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RESEARCH ARTICLE (ORIGINAL)

Nursing students' knowledge about basic life support

Conhecimentos dos estudantes de enfermagem sobre suporte básico de vida
Conocimiento de estudiantes de enfermería sobre soporte vital básico

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Abstract
Background: Knowledge about basic life support (BLS) in nursing students involves both technical skills (compressions and ventilations) and non-technical skills (clinical judgment and decision-making).
Objectives: To assess nursing students' sociodemographic and academic characteristics; to assess nursing students' theoretical knowledge about BLS and analyze the association between nursing students' sociodemographic and academic characteristics and their theoretical knowledge about BLS.
Methodology: Observational, descriptive, and correlational study with a sample of 496 nursing students selected using a nonprobability convenience sampling technique in two schools in the central region of Portugal.
Results: Students demonstrated a good level of knowledge about BLS, with an average of 30.93 ± 2.29 on a scale from 0 to 37 points. They had a very good level of knowledge about safety conditions, the technical components of airway assessment, chest compressions, and ventilations. The level of knowledge is associated with age, year of undergraduate studies, and practical experience in BLS.
Conclusion: Students have a good level of knowledge about BLS.

Keywords: knowledge; education, nursing; students, nursing; cardiopulmonary resuscitation

Resumo
Enquadramento: Os conhecimentos sobre suporte básico de vida (SBV) em estudantes de enfermagem requerem competências técnicas (compressões e ventilações), mas também competências não técnicas (julgamento clínico e tomada de decisão).
Objetivos: Avaliar as características sociodemográficas e académicas dos estudantes de enfermagem; avaliar os conhecimentos teóricos sobre SBV dos estudantes de enfermagem e relacionar as características sociodemográficas e académicas dos estudantes de enfermagem, com os seus conhecimentos teóricos sobre SBV.
Metodologia: Estudo observacional, descritivo e correlacional, onde participaram 496 estudantes, selecionados através de uma técnica de amostragem não probabilística por conveniência em duas escolas do centro de Portugal.
Resultados: Os estudantes evidenciam um bom nível de conhecimentos sobre SBV com uma média de 30,93 ± 2,29, numa escala de 0 a 37 pontos. Destacam-se muito bons conhecimentos sobre as condições de segurança, assim como das componentes técnicas de avaliação da via aérea, das compressões torácicas e ventilações. O nível de conhecimentos está relacionado com a idade, ano de licenciatura e experiência prática de SBV.
Conclusão: Os estudantes apresentam um bom nível de conhecimentos sobre SBV.

Palavras-chave: conhecimento; educação em enfermagem; estudantes de enfermagem; reanimação cardiopulmonar

Resumen
Marco contextual: Los conocimientos sobre el soporte vital básico (SVB) en los estudiantes de enfermería requieren competencias técnicas (compresiones y ventilaciones), pero también competencias no técnicas (juicio clínico y toma de decisiones).
Objetivos: Evaluar las características sociodemográficas y académicas de los estudiantes de enfermería; evaluar los conocimientos teóricos de los estudiantes de enfermería sobre el SVB, y relacionar las características sociodemográficas y académicas de los estudiantes de enfermería con sus conocimientos teóricos sobre el SVB.
Metodología: Estudio observacional, descriptivo y correlacional, con la participación de 496 estudiantes, seleccionados mediante una técnica de muestreo no probabilístico por conveniencia en dos escuelas del centro de Portugal.
Resultados: Los estudiantes mostraron un buen nivel de conocimiento sobre el SVB, con una media de 30,93 ± 2,29 en una escala de 0 a 37 puntos. Destaca un muy buen conocimiento de las condiciones de seguridad, así como de los componentes técnicos de la evaluación de las vías respiratorias, las compresiones torácicas y las ventilaciones. El nivel de conocimiento está relacionado con la edad, el año de graduación y la experiencia práctica en SVB.
Conclusión: Los estudiantes tienen un buen nivel de conocimiento sobre el SVB.

