Fluency and reading comprehension in students with and without stuttering

Fluência e compreensão da leitura em escolares com e sem gagueira

Juliana Sandoval Pinto[1] iD
Luana Altran Picoloto[1] iD
Simone Aparecida Capellini[2] iD
Talissa Almeida Palharini[1] iD
Cristiane Moço Canhetti de Oliveira[1,2] iD

ABSTRACT

Purpose: To analyze and to compare fluency parameters in spontaneous speech and reading and reading comprehension of school-age children who stutter and who do not stutter. **Methods:** Cross-sectional and prospective study approved by the Research Ethics Committee. Sample consisted of 30 scholars aged 8 and 11 years and 11 months divided into two groups: Study Group with 15 school-age children who stutter, Control Group with 15 school-age children who do not stutter. Participants underwent fluency evaluation of spontaneous speech, reading of expository and narrative texts, and reading comprehension evaluation. Inferential statistical analysis was conducted using the Mann-Whitney tests and correlation analysis was conducted using the Spearman's Coefficient test. **Results:** The comparison between the fluency parameters indicated that school-age children who stutter showed a greater amount of stuttering-like disfluencies, while school-age children who do not stutter showed longer flows of syllables and words per minute, in spontaneous speech and reading. Regarding reading comprehension, school-age children who stutter had lower performance than school-age children who do not stutter in both texts. There was no association between the frequency of disfluencies and reading comprehension in school-age children who stutter and who do not stutter. **Conclusion:** School-age children who stutter showed impairments in reading comprehension when compared to fluent, since there was no association between the frequencies of disfluencies with reading comprehension for both groups. It is suggested that reading comprehension be evaluated and, if necessary, improved in order to reduce the consequences of stuttering and provide learning of this school-age children.

RESUMO

Objetivo: Analisar e comparar os parâmetros da fluência na fala espontânea e leitura a compreensão de leitura de escolares que gaguejam com fluentes. **Método:** Estudo transversal e prospectivo aprovado pelo Comitê de Ética da Instituição. Amostra composta por 30 escolares com idade entre 8 e 11 anos e 11 meses divididos em dois grupos: Grupo Pesquisa com 15 escolares com gagueira, Grupo Controle com 15 escolares fluentes. Os participantes foram submetidos à avaliação da fluência da fala espontânea, leitura dos textos expositivo e narrativo, e avaliação da compreensão de leitura. A análise estatística inferencial foi realizada por meio dos testes de Mann-Whitney e para análise de correlação foi utilizado o teste de Coeficiente de Spearman. **Resultados:** A comparação entre os parâmetros da fluência indicou que escolares com gagueira manifestaram maior quantidade de disfluências típicas da gagueira, enquanto os fluentes mostraram maiores fluxos de sílabas e de palavras por minuto, na fala espontânea e na leitura. Em relação à compreensão de leitura, escolares com gagueira apresentaram desempenho inferior ao fluentes, em ambos os textos. Não houve associação entre a frequência de disfluências e compreensão de leitura, nos escolares com e sem gagueira. **Conclusão:** Escolares com gagueira apresentaram prejuízos quanto à compreensão de leitura quando comparados à fluentes, porém não houve associação entre a frequência de disfluências com a compreensão de leitura em ambos os grupos. Sugere-se que a compreensão da leitura seja avaliada e se necessário trabalhada a fim de reduzir as consequências da gagueira e favorecer aprendizagem deste escolar.

Correspondence address:
Cristiane Moço Canhetti de Oliveira
Universidade Estadual Paulista "Júlio de Mesquita Filho" – UNESP
Av. Hygino Muzzi Filho, 737, Vila Universitária, Marília (SP), Brasil,
CEP: 17525-000.
E-mail:
cristiane.canhetti-oliveira@unesp.br

INTRODUCTION

Stuttering is conceived as a neurodevelopmental disorder that affects the speech timing with a neurobiological bases, with disfluencies as primary clinical manifestations. However, muscular tensions, negative feelings and attitudes towards speech are also reported less frequently, thus being characterized as a multidimensional condition. In this sense, stuttering can limit students' ability to communicate and their participation in daily activities[1]. Furthermore, the general population's lack of understanding leads to stereotypes, stigmas and discrimination against people who stutter[2]. A study conducted in public and private schools in Brazil showed that, although early childhood education professionals had some knowledge about stuttering, it was not enough for them to be able to differentiate stuttering from other language disorders[3].

