

# Speech therapy's intervention for falling prevention in aging

## *Intervenção fonoaudiológica na prevenção de quedas no envelhecimento*

Carlos Kazuo Taguchi<sup>1</sup> 

Brenda Carla Lima Araújo<sup>1</sup> 

Leonardo Santos de Santana<sup>1</sup> 

Raissa Valença de Souza Santos<sup>2</sup> 

Jacqueline Pítanga Teixeira<sup>2</sup> 

Allan Robert da Silva<sup>1</sup> 

### Keywords

Accidental Falls  
Primary Prevention  
Healthy Aging  
Aging  
Postural Balance

### ABSTRACT

**Purpose:** to verify the effectiveness of a Speech Therapy intervention program to decrease the risk of falls in elderly people. **Methods:** Exploratory and intervention study where upon 148 volunteers from community, both genders, with an average of 68.6(± 6.5) years were submitted to the Dynamic Gait Index (DGI)- Brazilian brief and the Timed Up and Go (TUG). Volunteers with or without potential risk for falling were invited to participate in a 50-minutes long intervention program carried out for five consecutive weeks, based on Cawthorne and Cooksey exercises. Seventy-two volunteers 68.1(±6.5) years presented in at least three meeting, were reassessed. The results were analyzed by Wilcoxon, Chi-square, Spearman and Correlation Matrix tests, with  $p \leq 5.0\%$ . **Results:** Thirty-seven (25.0%) and 106 (71.6%) participants presented, respectively, risks for falls in the DGI-Brazilian brief and TUG. There was negative correlation between the DGI-Brazilian brief ( $p=0.034$ ) and positive with the TUG ( $p=0.0071$ ) with age and both instruments ( $p=0.0000016$ ). Through the comparison the initial and final data a positive correlation was found for the DGI-Brazilian brief and for TUG in the Chi-square test and by Wilcoxon's. Better performance was observed in both tests after the intervention. **Conclusion:** The intervention was effective in decreasing the risk for falls and improving gait performance, and functional and dynamic balance.

### Descritores

Acidentes por Quedas  
Prevenção Primária  
Envelhecimento Saudável  
Idoso  
Equilíbrio Postural

### RESUMO

**Objetivo:** Verificar a eficácia de uma intervenção fonoaudiológica para diminuição do risco de quedas. **Método:** Estudo exploratório e de intervenção em que 148 voluntários socialmente ativos, de ambos os sexos, com média de 68,6(±6,5) anos foram avaliados pelo Dynamic Gait Index (DGI)-Brazilian brief e o Timed Up and Go (TUG). Todos os voluntários, com e sem risco para quedas, foram convidados para o programa de intervenção realizado em cinco semanas consecutivas, com duração de 50 minutos baseados nos exercícios de Cawthorne e Cooksey. Destes, 72 com 68,1(±6,5) anos, com e sem riscos para quedas, que participaram de, pelos menos, três encontros foram reavaliados. Foram utilizados o teste de Wilcoxon, Qui-quadrado, Spearman e Matriz de Correlação, com  $p \leq 5,0\%$ . **Resultados:** Inicialmente, 37(25,0%) e 106(71,6%) dos voluntários apresentaram, respectivamente, riscos para quedas no DGI-Brazilian brief e no TUG. Verificou-se correlação negativa do DGI-Brazilian brief ( $p=0,034$ ) e positiva com o TUG ( $p=0,0071$ ) com a idade e entre os dois instrumentos ( $p=0,0000016$ ). Na comparação dos dados iniciais e finais de 72 voluntários averiguou-se correlação positiva no DGI-Brazilian brief e TUG no teste do Qui-quadrado e de Wilcoxon. Foi observado melhor desempenho nestes testes após a intervenção. **Conclusão:** A intervenção foi eficaz, uma vez que diminuiu o risco para quedas e melhorou o desempenho da marcha e equilíbrio funcional e dinâmico.

### Correspondence address:

Carlos Kazuo Taguchi  
Universidade Federal de Sergipe – UFS  
Rua João Carvalho de Aragão, 855,  
casa 02, Atalaia, Aracaju (SE), Brasil,  
CEP: 49037620.  
E-mail: carlostaguchi@hotmail.com

Study conducted at Universidade Federal de Sergipe, Aracaju (SE), Brasil.