Palabras clave: conocimiento; educación en enfermería; estudiantes de enfermería; reanimación cardiopulmonar

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Introduction

Nursing care is a very demanding activity. For this reason, the innovative teaching methodology is one of the most applied, using clinical simulation, which can foster interaction between the students' previous knowledge and the new knowledge acquired, leading to greater cognitive stability (Kim et al., 2016).
Through clinical simulation, which is often used in basic life support (BLS), nursing students consolidate and apply their theoretical knowledge into clinical practice, strengthening their technical skills (e.g., compressions and ventilations) and their non-technical skills (clinical reasoning, critical thinking, and clinical judgment; Erlam et al., 2017; Kappes-Ramirez, 2018; Kim & Ahn, 2019; Woda et al., 2017).
Considering that nurses are often the first professional group to identify a situation of cardiopulmonary arrest (CPA), the following aspect should be explored: What is the level of theoretical knowledge about BLS of nursing students in the central region of Portugal? Based on this research question, the following objectives were outlined: To assess nursing students' sociodemographic and academic characteristics; to assess nursing students' theoretical knowledge about BLS and analyze the association between nursing students' sociodemographic and academic characteristics and their theoretical knowledge about BLS.

Background

CPA is characterized by the sudden cessation of cardiac activity and has become one of the leading causes of death in the Western world (Suárez et al., 2019). This situation is confirmed by the lack of a palpable pulse, loss of consciousness, and absence of spontaneous ventilation (Cunha, 2015; Lima et al., 2020; Morais et al., 2019). Once this situation is detected, cardiopulmonary resuscitation maneuvers (BLS) should start as early as possible. These maneuvers involve chest compressions and ventilations in the person with CPA to restore blood circulation and breathing artificially. Only an effectively performed BLS algorithm increases the probability of survival (Cunha, 2015; Morais et al., 2019). According to Cunha (2015) and Morais et al. (2019), without BLS maneuvers, the probability of survival after CPA decreases to 11% 6 minutes after the absence of cardiac activity and spontaneous breathing. Therefore, CPA is an emergency that requires immediate intervention from a trained, coordinated health team with clinical reasoning and consolidated theoretical and practical knowledge (Lima et al., 2020). For this reason, BLS training is a constant need among nursing students - future professionals - to improve their performance. According to Hernández-Padilla et al. (2015) and Partiprajak and Thongpo (2016), the hospital nursing team is the first professional group to identify CPA in a patient. Thus, CPA recognition, activation of the in-hospital emergency team, and a safe and effective application of the BLS algorithm are essential (Partiprajak & Thongpo, 2016).
A study conducted in Thailand on the evolution of nursing students' knowledge before, after, and 3 months after BLS training found an increase in knowledge immediately after training. However, 3 months later, the acquired knowledge decreased again, although to a higher value than that obtained in the first moment (before: 15.270 ± 0.460; after: 22.970 ± 0.280; 3 months after: 18.270 ± 0.380; Partiprajak & Thongpo, 2016).
These data are in line with those obtained in a European study, where the authors found an increase in nursing students' cognitive knowledge about BLS between pre-test and post-test. These results were found regardless of whether in one of the groups the training was coordinated by students and in the other group it was coordinated by teachers. However, cognitive knowledge decreased significantly between post-test and the 3-month follow-up in the teacher-directed training group. This analysis supports the need for students to participate actively in the learning process, identifying needs, choosing outcomes, implementing strategies, and reflecting on the new skills acquired, in this case, about BLS (Hernández-Padilla et al., 2015).
In 2015, Cooper et al. also found that nursing students had acquired knowledge and skills about BLS, but in this case using clinical simulation.
Another study developed in Brazil with a group of nurses revealed deficits in the knowledge about BLS related to CPA, specifically in the approach to the victim, the identification of defibrillable rhythms, the rate of compressions per minute, and the depth of chest compressions (Lima et al., 2020).
Considering that the nursing team's solid knowledge about BLS contributes to an efficient performance in a CPA situation, nursing students' level of knowledge on this topic should be analyzed.

Research question and hypotheses

What is the level of theoretical knowledge about BLS of nursing students in the central region of Portugal?
There is a positive and significant correlation between nursing students' level of theoretical knowledge about BLS and their age; and There are significant differences between nursing students' level of theoretical knowledge about BLS and their year of undergraduate studies, clinical rotation, clinical experience, real-life experience in BLS, and certified training in BLS.

