Brazil in May 2018.

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The No Syphilis Project, a partnership between the MH, *Universidade Federal do Rio Grande do Norte* (UFRN), and the Pan American Health Organization (*Organização Pan-americana da Saúde* – OPAS), has been working on a broad front of goals including surveillance and health care, educommunication, governance, and syphilis research. The bulletin[4] mentioned also aligns the following objectives included in the project:

- Strengthening the epidemiological surveillance of acquired and congenital syphilis;
- Constituting an integrated and collaborative response to syphilis that articulates health care points in an inter-federative relationship;
- Articulating social sectors and communities to strengthen a rapid response to syphilis;
- Strengthening sexual health and reproductive health actions, especially in the context of primary care (reference)[4-6].

This article analyzed the hypothesis that the watershed between the growing trend of the syphilis epidemic in Brazil, which occurred between 2010 and 2018, and its decline, observed by the MH in 2019 and expressed in the Epidemiological Bulletin of 2020, may have occurred due to the performance of the No Syphilis Project, specifically here focusing on the hospitalizations for congenital syphilis that occurred between 2015 and 2019 in Brazil[7].

OBJECTIVE

Testing the hypothesis that the No Syphilis Project has influenced the decline in hospitalizations for congenital syphilis in Brazilian municipalities as of May 2018.

METHODS

The present work was an ecological study comparing time series of hospitalizations for congenital syphilis before and after the implementation of the No Syphilis Project in the *Priority Municipalities* for the project compared to the *Other municipalities.* Data on the series of hospitalizations for congenital syphilis were collected from the Hospital Information System of the Unified Health System (*Sistema de Informações Hospitalares do Sistema Único de Saúde* – SIH/SUS), by place of residence for the years 2015 to 2019, for all municipalities with hospitalizations for this cause in the period[7]. The survey selected the entire series available from 2015 to the last available months of 2020 and selected the time frame between January 2015 and December 2019. The 100 priority municipalities for the No Syphilis Project[5] were compared to the *Other municipalities* in terms of the evolution of hospitalizations for congenital syphilis in this period. For analysis purposes, the periods before and after May 2018 were used, when the network of supporters of the referred project was implemented. The totality of the 100 *Priority municipalities*[5] was included in the analysis, and not only the 72 that counted with the presence of the *institutional supporter* in their territory[4]. This analysis option, which could even have weakened an eventual significance of the results obtained, resulted from the fact that the presence of this *institutional supporter* was not the only action to fight syphilis in these municipalities[4].

On the contrary, as explained by SVS Epidemiological Bulletin No. 42, the network of supporters acted to reach the various policies to combat syphilis implemented in the municipalities, and therefore, it is not the only component of the strategy operating in the territory. This prevented the removal of 28 priority municipalities from the analysis, or their inclusion in the category *Other municipalities*, which would not have been conceptually correct either.

The χ^2 method[8-10] was used in order to verify and measure the differences between hospitalizations for congenital syphilis in the two groups of municipalities (*Priority and Other*) and in the two time series, the first from January 2015 to April of 2018 and the second from May 2018 to December 2019.

The paired records of hospital admissions occurred in the priority and in other municipalities, before and after the performance of the No Syphilis Project, are:

- between January 2015 and April 2018;
- between May 2018 and December 2019.

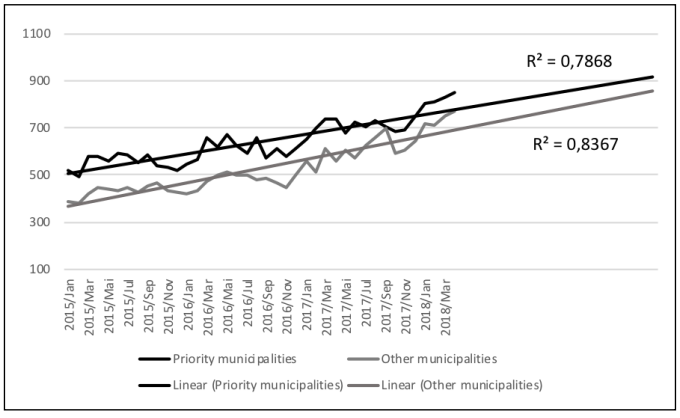
They were also submitted to linear regression[11-13], a statistic that allows estimating the degree of association and the expected value of a variable *y*, considering the values of variable *x* in order to verify, in this case, to what extent the project's performance changed the relationship of these variables to each other in the two periods analyzed.