<sup>1</sup> Universidade Federal de Sergipe – UFS - São Cristóvão (SE), Brasil.

<sup>2</sup> Hospital Universitário, Universidade Federal de Sergipe – UFS - Aracaju (SE), Brasil.

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## INTRODUCTION

As people age, the risk of comorbidities such as the events of falls that negatively impact the quality of life, increases. The risk ratio of a socially active elderly person falling is one in three when they are over 65 years old, and one in two when they are over 80 years old<sup>(1-3)</sup>. Factors such as age, polypharmacotherapy, female sex, economic dependence, and depression are strongly associated with falls in the elder population<sup>(4)</sup>. Therefore, there is a need to identify those who present any risk for falls<sup>(5)</sup>.

Several instruments assess gait, functional and dynamic balance, in addition to identifying elderly people with potential risks for falls. The Dynamic Gait Index (DGI) and the Timed Up and Go (TUG) are the best examples of this type of testing. They are easy to apply, with high sensitivity and specificity, identifying 30.0 to 70.0% of the elderly people with future risks for falls<sup>(2,3,6-8)</sup>. Current evidence suggests that gait assessment is in line with the identification of frailty, which is strongly associated with risks for falls<sup>(8,9)</sup>.

Some studies reinforce the importance of reducing the risk of falls through prevention and health promotion programs during senescence<sup>(4,10,11)</sup>. A national study<sup>(12)</sup> described a fall prevention program for elderly adults, with significant results, and highlighted that the speech-language therapist can work in this field, however, there is very little scientific evidence.

Evidence-based reviews with meta-analysis are promising<sup>(13,14)</sup> and point out that programs based on exercises or a combination of factors (multifactorial) reduce falls by between 19.0% and 34.0%, and recurrent falls by up to 24.0%. Given the need to assess and prevent fall events in the fastest-growing population, this study aimed to verify the effectiveness of an intervention to reduce the risk of falls in socially active elderly people.

## METHODS

The convenience sample consisted of 148 socially active volunteers from four municipalities in the interior of the state of

Sergipe, over 60 years old and of both genders. This exploratory and intervention study was approved by the institution's ethics committee under the number CAAE 0197.0.107.000-10.

All participants signed the Informed Consent Form following the precepts of resolution 510/2016 of the National Health Council. From the contact and approval of the health care unit in each municipality, we developed the study in three phases between January and December, 2019, lasting approximately two months in each municipality.

Phase 1): sociodemographic data collection and evaluation through Dynamic Gait Index (DGI) – Brazilian brief<sup>(15)</sup> and Timed Up and Go Test (TUG)<sup>(16)</sup>. The DGI-Brazilian brief is considered an important instrument for the assessment of balance and gait in the elderly population and allows the study of gait in different sensory contexts such as changes in gait speed, horizontal and vertical head movements, turning on the body axis, going up and downstairs. The maximum score is 15 points and a value equal to or below 11 points predicts risk for falls. Each volunteer underwent an assessment using the ordinal scale consisting of four categories scored according to their performance in each task: 3=normal gait, 2=mild impairment, 1=moderate impairment, and 0=severe impairment.

The TUG<sup>(16)</sup> is a protocol that aims to assess the individual's functional mobility and balance based on the time spent in the execution of the task of standing up and walking a distance of 6 meters from the sitting position. The low risk of falls and functional mobility occurs when the time used is less than 10 seconds, considered average between 10 and 20 seconds and high risk above 20 seconds.

Phase 2) All the elderly assessed, especially those who were identified as at risk for falls in at least one of the assessment protocols, were invited to participate in the intervention process. This phase lasted for five consecutive weeks in sessions spending approximately 50 minutes and was based on the protocol by Cawthorne and Cooksey<sup>(17)</sup> (Chart 1), adapted for this study. The activities carried out with two groups, with a maximum of 30 participants, were monitored by five undergraduate scientific