Methodology

This observational, descriptive, and correlational study was conducted with a sample of 496 nursing students selected through a nonprobability convenience sampling technique, in an extracurricular moment disseminated by the program directors and coordinators of two schools in the central region of Portugal. The inclusion criterion was having had theoretical training on BLS prior to completing the questionnaire, so first-year students were not included because they did not meet this criterion at the time of data collection.

The questionnaire was applied in a classroom in each of the schools, with all participants present. It consisted of short open-ended and closed-ended questions about nursing students' sociodemographic and academic characteristics: age, gender, year of undergraduate studies, previous clinical rotations, clinical rotation site, clinical experience (as medical assistants, operational assistants, firefighters), real-life experience in BLS, certified training in BLS). It also included 37 closed-ended questions (true/false) to assess nursing students' knowledge about BLS, based on a public instrument (scores ranging from 0 to 37 points) and the latest guidelines on BLS (Dixe & Gomes, 2015; Perkins et al., 2015).

The study was approved by the Ethics Committee of the Health Sciences Research Unit: Nursing (UICISA: E) of the Nursing School of Coimbra (Opinion No. P625-11/2019) and the heads of both schools. All participants gave their informed consent after being informed that the study would not interfere with their curricular evaluations. Furthermore, data confidentiality and anonymity were ensured.

Data were processed using IBM SPSS Statistics software, version 26.0, and analyzed using descriptive and inferential statistics. Concerning inferential analysis, parametric tests were used (Student's *t*-test and Pearson's correlation coefficient) if sample size was equal to or greater than 30, and non-parametric tests (Mann-Whitney's *U*-test) were used if sample size was less than 30 (in the case of real-life experience in BLS; Pestana & Gageiro, 2014). A $\alpha = 0.05$ was set as the critical level for statistical significance of the results of the hypothesis tests, rejecting the null hypothesis if the probability of making a Type I error was less than $p < 0.05$.

Results

The 496 participants were aged 19 to 49 years, with a median of 20 years (20.89 ± 3.79); 86.3% were women; 78% attended the 2nd year of the undergraduate nursing program; and 57.9% had never completed a clinical rotation (Table 1).

The reality of clinical experience was represented in the study sample through the participation of 64 nursing students who had already had contact with care delivery as operational assistants, medical assistants, or firefighters. In this sample, 16.1% of participants had certified training in BLS, and 5% had already performed BLS in a person after CPA.

Table 1

Nursing students' academic characteristics and experience in basic life support

Variable	Answers	No.	%
Year of undergraduate studies	2nd Year	387	78
	3rd Year	68	13.7
	4th Year	41	8.3
Clinical Rotation	Yes	209	42.1
	No	287	57.9
Clinical Rotation Site	Medicine	5	1
	Surgery	1	0.2
	Community and Family Health	2	0.4
	SIG	93	18.8
	Medicine, Surgery, Orthopedics, and SIG	67	13.5
	Medicine, Surgery, SCF, SMO, SIP, SIG, SMP, and Intensive Care	21	4.2
	Medicine, Surgery, SCF, SMO, SIP, SIG, SMP, and Emergency	20	4
Clinical Experience	Yes	64	12.9
	No	432	87.1
Real-life experience in BLS	Yes*	25	5
	No	471	95
Certified Training in BLS	Yes	80	16.1
	No	416	83.9

Note. No. = Number of Cases; % = Percentage of Cases; SCF = Family and Community Health; SIG = Elderly Health and Geriatrics; SIP = Infant and Child Health; SMO = Maternal Health and Midwifery; SMP = Mental Health and Psychiatrics; *100% in cardiopulmonary arrest; BLS = Basic Life Support.

Students obtained a median of 31 points (30.93 ± 2.29) in the variable Knowledge about BLS, which allowed scores from 0 to 37 points, with a minimum score of 24 and a maximum score of 37 points.

Concerning the items related to the knowledge about BLS, nursing students had excellent scores (100% and 99.8%, respectively) in the assessment of the safety of the site where the CPA victim is and the correct identification of the moment for assessing this component in the BLS algorithm, namely "Ensure you have safe conditions to approach the victim" and "Evaluate security conditions before approaching a victim" (Items 1.2. and 9.1.; Table 2).

Regarding the items related to the technical component of airway assessment, chest compressions, and effective ventilations, nursing students also had excellent scores (99.2%-99.6%) in the following items: "Check if breathing is normal or abnormal" and "Alternate 30 chest compressions with two effective breaths".

