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Diagnostic Accuracy of a Nocturia Single Question Scale as a Predictor of Severity of Lower Urinary Tract Symptoms in Men

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Abstract

Objective: This study evaluates the efficacy of the Nocturia Severity Quality Score (NSQS) as a simplified tool for assessing the severity of lower urinary tract symptoms (LUTS) in men, comparing it to the International Prostate Symptom Score (IPSS), the established standard.

Methods: We conducted a cross-sectional analysis on 697 men aged ⩾40 from two urban urology clinics in Brazil. Participants completed both the IPSS and the NSQS, the latter consisting of a single question assessing nocturia frequency on a scale from 0 to 4. Diagnostic accuracy was evaluated using receiver operating characteristic (ROC) curve analysis to compare the NSQS against the IPSS.

Results: The NSQS effectively distinguished between moderate/severe and mild/asymptomatic LUTS, achieving an area under the ROC curve of 0.75 (95% CI: 0.72-0.79). NSQS thresholds of ⩾2 and ⩾3 episodes per night corresponded to increased likelihoods of moderate to severe LUTS, with significant diagnostic value despite varying sensitivities and specificities.

Conclusion: The NSQS provides a valid, efficient alternative to the IPSS for the initial assessment of LUTS severity in men.

Categories: Urology, Health Policy
Keywords: health services accessibility, lower urinary tract symptoms, nocturia, prostatic hyperplasia, validation study

Introduction

Lower urinary tract symptoms (LUTS) encompass a range of problems with storage, voiding, and post-micturition symptoms, significantly affecting men worldwide [1]. Benign prostatic hyperplasia (BPH) is one of the most common urological diseases associated with progressive LUTS [2]. The impact of these symptoms extends beyond mere discomfort, often disturbing sleep, reducing quality of life, and indicating potential underlying pathologies [3].

In clinical practice, accurate assessment of LUTS is crucial for effective management and treatment, particularly in aging populations where prevalence increases [4]. The International Prostate Symptom Score (IPSS) is an eight-item questionnaire comprising seven symptom questions and one quality of life question, the recognized standard for evaluating LUTS severity [5-6]. It has been validated in many countries and enables the stratification of patients according to the severity of symptoms [7-9]. Despite its widespread validation, its length and complexity pose challenges, particularly in settings with limited time and resources [10,11]. Literacy and cultural differences can skew patients' comprehension of the questions, potentially misrepresenting symptom severity [10].

In Brazil, the diversity in educational backgrounds and constrained healthcare resources highlight the necessity for a more accessible diagnostic tool [12,13]. This need is particularly critical in primary care, where urologists may be scarce, and patient volume is high [14].

Simplified diagnostic tools such as single-question surveys have shown efficiency in various medical fields [15-18]. Single-question questionnaires provide a brief and easily administered tool for detecting diseases and have been recommended as a screening tool for different specific medical conditions. For LUTS, a simple yet reliable question focusing on nocturia, a symptom with a significant negative impact, could streamline the initial evaluation process and guide further diagnostic and therapeutic decisions.

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Previously, the single-question nocturia score proved to be an accurate and convenient tool for managing BPH patients [19]. Our objective was to evaluate how accurately the single-question scale assessing the frequency of nocturia episodes (NSQS) can determine LUTS severity in a Brazilian male population. The rationale for using the NSQS is its simplicity, as it saves time for both patients and clinicians, reduces the burden on respondents, and is especially useful in busy clinical settings or populations with low literacy. By proposing a streamlined approach, we aimed to provide a practical alternative to IPSS that accommodates the constraints of diverse clinical environments and improves patient care efficacy. An initial version of this article was previously published on a preprint server [20].

Materials And Methods

Study population

We conducted a cross-sectional study between July and December 2019. The study participants were men aged ⩾40. They were recruited from regular follow-up appointments at two urological clinics in different cities in Brazil. Subjects with active urinary tract infections or those who had experienced such an infection within the previous month were excluded.

All methods, definitions, and units follow the International Continence Society's standards to ensure rigor and reproducibility [1].

This observational study was approved by the Research Ethics Committee of the State University of Feira de Santana on May 9, 2017, under protocol no. 64704017.7.0000.0053, position statement 2.052.761. All participants provided written informed consent.