**Chart 1.** Description and frequency of the exercises adapted from Cawthorne and Cooksey

Eyes exercises	
Looking side to side	Three sets of 16 times
Looking up and down	Three sets of 16 times
Focusing a target and turn your head side to side	Three sets of 16 times
Focusing a target and move your head up and then down	Three sets of 16 times
Head exercises	
Turning the head side to side	Three sets of 16 times
Moving your head up and down	Three sets of 16 times
Spinning head movement clockwise and then counterclockwise	Two sets of 10 times
Trunk exercises	
Bending forward and picking up objects from the ground	A series of 10 times
Sitting and standing up without support	A series of 10 times
Changing from sitting to standing and turn round in between	A series of 10 times in each position
Balance exercises	
Throw a ball from hand to hand under the knee	A series of 5 times
Walking forward and to back with eyes open and then closed	A series of 10 times
Stepping forward and spin 360°	A series of 10 times

initiation scholarship students in Speech-language Therapy to ensure the physical integrity of all volunteers. At this stage, we estimated that between 25 and 60 volunteers were present at each meeting. The frequency was computed in a spreadsheet, and those who were present in at least 50.0% of the sessions went to Phase 3 of the study.

During the study, we evidenced that non-adherence to the program, dropouts, consecutive absences, events of falls, health problems and family commitments contributed to the exclusion of a part of the sample evaluated in Phase 1 (n=76).

There was no type of guidance regarding the execution of exercises at home, but doubts were resolved and another guidance on the risk of falls was informally provided during the development of the program.

Phase 3) Reassessment with Dynamic Gait Index (DGI) – Brazilian brief<sup>(15)</sup> and Timed Up and Go Test (TUG)<sup>(16)</sup> used in Phase 1. Initial and final data were tabulated and statistically analyzed. We considered as the dependent variable the results of the inventories adopted (before and after) and age as an independent variable. The gender variable was not included because the study sample was of convenience, with a predominance of the female gender. We used the Soft R Project: 3.12 program to present the descriptive and figures in box plot and to apply the Wilcoxon, Chi-square, Spearman, and Correlation Matrix tests with  $r_s$  value (weak, moderate, and strong correlation) and  $p$  equal to or less than 5.0%.

## RESULTS

The convenience sample consisted of 148 volunteers, 129 (87.2%) female and 19 (12.8%) male. The age group ranged from 60 to 84 years old with a mean of 68.6 ( $\pm 6.5$ ) years old and the frequency was 0.65 ( $\pm 1.29$ ) falls in the last year.

Table 1 shows the results of the assessment of the DGI-Brazilian brief and TUG by gender.

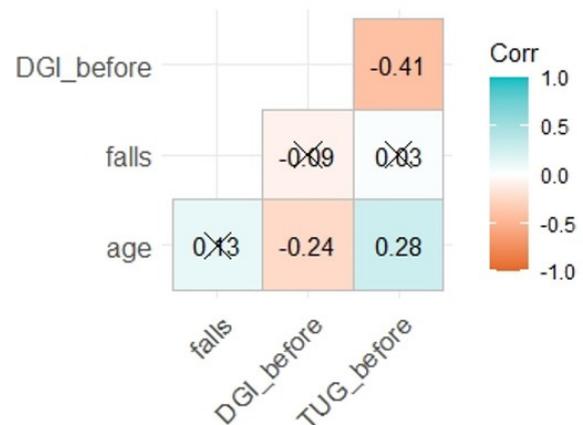
Among the volunteers, 37 (25.0%) had scores within the risk for falls in the DGI - Brazilian brief and 93 (62.8%) with increased execution time in the TUG. The distribution of scores or execution time was similar when compared by gender. Thus, there was no association of this variable with the two protocols, confirmed by the Wilcoxon test. The results obtained were  $p=0.960$  for the DGI-Brazilian brief and  $p=0.087$  for the TUG.

Figure 1 shows the Correlation Matrix developed before the intervention, in which we verified that age was significantly correlated with the risk measures. It was negative in the DGI-

Brazilian brief ( $r_s=0.24$ ;  $p=0.034$ ), and positive in the TUG ( $r_s=0.28$ ;  $p=0.0071$ ). Thus, the correlation was weak, but significant in both analyses.

We also observed a negative correlation ( $r_s=0.41$ ;  $p=0.00000016$ ) between the initial results of the two protocols used and, according to Spearman's test, the correlation was moderate and significant. Some results in Figure 1 were highlighted with an X, to emphasize that there was no correlation between the results of the Dynamic Gait Index – Brazilian brief and Timed Up and Go and age with the variable events of falls.