Given that the onset of stuttering occurs mainly up to the age of four, a student who stutters has lived with the disorder for years, and commonly has a perception of disfluencies[4]. Due to the importance of communication in the school and social environment, there is a greater negative impact on the experience of individuals who stutter during school years[5]. Therefore, these individuals may stop talking or participate less in social contexts[6]. Other studies have also reported that impairments in the social domain and in routine communicational situations are characteristics of the social ability of individuals who stutter[7].

In addition, although reading is highly valued and used in the school environment as an important learning tool, students with stuttering showed a greater amount of stuttering-like disfluencies and the total of disfluencies when compared to students without stuttering during reading activities[8]. Therefore, the authors reported that stuttering also has an impact on reading, albeit to a lesser extent than spontaneous speech. It is also known that tasks involving greater motor and melodic complexity, such as the self-expressive speech task, impair speech fluency[9].

In this context, students with communication disorders may have negative attitudes towards their own speech and, as a consequence, they may decrease their participation in oral reading activities, thus hindering their development of this skill[10].

Reading comprehension is a complex cognitive activity that integrates different forms of processing, including decoding and oral language comprehension skills[11]. There is evidence that the better the reading fluency, the greater the level of understanding[12,13].

In turn, comprehension abilities are divided into two levels, lower and upper. Decoding, vocabulary and oral language skills are located at the lower level, while strategies for reading comprehension and monitoring are at the upper level[14].

As an important step towards efficient word recognition, decoding is understood as the ability to convert graphemes into their respective phonemes, or the ability to integrate visual and phonological processing. Efficient decoding allows the conversion of a visual representation (from written material), allowing access to the mental lexicon and leading to the retrieval of orthographic, phonological and semantic information[15,16].

Decoding is also essential for a new set of skills, which are interconnected and increasingly complex, culminating in deep text processing, as it requires the acquisition and coordination of several essential skills, which operate below the word level, and require processing of phonemes in words, letter recognition and grapheme-phoneme association[15,16].

Therefore, reading is a complex task that requires the integration of skills involving language, attention, auditory memory, visual memory, word identification, structural and contextual analysis of the language, logical synthesis and vocabulary expansion[17]. Reading becomes fluent with the development of reading skills[18] and the integration of these skills and fluent reading are necessary for reading comprehension[12].

The investigation of reading comprehension in individuals who stutter is essential in order to investigate the impact of stuttering on learning. Investigating whether this population is at greater risk of having difficulty reading comprehension in relation to the population who does not stutter will contribute to the work of speech-language pathologists, who, in addition to promoting fluency, work to improve the social adjustment of students who stutter.

Therefore, this study aimed to analyze and compare the parameters of fluency in spontaneous speech and reading and the reading comprehension of students who stutter with fluent students.

METHODS

This is an observational, cross-sectional and prospective study with comparison between groups, which was approved by the Research Ethics Committee under Opinion no. 3.423.012. All ethical criteria were met according to regulations of the Conselho Nacional de Ética em Pesquisa (CONEP), including the signing of an Informed Consent Form (ICF).

Participants

The study consisted of a Study Group (SG) and a Control Group (CG), including students aged between 8 years and 11 years and 11 months (mean age of 8.93±1.03 months in the SG; and mean age of 9.27±1.16 in the CG; p=0.421), of both genders. As a convenience sample, the groups were matched by age group, ranging up to six months. The study group (SG) consisted of 15 students with stuttering, all male, from the Laboratório de Estudos da Fluência (LAEF), which is linked to a Clinical School of the School of Philosophy and Sciences (FFC-UNESP). In turn, the control group (CG) consisted of 15 students without stuttering, 7 male and 8 female, recruited from the local community.

Inclusion and exclusion criteria were defined for the selection of participants. The study included native Brazilian Portuguese-speaking students, chronologically aged between 8 and 11 years and 11 months, from the 3rd to the 5th grade of Elementary School with a satisfactory academic performance, as referred by the teachers. Specifically for the Study Group,

students should also be diagnosed with persistent developmental stuttering by a specialist professional, with a minimum of 3% of stuttering-like disfluencies, and a minimum score of 11 points (from 7 to 16 years and 11 months) in the Stuttering Severity Instrument (SSI-3[19]).