LUTS assessment

Nocturia was defined as any need to void during the main sleeping period, with each micturition event preceded and followed by sleep [1].

LUTS was assessed using the self-administered IPSS validated version. A research assistant clarified any uncertainties regarding the questionnaire content for patients with low literacy levels who experienced comprehension difficulties. The IPSS consists of seven questions addressing urinary symptoms: sensation of incomplete emptying, frequency, intermittency, urgency, weak stream, straining, and nocturia. Responses to the first six questions were scored on a scale of 0 (none), 1 (less than one in five), 2 (less than half the time), 3 (about half the time), 4 (more than half the time), and 5 (almost always). The last question, which evaluates nocturia frequency, was scored in six categories, from none to five or more times. These questions form a scale by summing the responses (0-5 for each response), and patients may be categorized as asymptomatic (0 points), mild symptoms (1-7 points), moderate symptoms (8-19 points), and severe symptoms (20-35 points).

The Nocturia Severity Quality Score (NSQS) was obtained from the last question of the IPSS that evaluates nocturia. It was scored in five ordered categories, from none to five or more times, and was administered independently to all patients (Appendix A).

Sample size calculation and diagnostic accuracy evaluation

Considering a minimal disease prevalence of 15% according to previous studies evaluating LUTS in the male population [21], a sample of at least 615 subjects would be necessary for 80% sensitivity and specificity, with an absolute precision of 5%.

We investigated the diagnostic properties of the NSQS (index test) for categorization of LUTS severity based on the IPSS score (reference standard). We recorded the time to complete each questionnaire to gauge respondents' burden.

This article complies with the recommendations of the Standards for Reporting of Diagnostic Accuracy initiative as a study of accuracy [22].

Statistical analysis

Data are presented as absolute values, frequencies, medians, and interquartile ranges (IQR). The sensitivity, specificity, predictive values, and likelihood ratio of each NSQS, including 95% confidence intervals (CI), describe the diagnostic accuracy. Receiver operating characteristic (ROC) curves were generated to visualize and calculate the area under the curve (AUC) used to describe the diagnostic characteristics of the NSQS in diagnosing the severity of LUTS. Statistical analyses were performed using GraphPad Prism, version 8.4.0 (GraphPad Software, San Diego, United States).

Results

Of the initial 763 patients enrolled, 697 were included in the final analysis. About 37 were excluded due to current or recent urinary tract infections, and 29 refused to participate. The median age of the participants was 60.0 (54.0-68.0) IQR years. The median IPSS was 9.0 (5.0-17.0) IQR, and the median NSQS was 2.0 (1.0-3.0) IQR.

Prevalence of LUTS

According to the IPSS, the severity of symptoms among the participants was classified as mild in 262 (37.6%), moderate in 279 (40.0%), and severe in 129 (18.6%) patients. Twenty-seven (3.8%) patients were asymptomatic.

The NSQS was zero in 118 patients (17%), one in 141 (20%), two in 197 (28%), three in 144 (21%), and four or more in 95 (13%). The NSQS was significantly higher in subjects with moderate/severe LUTS than in asymptomatic and mild symptoms, respectively, with 2.0 (2.0-3.0) IQR and 1.0 (0.0-2.0) IQR ($p < 0.001$). These data are detailed in Figure *1*.