For the second phase of the study, we invited all participants and 72 (48.6%) of them, (63 (90.4%) female and 9 (9.6%) male), with and without risks for falls, were present in at least three of the five sessions, were re-evaluated and their data analyzed in Phase 3. The mean age was 68.1 ( $\pm 6.5$ ) years old and the self-report was 0.59 ( $\pm 1.12$ ) falls in the last year. In the evaluation phase, 57 (79.2%) presented alterations in the TUG and 20 (27.4%) in the DGI-Brazilian brief and the same percentage in both protocols. In the reassessment phase, 18 (25.0%) presented alterations in the TUG and 4 (5.6%) in the DGI-Brazilian brief and the same percentage in both protocols.



**Caption:** DGI = Dynamic Gait Index-Brazilian brief; TUG = Timed and Up and Go; Corr = Correlation; X = No Correlation

**Figure 1.** Matrix Correlation to verify association of the Dynamic Gait Index Brazilian brief and Timed Up and Go Test with age and falls before the intervention time

**Table 1.** Average score, median and standard deviation of the scores of the Dynamic Gait Index - Brazilian brief and Timed Up and Go of 148 volunteers by gender

Tests	Statistics	Male (n=19)	Female (n=129)
DGI-Brazilian brief	Average	12.68	12.63
	Median	13	13
	Standard Deviation	1.37	1.77
TUG	Average	11.57	13.02
	Median	10	12
	Standard Deviation	4.18	5.14

**Caption:** DGI-Brazilian brief = Dynamic Gait Index -Brazilian brief

**Tabela 2.** Absolute distribution the results of volunteers for normal and changed standard according to *Dynamic Gait Index -Brazilian brief e TUG (n=72)*

Risk Measure	State	Before	After
DGI-Brazilian brief	Normal	53	68
	Standard		
	Changed	19	4
	Total	72	72
TUG	Normal	26	52
	Standard		
	Changed	46	20
	Total	72	72

**Caption:** DGI-Brazilian brief = *Dynamic Gait Index -Brazilian brief*; TUG = *Timed and Up and Go*

The statistical analysis showed the lack of correlation between age and reporting of falls with the results of the DGI-Brazilian brief and Timed Up and Go when comparing the initial and final data to the intervention.

Table 2 shows the distribution of the absolute number of volunteers in conjunctions within the normal or altered standard according to the DGI -Brazilian brief and TUG cutoff scores.

We noticed that for the DGI-Brazilian brief, the situation of volunteers within the normal standard went from 52 to 68 at the end of the intervention. The Chi-square test indicated the association between intervention and condition, as there was a significant decrease in the proportion of altered individuals ( $p=0.0015$ ). When comparing the total performance of volunteers in the DGI-Brazilian brief, there was a variation in the initial situation within the normal standard, which went from 12.6 ( $\pm 1.81$ ) to 14.07 ( $\pm 1.55$ ) points, at the end of the intervention.

Figure 2 shows the box plot showing the change in mean values and range of variation in conditions before and after the intervention for the DGI-Brazilian brief.

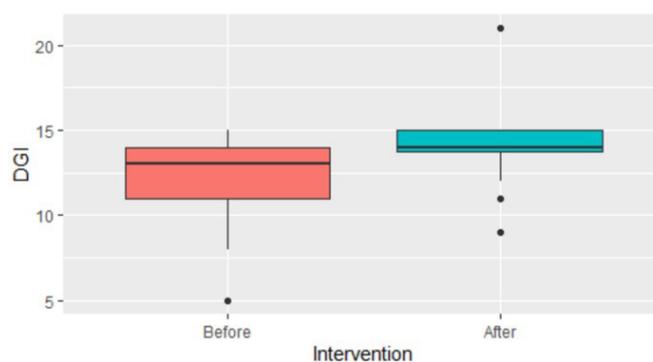
In the analysis of the results of the DGI-Brazilian brief in the conditions before and after the intervention, the Wilcoxon Test showed a positive association, showing that there was an increase in the score after the intervention ( $p=0.00000019$ ).

In the TUG, we noted that the volunteers classified as within the normal standard increased from 15 to 54 in absolute number, revealing an association in the conditions before and after the intervention. When applying the Chi-square test, there was a significant decrease in the proportion of altered individuals ( $p=0.000029$ ). Thus, there was a change in the execution time of the initial conjunction test from 12.47 ( $\pm 4.05$ ) to 9.5 ( $\pm 2.29$ ) seconds in the final, proving an improvement in dynamic balance, and as consequence, the reduction for falling.