In turn, to participate in the control group, the student could not have a current or previous complaint of stuttering or cluttering.

The exclusion criteria for both groups were as follows: history of school failure, students without sensory, motor or cognitive impairment, no complaints, referral or care in place for speech, psychological or neurological demands, for diagnosed conditions that could impact results.

Materials and procedures

Data collection for both groups was carried out in a quiet laboratory at a school clinic. Students in both groups interacted with the researcher and all procedures were performed in a single session, with an average duration of 30 minutes, recorded on a video camera for later transcription.

The procedures included an assessment of fluency in spontaneous speech, reading of expository ("*O piolho*") and narrative ("*O guarda-chuva*") texts, and assessment of reading comprehension.

In order to assess the students' fluency, the researchers performed audiovisual records of the spontaneous speech sample with 200 fluent syllables and readings of the expository and narrative texts, using a Sony HDR-CX350 digital camera and a Omega Atek tripod.

The speech and reading samples were transcribed in full, using a computer and supra-aural headphones, considering a total of 200 fluent syllables. Disfluencies were recorded and coded in the text using a specific protocol used at the institution. Subsequently, the study carried out the analysis and characterization of the typology of disfluencies, according to the following description: Stuttering-like disfluencies (SLD): block, prolongation, pause, intrusion, sound repetition, syllable repetition and word repetition - up to three; Other disfluencies (OD): interjection, hesitation, revision, incomplete word, phrase repetition and word repetition - up to two[20,21].

The following measures were used to determine the frequency of disfluencies: percentage of stuttering-like disfluencies (SLD), other disfluencies (OD) and total disfluencies (TD, as the sum of SLD and OD). Then, the total number of occurrences of the typologies was added to the sample, multiplied by 100 and divided by 200, which corresponds to the total of fluent syllables, in order to calculate the percentage of each of the measures mentioned above.

As internationally recognized by the scientific community in the speech-language pathology diagnosis of the disorder, this study adopted the presence of at least 3% of stuttering-like disfluencies as a criterion[22].

The Reading Comprehension Assessment (RCA)[14] was used to investigate reading comprehension. The reading comprehension procedure of the protocol consists of questions of micro and macrostructures, based on the mental representation model of understanding to assess comprehension through eight multiple choice questions.

In addition, the Stuttering Severity Instrument (SSI-3)[19] was used to investigate the severity of stuttering, which aims to classify the severity of the disorder as very mild, mild, moderate, severe and very severe. The instrument was applied according to the instructions provided in the manual and the analysis investigated the percentage of stuttering-like disfluencies (SLD), the average duration of the three main SLD and the physical concomitants.

Statistical analysis

The data were entered into a database using an Excel 2013 spreadsheet and were later analyzed using the STATISTIC 7.0 software. Inferential analysis was performed using the Mann-Whitney U test to compare the performance of participants in both groups, SG and CG (intergroup analysis). Then the Spearman's rank correlation coefficient was used to analyze the correlation for variables with non-parametric distributions. A significance level of $p < 0.050$ was adopted, and the significant results were marked with an asterisk.

RESULTS

The intergroup analysis in spontaneous speech showed differences between the SG and the CG in all fluency parameters. The SG showed a higher frequency of stuttering-like disfluencies (SLD), other disfluencies (OD) and total disfluencies (TD). On the other hand, the speech rate was higher in the CG, in the flow of syllables and words per minute (SPM and WPM) (Table 1).

The comparison of fluency parameters when reading both texts, expository and narrative, showed that the SG had a higher occurrence of stuttering-like disfluencies (SLD), while the CG had higher flows of syllables and words per minute (Table 2). The SG also showed a higher frequency of total disfluencies (TD) in the narrative text compared to the CG.

Regarding the reading comprehension of the two texts, the CG had a better reading comprehension in both texts when compared to the SG (Table 3).

Table 4 shows the association between the speech rate and reading comprehension of the SG and the CG for both texts. It can be noted that the flows of syllables and words per minute had no significant association with reading comprehension.

Table 5 also shows that there was no association between the stuttering-like disfluencies, the total disfluencies and the reading comprehension of the SG and CG for the two texts.

Figures 1 and 2 show the average values of percentage of stuttering-like disfluencies, total disfluencies and the number of correct marks by participants in both groups, distributed by chronological age (8, 9, 10 and 11 years of age). With the exception of the 10-year group for the narrative text, in both texts the SG had a lower number of correct marks regarding the comprehension of the texts when compared to the CG.