RESULTS

The results presented below are from SIH/SUS. The graphics and tables presented here correspond to the chronological period before and after the operational start of the No Syphilis Project standardized for analysis purposes, according to the Epidemiological Bulletin No. 42, of 2020[4], of the SVS.

DISCUSSION

Until April 2018, the syphilis epidemic showed no sign of declining, on the contrary, that month of the historical series was the one that, for priority municipalities, had the highest number of records (**Graphic 1**)[3,7].



Graphic 1 – Hospitalizations for congenital syphilis in the 100 priority and in the other municipalities between January 2015 and April 2018 and linear projection until December 2019.

The epidemiological inertia was of such magnitude that the No Syphilis Project seemed insufficient to produce, in the short term, noticeable changes in the course of the epidemic. The projections in **Graphic 1** show that:

- the lines drawn by the *Priority* and the *Other municipalities* were, until April 2018, parallel and increasing, with very strong R^2 determination coefficients for the verified trends — of 0.786 for the trend corresponding to the variable *Other municipalities* and 0.836 for the corresponding *Other municipalities* variables;
- *Priority municipalities*, according to the same trend projections, should have persisted as the largest source of hospitalizations for congenital syphilis until December 2019 (**Graphic 1**).

However, the start-up of the No Syphilis Project coincided with a profound change in the course of the epidemic (**Graphic 2**).

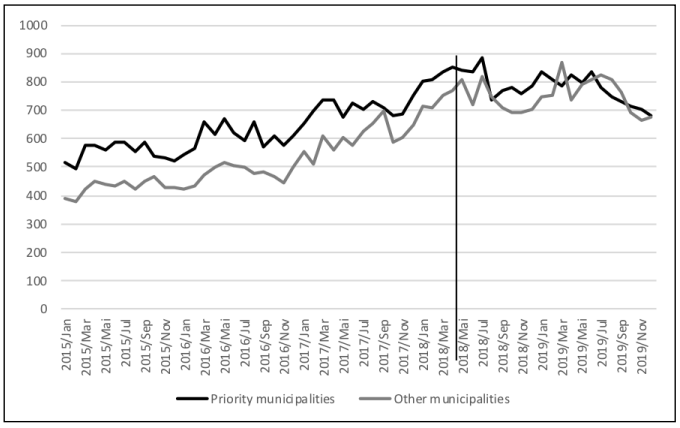
When comparing **Graphic 1**, which shows increasing future trends in both groups of municipalities between April 2018 and December 2019, with **Graphic 2**, which shows what really happened in relation to the number of hospitalizations for congenital syphilis in the period projected in **Graphic 1**, it is possible to note that, as of May 2018, there was an inversion of the epidemic curve for *Priority municipalities* whose hospitalizations showed an increasing trend since at least 2010[3].

It should be highlighted that the 2019 data may have been negatively influenced by the COVID-19 pandemic, which overwhelmed Municipal and State Health Departments with scheduled tasks for surveillance and health care. This burden was of magnitude to impair the quality of notification of compulsory notification diseases, such as syphilis, whose data from the previous year is sent, in part, in the following year.