The analysis of the items with a significant percentage of incorrect answers identified one of the stages of the BLS algorithm that should be worked on with nursing students: asking for help before starting chest compressions. The items that recognize this gap are as follows: "Even if you are alone, do not leave the victim"; "If you are alone, leave the victim and go ask for help"; and "Start chest compression immediately".

Table 2

Nursing students' knowledge about basic life support

Questions	Correct Answers		Incorrect Answers	
	N	%	*N*	%
1. Faced with a seemingly unresponsive victim:				
1.1. Try to approach, even if exposed to danger	491	99	5	1
1.2. Ensure you have safe conditions to approach the victim	496	100	0	0
1.3. Check if the victim is responding to stimuli or not (tapping the shoulder or asking if the person is ok)	491	99	5	1
1.4. Stimulate the victim by shaking his/her head	486	98	10	2
2. In case the victim does not respond to stimulation:				
2.1. Place a coat under the victim's head to avoid injuries on the floor	390	78.6	106	21.4
2.2. Check if breathing is normal or abnormal	492	99.2	4	0.8
2.3. Give water with sugar	492	99.2	4	0.8
3. To continue a proper operation one must:				
3.1. Place the victim on the side to avoid choking	240	48.4	256	51.6
3.2. Do extension of the head and/or chin lift	472	95.2	24	4.8
3.3. If the victim is not responding or breathing (or with abnormal breathing), shout for help	378	76.2	118	23.8
3.4. Put a hard object in the mouth to avoid biting the tongue	474	95.6	22	4.4
4. If the victim is breathing:				
4.1. If not a polytrauma, position the victim on the side	485	97.8	11	2.2
4.2. Ask somebody to call 112	455	91.7	41	8.3
4.3. Even if you are alone, do not leave the victim	101	20.4	395	79.6
5. If the victim is not breathing, coughing and there is no movement:				
5.1. Ask somebody to call 112	486	98	10	2
5.2. Give four strong thrusts on the victim's chest to stimulate breathing	482	97.2	14	2.8
5.3. If you are alone, leave the victim and go ask for help	159	32.1	337	67.9
5.4. Put victim on the side	443	89.3	53	10.7
5.5. Start chest compression immediately	75	15.1	421	84.9
6. After checking the victim is not breathing and asking for help, one must:				
6.1. Blow into the victim's mouth, checking if the chest moves	297	59.9	199	40.1
6.2. Wait for the arrival of specialized help	300	60.5	196	39.5
6.3. Observe the victim's mouth again, in case the blow has not been effective	243	49	253	51
6.4. Start chest compressions	466	94	30	6
6.5. Pinch the victim's nostrils with thumb and index finger	270	54.4	226	45.6
7. When performing chest compressions:				
7.1. Do chest compressions with the victim's arms straight	484	97.6	12	2.4
7.2. Place the victim on the side	489	98.6	7	1.4
7.3. Start chest compressions at a rate of 50 per minute	458	92.3	38	7.7
7.4. Compress the chest the largest number of times possible	450	90.7	46	9.3
7.5. High count the number of chest compressions performed	465	93.8	31	6.3
8. When performing cardiopulmonary resuscitation one should:				
8.1. Alternate 30 chest compressions with two effective breaths	494	99.6	2	0.4
8.2. Know how long the victim has being revived	476	96	20	4
8.3. Keep BLS until arrival of specialized aid or the victim recovers signs of circulation	480	96.8	16	3.2
8.4. Alternate 15 chest compressions with two effective breaths (15: 2)	490	98.8	6	1.2
8.5. Suspend cardiopulmonary resuscitation when feeling exhausted	429	86.5	67	13.5
9. Regarding the rescuer's safety:				
9.1. Evaluate security conditions before approaching a victim	495	99.8	1	0.2
9.2. In case of electric shock, immediately grab the victim to keep him/her away from danger	477	96.2	19	3.8
9.3. If the security conditions are not met, do not approach the victim	488	98.4	8	1.6

The correlation between the variable age and the level of knowledge about BLS revealed a statistically significant difference (r = 0.101; $p \leq 0.05$) between both variables. The same situation occurred in the correlation between the level of knowledge about BLS and the variable year of undergraduate studies (F = 6.658; $p \leq 0.001$).
No difference was found between men and women regarding knowledge ($p > 0.05$). However, students who had completed clinical rotations, those who had clinical experience as operational assistants, medical assistants, or firefighters, and those who had certified training in BLS had, on average, better knowledge about BLS, with these differences being statistically significant (Table 3).