Table 1. Intergroup comparison regarding frequency of disfluencies and speech rate in spontaneous speech

	Study Group				Control Group				p-value
	Mean	SD	Minimum	Maximum	Mean	SD	Minimum	Maximum	
SLD	18.33	8.76	6.00	32.00	1.00	0.76	0.00	2.00	**0.000***
OD	12.73	8.00	2.00	34.00	5.47	3.11	0.00	10.00	**0.002***
TD	31.07	15.62	12.00	66.00	6.47	3.16	1.00	11.00	**0.000***
SPM	146.17	54.48	72.24	279.06	219.82	45.66	150.00	286.00	**0.001***
WPM	86.90	32.02	58.36	165.00	114.11	39.63	14.00	170.45	**0.008***

*Mann-Whitney U test;*p-value<0.05 statistically significant
Caption: SD = standard deviation; SLD = stuttering-like disfluencies; OD = other disfluencies; TD = total disfluencies; SPM = syllables per minute; WPM = words per minute. Source: Prepared by the author

Table 2. Intergroup comparison regarding frequency of disfluencies and speech rate when reading expository and narrative texts

Texts	Variables	Study Group				Control Group				p-value
		Mean	SD	Minimum	Maximum	Mean	SD	Minimum	Maximum	
Expository text	**SLD**	6.93	6.32	0.00	22.00	1.27	1.39	0.00	4.00	**0.002***
	OD	5.13	4.41	0.00	16.00	4.53	3.54	0.00	12.00	0.818
	TD	11.40	8.72	2.00	31.00	5.80	4.20	0.00	14.00	0.058
	SPM	157.02	58.43	56.87	240.00	221.15	69.76	113.20	342.85	**0.021***
	WPM	73.96	25.96	27.86	108.46	105.57	32.72	55.29	162.85	**0.015***
Narrative text	**SLD**	6.27	4.37	1.00	17.00	0.47	0.74	0.00	2.00	**0.000***
	OD	5.67	5.90	1.00	29.00	3.93	2.37	0.00	8.00	0.801
	TD	11.80	8.06	2.00	30.00	4.40	2.64	0.00	10.00	**0.001***
	SPM	152.68	57.08	41.23	235.29	228.73	64.87	131.86	363.63	**0.005***
	WPM	81.35	30.13	23.09	128.23	123.01	34.74	71.86	196.06	**0.004***

*Mann-Whitney U test;*p-value<0.05 statistically significant
Caption: SD = standard deviation; SLD = stuttering-like disfluencies; OD = other disfluencies; TD = total disfluencies; SPM = syllables per minute; WPM = words per minute. Source: Prepared by the author

Table 3. Intergroup comparison of reading comprehension of expository and narrative texts

Correct marks in texts	Study Group				Control Group				p-value
	Mean	SD	Minimum	Maximum	Mean	SD	Minimum	Maximum	
Expository	4.07	1.91	1.00	8.00	6.20	1.32	4.00	8.00	**0.003***
Narrative	3.73	2.09	1.00	7.00	6.00	1.31	4.00	8.00	**0.004***

*Mann-Whitney U test;*p-value<0.05 statistically significant
Caption: SD = standard deviation. Source: Prepared by the author

Table 4. Association between speech rate and reading comprehension of expository and narrative texts in groups

GROUPS	Variables	Correlation coefficient (r)	p-value
Study Group	SPM × Correct marks in expository text	0.030	0.916
	WPM × Correct marks in expository text	0.087	0.758
	SPM × Correct marks in narrative text	0.468	0.079
	WPM × Correct marks in narrative text	0.512	0.051
Control Group	SPM × Correct marks in expository text	0.349	0.202
	WPM × Correct marks in expository text	0.325	0.238
	SPM × Correct marks in narrative text	0.178	0.527
	WPM × Correct marks in narrative text	0.155	0.580

Spearman's rank correlation coefficient
Caption: SPM = syllables per minute; WPM = words per minute. Source: Prepared by the author

Table 5. Association between SLD, TD and reading comprehension of expository and narrative texts in groups