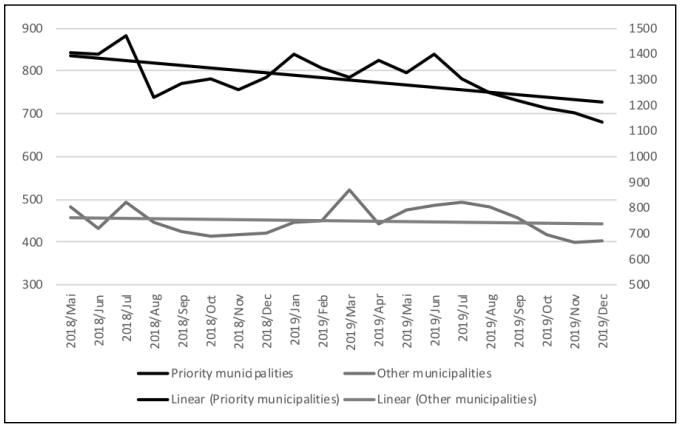
However, the data presented in the results of the present study originated from the SIH/SUS, specifically from hospitals and maternity hospitals that treated cases of congenital syphilis. Such a segment of the hospital service had to maintain, throughout the pandemic, stability in the supply of services governed not by the overload produced by COVID-19, but by the imposed flow of births. Added to this is the fact that the SIH/SUS data comprise the financing process of the SUS Hospital System and the Hospitalization Term (HT), which gives this system a faster speed in producing information that is, in addition, audited, as they make up the payment process for the procedures performed[14-16].

Table 1 statistically shows the phenomenon identified in **Graphics 1 and 2** and the χ^2 test attests, with $p<0.00001$, that the results in the periods before and after the implementation of the project cannot have happened by chance. This means that for the trend identified between January 2015 and April 2018 to be changes in the following period, from May 2018 to December 2019, an active variable would have taken part in the process. This finding is, therefore, compatible with the performance of the No Syphilis Project in a chronologically precise and statistically significant way, establishing a "cause" that precedes "results".

Despite this significant difference between the numbers before and after April 2018, one can say that the *Other municipalities* were also influenced by a culture of coping with syphilis that overflowed to them through the various health policies mentioned in Epidemiological Bulletin No. 42, of 2020, from SVS[4], such as the greater availability of benzathine penicillin or the capillarization of diagnostic tests for Basic Health Units (*Unidades Básicas de Saúde* – UBS), in addition to the advertising campaigns[17] that reached Brazil as a whole. Although it is not possible to weigh these variables here, it is fair to consider that these actions exceed the limits of the *Priority municipalities* and may contribute to explain the fact that in the *Other municipalities*, despite there being no inversion of the growth trend as clear as in the *Priority municipalities*, the growing trend up to April 2018 was converted into a plateau, with a declining bias (**Graphic 3**).



Graphic 2 – Hospitalizations for congenital syphilis in the 100 priority and other municipalities between January 2015 and December 2019.

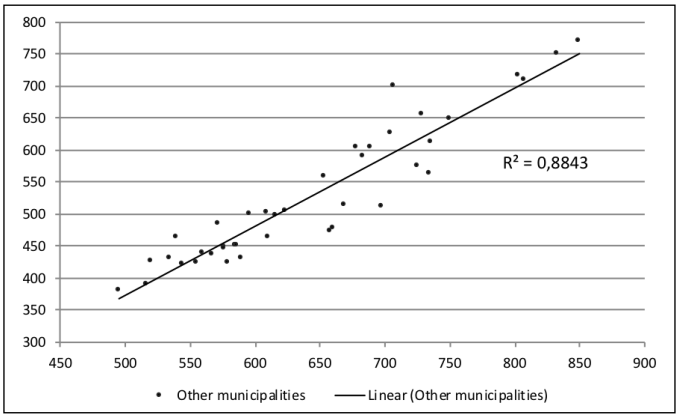


Graphic 3 – Hospitalizations for congenital syphilis in the 100 priority and other municipalities between May 2018 and December 2019.

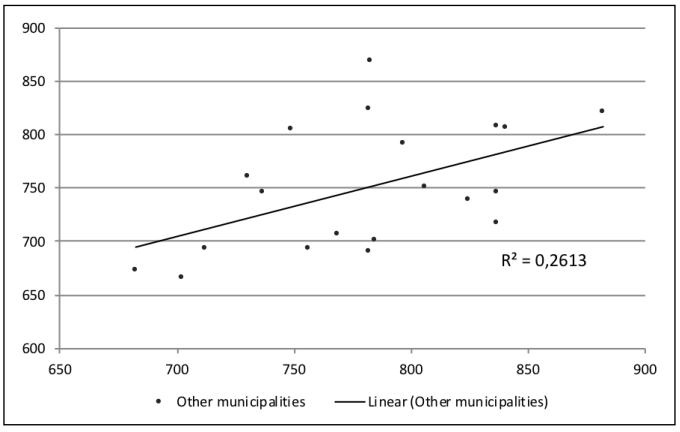
Table 1 – Distribution of hospitalizations for congenital syphilis before and after April 2018, according to the group of Priority and Other municipalities.