Table 3

Correlations between nursing students' knowledge, academic characteristics, and experience in basic life support

	Variable	*Answers*	*M*	*SD*	*t*	*p*
Knowledge	**Gender**	Male	30.57	2.294	1.361	0.174 ^{ns}
		Female	30.98	2.294		
	Clinical Rotation	Yes	31.66	2.243	-6.317	0.000***
		No	30.39	2.187		
	Clinical Experience	Yes	31.67	2.501	-2.806	0.005**
		No	30.81	2.247		
	Certified Training in BLS	Yes	31.63	2.399	-2.999	0.003**
		No	30.79	2.254		

Note. M = Mean; *SD* = Standard deviation; ^{ns} $p > 0.05$ = non-significant difference; * $p \leq 0.05$ = significant difference; ** $p \leq 0.01$ = very significant difference; *** $p \leq 0.001$

Finally, data analysis revealed that students who had experience in performing BLS after a CPA situation had better knowledge about BLS than those who did not have that experience, with this difference being statistically significant (U = 4430.000; p = 0.035).

Discussion

In this study, 86.3% of the sampled 496 nursing students were women, as the majority of the Portuguese population (52.2%; Instituto Nacional de Estatística, 2012). Of all nursing students, 16.1% had certified training in BLS, regardless of the institution or association where they may have received it, which is in line with Dixe and Gomes (2015), who found that 17.8% of participants had undergone BLS training. Analyzing these data, both the nursing students, the majority of whom attended the second year of the undergraduate nursing program at the time of data collection, or the population in general referred to in the previous study, it is observed that there is more than a quarter of the global population do not have certified training in BLS. This is a priority area in terms of the mobilization of theoretical-practical knowledge and efficiency in the prompt response of people involved in BLS, thus there is a greater need for investment than that found in these studies (Charlier et al., 2020; Dixe & Gomes, 2015; Lima et al., 2020).
Concerning the real-life experience in BLS, 5% of nursing students reported having already performed it on a CPA victim. This percentage, although slightly lower, is in line with published data, where 14.6% of participants had already performed BLS, 11.6% of whom to patients after a heart attack and, consequently, CPA (Dixe & Gomes, 2015). Moreover, according to Barata (2017), only 8.3% of participants had already performed BLS in real life.
Concerning nursing students' knowledge about BLS, these results show that students have a high level of knowledge, with an average of 31 out of 37 points, and a minimum of 24 points. Students scored higher in those items related to assessing the safety conditions of the site where the victim is and the correct identification of the moment to perform it in the BLS algorithm. The percentage of correct answers to both of these items – "Ensure you have safe conditions to approach the victim" and "Evaluate security conditions before approaching a victim"– is consistent with the percentages found by Dixe and Gomes (79% and 79.9%, respectively; 2015), although the percentages are slightly higher in this study. The analysis of these results shows that nursing students are well prepared to identify the safety conditions and the moment to assess them. Two other studies also found that students were able to properly assess the safety conditions (Barata, 2017; Santos, 2018).
In addition to the assessment of the safety conditions, the technical component of airway assessment and the performance of effective chest compressions and ventilations showed extremely positive results among nursing students. The following items obtained a percentage of correct answers of 99.2%-99.6%: "Check if breathing is normal or abnormal" and "Alternate 30 chest compressions with two effective breaths". These results are indicators of nursing students' good level of knowledge about the stages

of airway observation, performance of chest compressions, and ventilations in the BLS algorithm. Compared to other studies, an inversion was found concerning the results obtained, with participants revealing a lack of knowledge about the performance, rate, and depth of chest compressions, as well as about the performance of effective ventilations, obtaining only 20.2%-44.4% of correct answers (Charlier et al., 2020; Dixe & Gomes, 2015; Santos, 2018). The results found in another study are in line with those found in this study regarding the good level of knowledge about the performance of chest compressions (Santos, 2019).