GROUPS	Variables	Correlation coefficient (r)	p-value
Study Group	SLD × Correct marks in expository text	-0.340	0.215
	TD × Correct marks in expository text	-0.244	0.382
	SLD × Correct marks in narrative text	-0.275	0.320
	TD × Correct marks in narrative text	-0.321	0.243
Control Group	SLD × Correct marks in expository text	-0.314	0.254
	TD × Correct marks in expository text	-0.086	0.760
	SLD × Correct marks in narrative text	0.185	0.509
	TD × Correct marks in narrative text	0.122	0.664

Spearman's rank correlation coefficient
Caption: SLD =stuttering-like disfluencies; TD = total disfluencies. Source: Prepared by the author
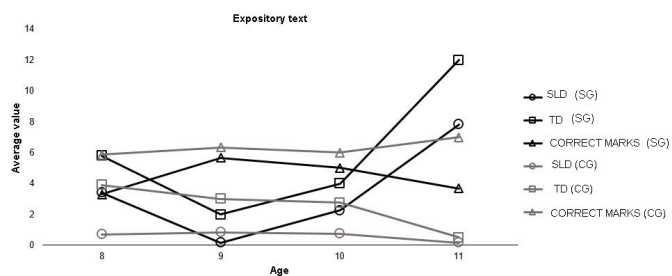
Figure 1. Comparison of the means of stuttering-like disfluencies, total disfluencies, and correct marks in expository text of study group and control group, according to age

Caption: SLD = stuttering-like disfluencies; TD = total disfluencies; SG = study group; CG = control group
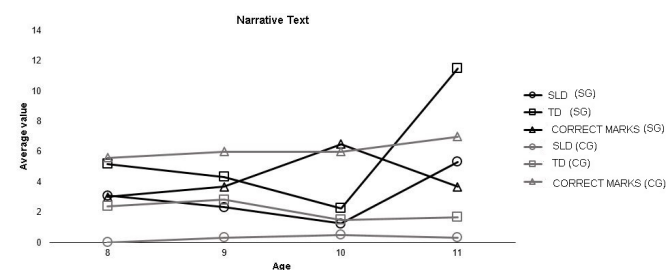

Figure 2. Comparison of the means of stuttering-like disfluencies, total disfluencies, and correct marks in narrative text of study group and control group, according to age

Caption: SLD = stuttering-like disfluencies; TD = total disfluencies; SG = study group; CG = control group

DISCUSSION

The literature shows the relevance of speech-language pathology intervention in stuttering in order to mitigate the impact of the disorder on the individual's life, especially among students[1,5]. Among the negative impacts of stuttering on this population, there are issues related to learning, such as reading comprehension. There is evidence that the better the reading fluency, the greater the level of understanding[12,13]. According to the theory of automaticity in reading[23], proficient word decoding occurs when readers are able to go beyond conscious decoding to automatic decoding, without errors. This means that it must be accurate, favoring reading comprehension and showing an important relationship between fluency and reading rate with the reader's understanding. However, no investigations were found in the literature regarding reading comprehension in disfluent students. Therefore, this study aimed to analyze and compare the parameters of fluency in spontaneous speech and reading and the reading comprehension of students who stutter with fluent students.

Regarding the parameters of fluency in spontaneous speech, there was a statistical difference between the groups, whether due to the frequency of disfluencies, or to the flows of syllables and words per minute. These findings are in line with a previous study that showed that stuttering-like disfluencies and other disfluencies are reported more frequently in individuals who stutter when compared to fluent individuals, as these manifestations are essential characteristics of the disorder[24]. In addition, the disfluencies in the speech flow of individuals who stutter lead to a reduction in the speech rate[25].

Thus, the results obtained in the control group are in line with findings in the literature reporting that individuals without stuttering had a lower frequency of disfluencies and a greater flow of words and syllables per minute when compared to individuals who stutter[6,8].

The reading results were similar in both texts, with the SG showing a higher frequency of disfluencies, and a lower reading rate when compared to the CG. These data are also in line with the literature that reports that stuttering individuals have lower values of speech rate, as well as a greater occurrence of disfluencies during oral reading when compared to fluent individuals[20].

Regarding the findings on reading comprehension, the students in the SG had losses in this ability for both texts. In turn, this finding corroborated a study that showed that variations in reading fluency played an important role in reading comprehension[26]. In addition, it is believed that the reduced reading rate of students who stutter may have contributed to this result, since Colombo and Cárnio[27] reported that the reading rate contributes to the understanding of the information read. The SG also had higher values of standard deviation compared to the CG, reinforcing the variability in the responses of reading comprehension. Since factors such as neurological, psychological, emotional and attentional conditions had greater variation among students who stutter, this may explain the impact on this variability in the results of reading comprehension by increasing their standard deviation.