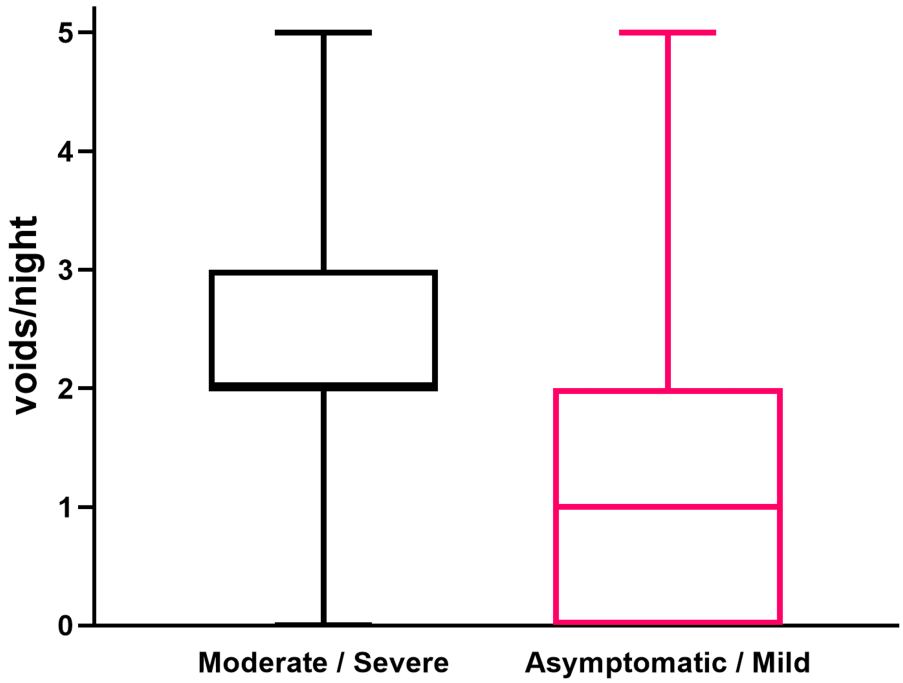


FIGURE 1: Box plot of nocturia episodes in subjects with moderate/severe versus asymptomatic/mild LUTS

LUTS: lower urinary tract symptoms

NSQS diagnostic properties

The NSQS demonstrated good overall accuracy in distinguishing more severe LUTS, as indicated by an area under the ROC curve of 0.75 (95% CI 0.72-0.79). Numbers 0-5 refer to episodes of nocturia (Figure *2*).

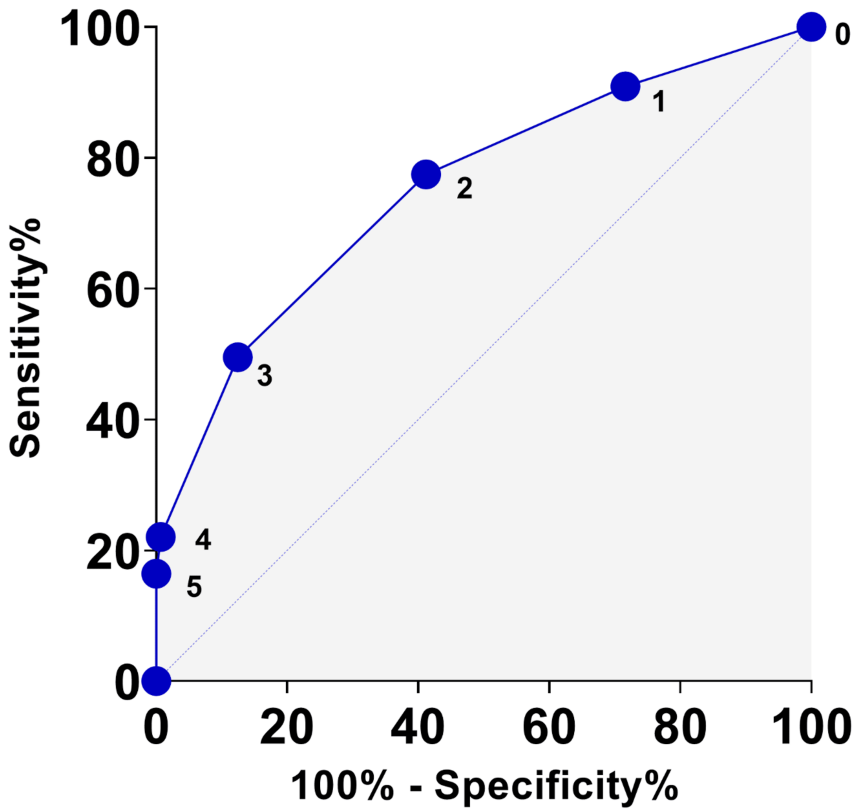


FIGURE 2: ROC curves for NSQS in distinguishing between patients with absent/mild (IPSS < 8) and moderate/severe (IPSS ≥ 8) LUTS

ROC curves: receiver operating characteristic curves; NSQS: nocturia single question scale; IPSS: international prostate symptom score; LUTS: lower urinary tract symptoms

Table *1* presents detailed analyses of sensitivity, specificity, and likelihood ratios for each NSQS threshold.