	Priority municipalities	Other municipalities	Total universe	χ^2
Hospitalizations				
Before April 2018	25,716 (62.20%)	21,066 (59.40%)	46,782 (60.40)	
Occurred between May 2018 and December 2019	15,631 (37.80%)	15,002 (41.60%)	30,633 (39.60)	p<0.00001
Totals	41,347 (100%)	36,068 (100%)	77,415 (100%)	

It should also be highlighted, considering the universality of the change in the epidemiological scenario of syphilis in Brazil, which is evident, although to a lesser extent, also in the *Other municipalities*, as shown in **Graphic 3**, the actions of the State and municipal governments resulting from greater awareness of the problem, which has become an important object of interest to the State and Municipal Health Secretariats, the National Council of Health Secretaries (*Conselho Nacional de Secretários de Saúde* – CONASS) and the National Council of Municipal Health Secretariats (*Conselho Nacional de Secretarias Municipais de Saúde* – CONASEMS); institutions that have had a managerial participation in the coordination and execution of the activities of the No Syphilis Project. This priority and interest gain attests to the fact that in the *Mostra Brasil aqui tem SUS* Catalog, published by CONASEMS in 2016, the term syphilis was mentioned only nine times, and none of the works presented there had the term "syphilis" in the title of the reported experience. In 2019, the 16th *Mostra Brasil aqui tem SUS* Catalog quoted the word "syphilis" 60 times, the term being present in the titles of ten works, among which one was awarded at the regional level for the Northern Region. The study comes from the municipality of Várzea Grande, Mato Grosso, not listed among the *Priority* ones[18,19].



Graphic 4 – Distribution of hospitalizations for congenital syphilis that occurred between January 2015 and April 2018 in "Other municipalities", according to the records of "Priority municipalities".



Graphic 5 – Distribution of hospitalizations for congenital syphilis that occurred between May/2018 and December/2019 in the "Other municipalities", according to the records of "Priority municipalities".

The distribution of hospitalizations for congenital syphilis in the *Other municipalities*, according to the *Priority municipalities* from January 2015 to April 2018 (**Graphic 4**), showed a determination coefficient of 0.8843 between the two variables, showing that the epidemic occurred practically identical in the two groups of municipalities. The "coefficient of determination" does not mean, of course, that the *Priority municipalities* have "determined" the course of the epidemic in the *Other municipalities*, the strength of the association between the two variables demonstrates that the determinants of the syphilis epidemic that produced such identified hospitalization curves acted homogeneously in the set of Brazilian municipalities in the period that preceded the No Syphilis Project.

However, corroborating the comparative results explained above, the distribution of hospitalizations for congenital syphilis in the *Other municipalities*, according to the *Priority municipalities* from the period from May 2018 to December 2019, has a determination coefficient or R^2 of only 0.2613, significantly showing that some active variable operated in the sense of producing disassociation or disidentification (**Table 1**) between the two curves that remained practically parallel since well before 2015[3] (**Graphics 1, 2 and 5**).

Table 2 shows p<0.00001, a significant magnitude for the regression between the two variables during the period from January 2015 to December 2019, showing their association mathematically. Standard error, in turn, proved to be about 50% lower in the association between these variables, 31.68, against 46.71 for hospitalizations for congenital syphilis in the period after the program was in operation, from May 2018 to December 2019 (**Table 2**), when the two variables no longer expressed convergence, but dispersion (**Graphics 4 and 5**).

Graphics 4 and 5 are illustrative of the behavior between the variables in the periods before and after the performance of the No Syphilis Project. The curves leave no doubt as to the much more polarized alignment shown in **Graphic 4** compared to **Graphic 5**, in which the dispersion is clear, attesting to what the statistics show in the numbers.