The results obtained by the CG agree with previous studies that showed that reading fluency is significantly related to the reading comprehension ability, and that the higher the reading fluency, the better the level of comprehension[26].

This study found no association between the flow of words and syllables per minute and reading comprehension in the two groups investigated, which is in line with the results obtained in an investigation with Italian students who did not stutter[28]. However, there are studies in the literature proving the relationship between word flows and syllables per minute with reading comprehension[12,29].

This diversity of findings regarding the significant relationship between speech rate and reading comprehension in students who stutter may have occurred for two reasons: (1) the diversity regarding the degrees of stuttering severity, as showed by the SG; (2) the sample size, since there is a statistical tendency (p=0.051) for an association between the flow of information (number of words per minute) with the understanding of the reading of the narrative text. The data show a potential positive relationship between the variables, suggesting that the greater the flow of words per minute, the greater the number of correct marks in the narrative text. In this sense, the therapeutic plan of students who stutter should investigate the objective of increasing the flow of words read per minute, in addition to the conventional objective of increasing the flow of information in spontaneous speech. This type of approach may prevent difficulties in reading comprehension in this population.

The analysis of the association between speech rate and reading comprehension and frequency of disfluencies and reading comprehension suggests that the flows of syllables and words per minute have a greater influence on the comprehension of the text when compared to the frequency of disfluencies. This is a relevant finding with clinical implications that should be highlighted. In clinical practice with the population of students who stutter, the work of promoting fluency in reading is not always valued. Given that the literature has a broad theoretical foundation regarding the impairment of the disorder in oral communication, some professionals tend to focus on spontaneous speech in therapy. These theoretical bases include protocols or tests to assess fluency that prioritize spontaneous speech, and do not highlight the need to also evaluate this student's reading. The complaint of family members who generally want to improve fluency in spontaneous speech may also impact therapy, since this speech sample is used more frequently in social relationships, exposing the student to embarrassing situations.

Although no significant association between reading fluency and reading comprehension was found in this study, the comparison of students with and without stuttering showed that the disorder impaired reading comprehension. Therefore, this study was a pioneer in showing a new negative impact of stuttering on the life of the student who stutters, which was the lower reading comprehension when compared to fluent students. The losses were reported both in the reading of expository and narrative texts.

It should be noted the difference in the correct answer curves for reading comprehension between students who stutter and fluent students. In this sense, the CG had an upward curve, thus showing an improvement over the years, while the SG had a different curve, with a clear distinction in the performance of 11-year-old students. Further studies with a larger group of participants by age group should be conducted in order to investigate similarities and distinctions between the performance of students who stutter and fluent students.

In addition to all the impacts on communication and participation in activities of daily living and in social contexts[1,6,7], the results obtained show that students who stutter commonly also have impacts on educational fields[30], such as reading comprehension.

Therefore, the academic environment is challenging for people who stutter due to the speech difficulties inherent to the disorder and the social demand of classmates. The difficulty in promptly starting a speech is one of the obstacles of students who stutter, and this incompatibility between the desire to speak and the momentary inability to produce the words leads to anxiety, frustration and fear.

Finally, this study contributes to clinical practice by emphasizing the importance of considering reading comprehension difficulties as another impact of stuttering. In this sense, this study suggests an evaluation and possible treatment of reading comprehension, in addition to the evaluation of reading fluency, in order to reduce the consequences of stuttering and favor the learning process of these students.

CONCLUSION

The analysis of the fluency parameters of students with and without stuttering showed different behaviors in spontaneous speech and in reading regarding the frequency of stuttering-like disfluencies and speech rate.

The comparison of the reading comprehension performance of students who stutter with fluent students showed that students who stuttered had lower performance in the expository and narrative texts. However, no association was found between the frequency of disfluencies with reading comprehension in both groups.

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Author contributions

JSP study design and collection, sample selection and diagnosis of cases, data analysis and tabulation and article writing; LAP sample selection and diagnosis of cases, data analysis and tabulation and article writing; SAC data analysis and article writing; TAP data analysis and tabulation, and article writing; CMCO study conception and design, discussion of findings and general guidance of the stages and preparation of the study, as professor adviser.