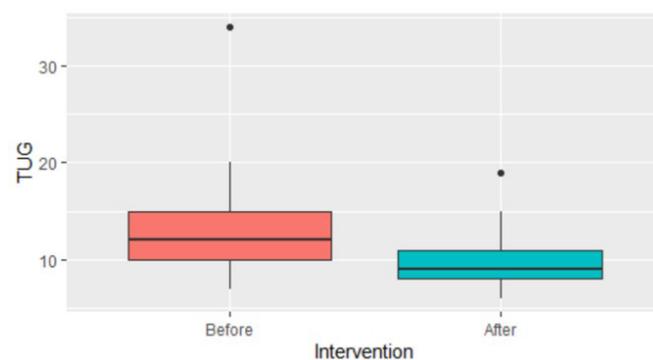
Figure 3 shows the box plot showing the mean values and range of variation in conditions before and after the intervention for the TUG.

For the TUG, the Wilcoxon paired test proved a difference in the TUG before and after the intervention between patients ( $p=0.000000095$ ). Thus, there was an evolution in the functional situation and a decrease in the risk of falls.

Spearman's Correlation Test between Dynamic Gait Index -Brazilian brief and TUG in the initial phase and after the intervention showed  $r_s = -0.340$ ;  $p = 0.0034$  and  $r_s = -0.348$ ;



**Caption:** DGI-Brazilian brief = *Dynamic Gait Index -Brazilian brief*  
**Figure 2.** Box-Plot with maximum and minimum and average scores of the Dynamic Gait Index test (DGI) - Brazilian brief before and after the intervention time of 72 volunteers



**Caption:** TUG = *Timed and Up and Go*  
**Figure 3.** Box-Plot with maximum and minimum and average scores of the Timed Up and Go Test before and after the intervention time of 72 volunteers

$p=0.0027$  respectively, that is, it was negative, moderate, and significant.

## DISCUSSION

The results obtained in this study showed that the speech-language therapy intervention reduced the risk of falls and improved gait performance and functional and dynamic balance, as evidenced by the increase in the DGI-Brazilian brief score and the decrease in the time to perform the TUG.

The analysis by simple percentage distribution found that females reported almost twice as many falls as males. Even most of the volunteers were female, the statistical analysis did not show a correlation between the events of falls and gender. Previous studies have identified a greater tendency for females to present loss of bone mass, susceptibility to mental disorders, risk of physical wear and tear, and being vulnerable to the Fragility Syndrome, which potentiates the events of falls<sup>(4,5,18-22)</sup>. Another study found that in a population with a predominance of females, 46.7% reported a fall in the last year<sup>(23)</sup>. This data was superior to the results of our study.

In this research, the performance of the volunteers in the two assessment protocols was similar between the gender, both in the mean and in the standard deviation (Table 1). This was in disagreement with studies that showed that the female gender has worse performance in the qualitative assessments that indicate risks for falling<sup>(4,5)</sup>.

On the other hand, current evidence suggests that age is a predisposing factor for falls, as it affects all systems responsible for the integration of sensory information that maintains human body balance<sup>(5,8,19)</sup>. Thus, we observed the occurrence of an age relationship with the two protocols, as described in Figure 1, which showed that as age increased, the score in the DGI-Brazilian brief decreased and more time was spent on the TUG. These results are in line with previous studies<sup>(4-6,12)</sup> that proved the relationship of these tests with age and that one in three elderly people in the community aged 65 years old or over and one in two in those aged over 80 years old, they would have at least one fall per year<sup>(3,13,14)</sup>. Also, 30.0% of the elderly people who had fallen once will fall again<sup>(19)</sup>. Age would be related to psychological factors such as depression or anxiety and would cause worse performance in the assessments and would potentiate the events of falls. Studies show that it would also represent 40.0% of deaths from accidental falls from their height (3.23).

The analysis of the DGI-Brazilian brief showed that the results were in line with recent studies<sup>(4,15,21)</sup> which showed that from 30.0% to 40.0% of the elderly people have altered functional balance measured by this protocol and that also highlighted the possibility that the oldest population has a greater risk of falling. The association of the report of previous falls with the DGI-Brazilian brief was non-existent in this study, which disagrees with studies that showed that elderly people who fell present alterations in functional balance and gait<sup>(4,21)</sup>. This finding can be justified by the difficulty and/or imprecision of answers about self-report of previous falls, and the sample is composed of socially active volunteers.