Table 2 – Coefficient of determination (R^2) of hospitalizations for congenital syphilis that occurred in the remaining municipalities between January 2015 and April 2018 and between May 2018 and December 2019, distributed according to the records for the same referred hospitalizations that occurred in the hundred priority municipalities for the No Syphilis Project in the same period.

Hospitalizations for congenital syphilis until April 2018			
	R^2	**Standard error**	**p**
Priority municipalities *Other municipalities*	0.884	31.68	p<0.00001
Hospitalizations for congenital syphilis between May 2018 and December 2019			
Priority municipalities	R^2	Standard error	p
Other municipalities	0.261	46.71	p=0.02126

Such differences, as shown in **Graphic 3**, were more striking in the *Priority municipalities,* where the pandemic trend, which was growing until April 2018, started to decline.

These findings are consistent with each other and speak in favor of the effectiveness of the actions developed by the No Syphilis Project in *Priority municipalities*, converging with the guiding hypothesis of the work. Although ecological studies do not allow the measurement of causality [20], it is important to emphasize that the results found in the present study met the totality of Hill's causality criteria[21], namely:

- Strength of the association;
- Consistency;
- Specificity;
- Temporality (cause-before-result);
- Biological gradient (the results were more accentuated in the *Priority municipalities* where the policies were applied in a more demanding way than in the *Other municipalities*, for which there was an "overflow");
- Biological plausibility;
- Consistency;
- Experimental evidence (if considering the world record of good results obtained in initiatives to combat syphilis)[22-29];
- Analogy.

CONCLUSION

The present study shows, first, that the trend of hospitalizations for congenital syphilis considering the series started in January 2015 and April 2018 and projected for December 2019 was of continuous growth (**Graphic 1**). The operational start of the No Syphilis Project coincides, therefore, with the decline in hospitalizations for congenital syphilis in the *Priority municipalities* and in the stabilization of hospitalizations in the *Other municipalities* (**Graphics 2 and 3**).

The comparison between the series before and after the Project referring to hospitalizations for congenital syphilis in the *Priority municipalities* and in the *Other municipalities*, proved to be significant ($p<0.00001$, **Table 1**), confirming the low probability that the inversion found in epidemic trend could be due to chance.

At the same time, the dispersion of hospitalization for congenital syphilis that occurred in the *Other municipalities* according to the hospitalizations that occurred in the *Priority municipalities* in the period prior to the No syphilis Project present a very strong coefficient of determination (R^2), equivalent to 0.884, showing that, until the project, the behavior of the two groups of municipalities in the face of the syphilis epidemic was practically the same (**Table 2**). However, from the start of the No Syphilis Project, the two groups of municipalities began to behave differently in the face of the epidemic. In the *Priority municipalities,* hospitalizations started to decline and in the *Other municipalities* they stabilize. The determination coefficient (R^2), then, decreased from 0.884 to 0.261 (**Table 2**).

Visually, the two dispersions shown in **Graphics 4 and 5** are very clear from the misalignment that has come to exist between the series. While in **Graphic 4** the hospitalizations for congenital syphilis that occurred in the *Other municipalities* are in line with those of the *Priority municipalities*, in **Graphic 5**, which represents the linear regression of the series after the project's operational start, its results appear dispersed, showing a coherent misalignment with actions that modified the dynamics of the epidemic in the territories.

The results, analyses, and graphic expressions presented are robust from a quantitative point of view, since they involve thousands of hospitalizations, showing considerable epidemic inertia, and are coherent among each other. Overall, the results are consistent with the hypothesis that the No Syphilis Project had a decisive influence on the decline in hospitalizations for congenital syphilis in Brazilian municipalities as of May 2019.

Although ecological studies cannot establish causality, the findings of the present study met all nine Hill's Causality Criteria.

Participation of each author

Ricardo A. M. Valentim: organization, bibliographic research, writing of the original manuscript; editing, revision. Ion G. M. de Andrade: organization, bibliographic research, writing of the original manuscript; editing, revision. Carlos A. P. de Oliveira: edition, revision.

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Conflict of interests

There is no conflict of interests involved.

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