As for the items that nursing students need to improve, this study found gaps in the request for help to third parties before starting chest compressions. Dixe and Gomes (2015) also found a lack of knowledge about the step in the BLS algorithm related to getting help, obtaining low percentages of correct answers in the following items: "Even if you are alone do not leave the victim", "If you are alone, leave the victim and go ask for help", and "Start chest compression immediately", with 8.4%, 29%, and 39.6%, respectively. This knowledge gap is more evident in the item related to having to leave the victim if you are alone and cannot ask for help (Dixe & Gomes, 2015). Data from another study show this lack of knowledge about the moment of asking for help, with only 39% of the students doing it so correctly (Charlier et al., 2020). Santos (2018) found opposite results to those found in this study, with 100% of the participants reporting that they would immediately ask for help if the victim was not breathing.

In terms of correlations, the age variable showed statistically significant differences ($p \leq 0.05$) when correlated with nursing students' knowledge about BLS. Based on this information, it can be concluded that older nursing students have a better knowledge about the BLS algorithm. This conclusion can be drawn based on the fact that students have several clinical rotations throughout their undergraduate nursing program, where they are in permanent contact with real-life situations. These data are confirmed by statistically significant differences between knowledge, the year of undergraduate nursing studies ($p \leq 0.001$), the completion of clinical rotations ($p \leq 0.001$), and the clinical experience before their nursing program ($p \leq 0.01$).

The access to certified training in BLS also influenced nursing students' knowledge about BLS ($p \leq 0.01$), which calls for good BLS training during the undergraduate nursing program and strengths the need for continuous training on this topic throughout their academic and professional careers. As a result, students' and nurses' knowledge will increase and their performance in a CPA situation will improve (Dixe & Gomes, 2015; Hernández-Padilla et al., 2015; Partiprajak & Thongpo, 2016). This situation is confirmed in other studies with face-to-face and online training for laypersons that found positive and statistically significant correlations between certified training in BLS and the participants' level of knowledge (Barata, 2017; Santos, 2018; Santos, 2019).

The results of this study also showed that nursing students who performed BLS in people after CPA have more theoretical knowledge about BLS than those who did not perform BLS maneuvers. Based on this information, it can be said that theory complemented by practice results in a good acquisition of theoretical-practical knowledge and, consequently, a better response in a real-life CPA situation. Thus, if nursing students are better prepared to apply their knowledge about BLS, nursing teams will also provide a more efficient response to CPA patients (Hernández-Padilla et al., 2015; Partiprajak & Thongpo, 2016).

The limitations of this study include the nonprobability convenience sampling technique used for data collection and the selection of nursing students from only two higher education institutions.

Conclusion

This study involved undergraduate nursing students, mostly 2nd-year students, and revealed that more than a quarter of the participants do not have certified training in BLS, which is a priority area for investment.

In this sample, where only 5% of the 496 nursing students had already performed BLS on a CPA victim, students demonstrated to possess knowledge about BLS, with an average of 31 out of 37 points and a minimum of 24 points. Based on these results, it can be concluded that these nursing students from two higher education institutions have solid knowledge about BLS.

Nursing students had higher levels of knowledge about the following steps of the BLS algorithm: assessment of the safety conditions; airway assessment; chest compressions; and effective ventilations. Nursing students should improve the step of the BLS algorithm associated with getting help before starting chest compressions.

Based on this study, it can be concluded that nursing students' level of knowledge about BLS is influenced by age, year of undergraduate studies, clinical rotations, clinical experience before entering the nursing undergraduate program, and certified training in BLS.

In terms of implications for clinical practice, this study reveals the need to continue to offer BLS training to nursing students with a view to providing nurses with knowledge and skills to act in a CPA situation. The possibility of all nursing students receiving certified BLS training is viewed as an asset. Nursing students should continue to practice in their clinical rotations or through clinical simulation to consolidate their knowledge about BLS.

Future research should replicate this study with a larger and more representative sample of nursing students in Portugal to characterize BLS training in the undergraduate program and identify training needs.

Author contributions

Conceptualization: Duarte, H. M.
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Methodology Duarte, H. M., Dixe, M. A.
Writing – original draft: Duarte, H. M.
Writing – review & editing: Duarte, H. M., Dixe, M. A.

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