In the performance on the Timed Up and Go, the results obtained were in agreement with other studies<sup>(4,8,15,21)</sup> that revealed changes in a dynamic balance between 60.0 and 80.0% in elderly people in the community. This percentage may exceed 90.0% when institutionalized elderly people are evaluated<sup>(24)</sup>. Research has pointed out the relationship between longer time spent on the test, suggestive of impaired dynamic balance, with reports of falls and age<sup>(4,15)</sup>. The findings presented did not show an association with the report of previous falls; however, the oldest had a higher prevalence of falls, which was observed in other studies<sup>(4,15,21)</sup>.

Despite the poor performance of the DGI-Brazilian brief to indicate risks of falls in the population assisted, we observed that when added to the TUG, we identified an important percentage of this sample and included it in the intervention program. Despite the weak but significant correlation between the two tests, other studies<sup>(4,12)</sup> highlighted the importance of using more than one instrument to assess the risk of an elderly person falling. We also highlight the use of TUG as a screening tool to early identify the Frailty Syndrome, to enable the planning of interventions, and prevention of functional decline<sup>(6)</sup>, as this can be positively associated with vulnerability<sup>(24)</sup>.

Despite the limits of analysis of the results of the tests and variables studied, we highlight that a single causal factor is not able to predict events of falls because others correlate with each other or with others, in addition to age or gender, as indicated by other references<sup>(5,6,18,20,21)</sup>.

As shown in Table 2, the performance on both tests in the pre- and post-intervention period was modified. In the DGI, there was an increase in the final score, reaching the maximum in some cases, and in the TUG, there was a decrease in the time spent to perform the test, which demonstrated that there was an improvement in the functional condition. Therefore, there was a decrease in the risk of falls, indicating that the fall prevention program was effective.

The significant correlations found between performance before and after the intervention program corroborate the results of clinical trials from other studies<sup>(4,12,15,25)</sup> that concluded the effectiveness of the exercises of Cawthorne and Cooksey in preventing falls in elderly people. The use of other resources such as multisensory exercises, lower limb strengthening programs, Tai Chi, and dance have also been reported<sup>(2,9,26-29)</sup> as strategies to improve functional balance, mobility, and gait, being good mechanisms to be explored for actions aimed at healthy aging.

We highlight that actions that include the practice of exercise can be effective in advising on health in the lives of elderly people to reduce the costs of care and health services, and maybe the best way to avoid falls<sup>(30)</sup>. As this study cannot be characterized as a non-randomized clinical trial, it stands out for describing a program that can be included in the practice of healthcare for elderly adults, being innovative in this way. The promising analysis of the results reinforces the proposal to use simple assessment and intervention instruments, according to the principle that, to prevent the recurrence of falls, community prevention programs must be implemented, as there are several risk factors for falls that can be modifiable<sup>(5)</sup>.

The adoption of evaluation resources, simple execution exercises, and easy to implement program suggested here, converge with the thought that the decrease and future fall and balance improvement result from the possibility of these exercises to provide subsidies for new rearrangements of peripheral sensory information organized for the construction of new standards of maintenance of body balance<sup>(25)</sup>.

In this intervention study, we observed an improvement in the results of the reassessment with the same initial protocols, which demonstrated that the promotion and prevention of falls contributed to changing conditions and reducing the risk of falls in the elderly participants evaluated<sup>(4,16,25)</sup>. In this sense, given the growing increase in the elderly population with greater susceptibility to falling risks<sup>(1, 4-6,9,15)</sup>, multidisciplinary actions, including speech-language therapy, should maximize the quality of life of the elderly population<sup>(5,10,11)</sup>.

## CONCLUSION

We concluded that the intervention was effective, as it reduced the risk of falls and improved gait performance and functional and dynamic balance.

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## Author contributions

CKT participated in the project implementation, monitoring, selection of volunteers, data collection, tabulation and analysis, and final writing of the article; BCLM performed the data analysis, supervision of the text, and collaboration in the final writing of the article; LSS, RVSS, and JPT participated in the review, tabulation, and analysis of the data; ARS participated in sample selection and statistical analysis.