Number of nocturia episodes				
NSQS	1	2	3	4
Sensitivity (95% CI)	90.9% (87.7-93.3)	77.4% (73.1-81.2)	49.5% (44.6-54.5)	22.0% (18.1-26.4)
Specificity (95% CI)	28.4% (23.5-33.8)	58.4% (52.7-64.0)	87.2% (82.8-90.8)	98.2% (96.0-99.4)
LR+	1.27	1.86	3.87	12.75
LR-	0.32	0.39	0.58	0.49
Youden index	119.3	135.8	136.7	120.2

TABLE 1: Diagnostic parameters of NSQS thresholds for discriminating between patients with mild (IPSS < 8) and moderate/severe (IPSS ≥ 8) LUTS

NSQS: nocturia single question scale; IPSS: international prostate symptom score; CI: confidence intervals; LR+: positive likelihood ratio; LR-: negative likelihood ratio; LUTS: lower urinary tract symptoms

The median time required to complete the NSQS was significantly shorter compared to the IPSS, with median times of 0.28 (0.12-0.45) IQR minutes and 2.7 (2.3-3.5) IQR minutes, respectively ($p < 0.001$).

Discussion

This study demonstrates that the NSQS is an effective tool for assessing the severity of LUTS in adult men. Its overall accuracy (AUC of 0.75) supports its use in primary care. The NSQS, particularly at cut-offs of 2 and 3 nocturia episodes, demonstrated robust diagnostic value, offering a viable alternative to the more cumbersome IPSS.

NSQS ⩾ 2 is particularly relevant as it is the standard number of voids considered in the definition of nocturia, with most authors recognizing two voids per night as the clinical threshold that notably affects quality of life [23-25]. Conversely, NSQS ⩾ 3 demonstrates slightly higher overall accuracy and superior specificity, making it highly effective in predicting moderate to severe LUTS despite lower sensitivity, a feature precious in primary care settings where resources and specialist availability are limited. A previous study [20] has also investigated the role of a single nocturia question in the evaluation of 162 African men aged over 50 and revealed NSQS ⩾ 3 as the most effective threshold, showing higher sensitivity (87.0%) and specificity (91.0%) for distinguishing severity of LUTS, in contrast to our findings, which may reflect regional educational and cultural differences affecting patient responses.

Other efforts have been applied to create simplified methods capable of evaluating LUTS in adult men, such as the Urgency, Weak stream, Incomplete emptying, and Nocturia (UWIN) questionnaire, recently validated in Brazilian Portuguese by our group [26-27]. UWIN provides comparable results to the IPSS, using a more straightforward format and taking less time to complete. However, it comprises a four-question questionnaire with scores ranging from 0 to 3, adding to a composite score of 0 to 12. The UWIN, although simpler than IPSS, might still add considerable effort from respondents and physicians. Other abbreviated Patient-Reported Outcome Assessments (PROs) have been proposed to decrease the burden of IPSS on respondents and clinicians, such as the Quick Prostate Test (QPT) and Frequency, Leakage, Overnight voiding, and Weak stream (FLOW) [28,29]. These instruments demonstrated valid equivalence to the IPSS and some advantages, including efficiency and ease of application.

The methodology employed in this study leveraged a cross-sectional design and utilized a single-question NSQS. It contrasts with the more complex IPSS, traditionally recognized for its thoroughness but criticized for its length and difficulty, especially in diverse educational backgrounds [10,11]. Our approach aimed to simplify the diagnostic process without compromising the quality of assessment, particularly in settings constrained by time and resources [12,13].

The predominantly urban, well-educated male demographic in this study might limit the generalizability of our findings to broader populations. This aspect is particularly relevant as lower educational levels have been shown to impact the comprehension and effectiveness of self-administered questionnaires like the IPSS [10,11,30].

Simplified tools such as the NSQS can significantly enhance diagnostic efficiency, improve patient throughput, and increase satisfaction in healthcare settings with limited resources. These tools reduce the burden on patients and healthcare providers, facilitating quicker clinical decision-making [27-29].

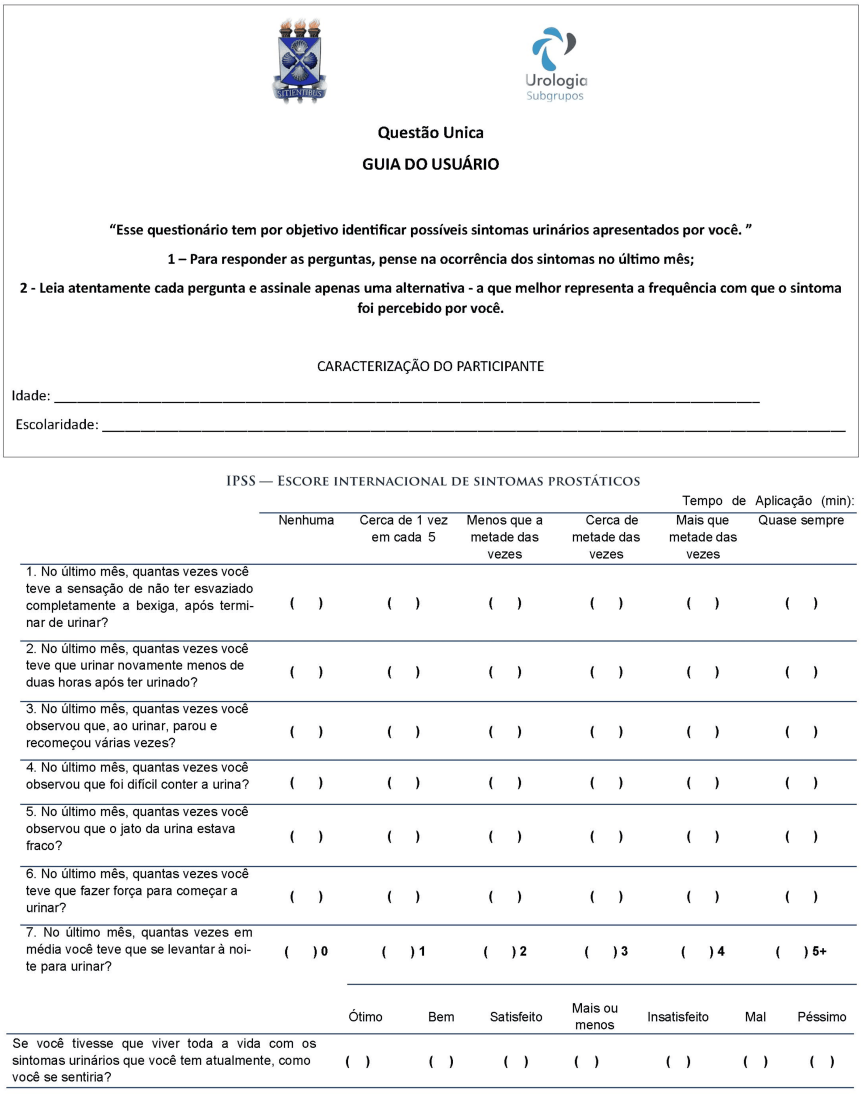
While our findings are promising, they must be interpreted with caution due to some limitations. This study was a non-randomized cohort of Portuguese-speaking Brazilian men in two tertiary urological centers in an urban region. The demographic profile of our respondents, primarily urban males with a high education level, potentially influences our findings' generalizability. Additionally, the study relied on self-reported data for assessing symptoms, which may introduce recall bias and subjectivity, potentially affecting the accuracy of the findings. Future research should aim to validate the NSQS across more diverse populations to enhance its applicability and reliability in different clinical and cultural contexts.

Conclusions

This study establishes the NSQS as a practical, efficient, and reliable tool for predicting the severity of LUTS in men. The NSQS balances simplicity with good diagnostic accuracy. Our findings demonstrate that patients with one or no voids per night have a low probability of severe LUTS, while those reporting three or more voids are likely to experience moderate to severe symptoms. This clinical tool can optimize clinical care and potentially reduce clinician burden. It is suitably used in resource-limited settings and among populations with varying literacy levels.

Appendices

Appendix A



Questão Unica

GUIA DO USUÁRIO

"Esse questionário tem por objetivo identificar possíveis sintomas urinários apresentados por você. "

1 – Para responder as perguntas, pense na ocorrência dos sintomas no último mês;

2 - Leia atentamente cada pergunta e assinale apenas uma alternativa - a que melhor representa a frequência com que o sintoma foi percebido por você.

CARACTERIZAÇÃO DO PARTICIPANTE

Idade: _____

Escolaridade: _____

IPSS — Escore internacional de sintomas prostáticos

Tempo de Aplicação (min):

	Nenhuma	Cerca de 1 vez em cada 5	Menos que a metade das vezes	Cerca de metade das vezes	Mais que metade das vezes	Quase sempre
1. No último mês, quantas vezes você teve a sensação de não ter esvaziado completamente a bexiga, após terminar de urinar?	( )	( )	( )	( )	( )	( )
2. No último mês, quantas vezes você teve que urinar novamente menos de duas horas após ter urinado?	( )	( )	( )	( )	( )	( )
3. No último mês, quantas vezes você observou que, ao urinar, parou e recomeçou várias vezes?	( )	( )	( )	( )	( )	( )
4. No último mês, quantas vezes você observou que foi difícil conter a urina?	( )	( )	( )	( )	( )	( )
5. No último mês, quantas vezes você observou que o jato da urina estava fraco?	( )	( )	( )	( )	( )	( )
6. No último mês, quantas vezes você teve que fazer força para começar a urinar?	( )	( )	( )	( )	( )	( )
7. No último mês, quantas vezes em média você teve que se levantar à noite para urinar?	( ) 0	( ) 1	( ) 2	( ) 3	( ) 4	( ) 5+

	Ótimo	Bem	Satisfeito	Mais ou menos	Insatisfeito	Mal	Péssimo
Se você tivesse que viver toda a vida com os sintomas urinários que você tem atualmente, como você se sentiria?	( )	( )	( )	( )	( )	( )	( )

3

FIGURE 3: Questionnaire (Portuguese version)

International Prostate Symptom Score (I-PSS)

Date:	Not At All	Less Than 1 Time In 5	Less Than Half The Time	About Half The Time	More Than Half The Time	Almost Always	YOUR SCORE
1. Incomplete Emptying Over the past month, how often have you had a sensation of not emptying your bladder completely after you finish urinating?	0	1	2	3	4	5	
2. Frequency Over the past month, how often have you had to urinate again less than two hours after you have finished urinating?	0	1	2	3	4	5	
3. Intermittency Over the past month, how often have you found you stopped and started again several times when you urinated?	0	1	2	3	4	5	
4. Urgency Over the past month, how often have you found it difficult to postpone urination?	0	1	2	3	4	5	
5. Weak Stream Over the last month, how often have you had a weak urinary stream?	0	1	2	3	4	5	
6. Straining Over the past month, how often have you had to push or strain to begin urination?	0	1	2	3	4	5	
	None	Once	Twice	3 times	4 times	5 or more	YOUR SCORE
7. Nocturia Over the past month how many times did you most typically get up each night to urinate from the time you went to bed until the time you got up in the morning?	0	1	2	3	4	5	
Total I-PSS Score							

Urologia
Subgrupos

FIGURE 4: Questionnaire (English version)

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Jose Bessa , Cristiano Gomes, Caroline S. Silva, Ricardo B. Tiraboschi, Carlos S. Bellucci, Jose Murillo B. Netto

Drafting of the manuscript: Jose Bessa , Cristiano Gomes, Caroline S. Silva, Ricardo B. Tiraboschi, Carlos S. Bellucci, Jose Murillo B. Netto, Matheus A. Alvaia, Eduardo Miranda

Critical review of the manuscript for important intellectual content: Jose Bessa , Cristiano Gomes, Caroline S. Silva, Ricardo B. Tiraboschi, Carlos S. Bellucci, Jose Murillo B. Netto, Matheus A. Alvaia, Eduardo Miranda

Supervision: Jose Bessa , Cristiano Gomes, Ricardo B. Tiraboschi

Acquisition, analysis, or interpretation of data: Caroline S. Silva, Carlos S. Bellucci, Matheus A. Alvaia, Eduardo Miranda

Disclosures

Human subjects: Consent for treatment and open access publication was obtained or waived by all participants in this study. Research Ethics Committee of the State University of Feira de Santana issued approval 64704017.7.0000.0053. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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Caroline Silva and Carlos Belucci contributed equally to the work and should be considered co-first authors. Thankfully, Dr. Caio V. Suartz and Vicktor Bruno Pereira Pinto helped us produce the final version of this paper.

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