







Measures for the prevention of COVID-19 transmission for prehospital care workers

Medidas de prevenção da transmissão de COVID-19 para profissionais do atendimento pré-hospitalar

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ABSTRACT

Objective: to identify measures to prevent transmission of COVID-19 for prehospital care health care workers. **Methods:** integrative review using LILACS and BDNF databases via the Virtual Health Library, CINAHL, MEDLINE/PubMed, *Web of Science*, EMBASE, Cochrane Library, and SCOPUS. **Results:** eight publications were included that presented recommendations regarding the use of safety equipment by healthcare professionals and ambulance drivers and measures to prevent the risk of infection during invasive airborne procedures in suspected or contaminated COVID-19 patients. **Conclusion:** the preventive measures directed to prehospital care professionals were proper use of personal protective equipment and changes in the management of suspected/contaminated patients by COVID-19 and in invasive procedures or transportation of these patients. In addition, it is essential the cleaning and disinfection of the ambulances and their equipment.

Descriptors: Coronavirus Infections; Transportation of Patients; Personal Protective Equipment; Prehospital Care.

RESUMO

Objetivo: identificar medidas de prevenção da transmissão de COVID-19 para profissionais de saúde do atendimento pré-hospitalar. **Métodos:** revisão integrativa por meio das bases de dados LILACS e BDNF via Biblioteca Virtual em Saúde, CINAHL, MEDLINE/PubMed, *Web of Science*, EMBASE, Cochrane Library e SCOPUS. **Resultados:** foram incluídas oito publicações que apresentaram recomendações referentes ao uso de equipamentos de segurança pelos profissionais de saúde e motoristas de ambulâncias e medidas de prevenção do risco de infecção durante procedimentos aéreos invasivos em pacientes suspeitos ou contaminados de COVID-19. **Conclusão:** as medidas preventivas dirigidas aos profissionais do atendimento pré-hospitalar foram: uso adequado de equipamentos de proteção individual e; mudanças no manejo de pacientes suspeitos/contaminados pelo COVID-19 e em procedimentos invasivos ou no transporte desses pacientes. Além disso, é fundamental a limpeza e desinfecção das ambulâncias e seus equipamentos.

Descritores: Infecções por Coronavírus; Transporte de Pacientes; Equipamentos de Proteção Individual; Assistência Pré-Hospitalar.

Introduction

The pandemic of Coronavirus, Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), causing Coronavirus Disease (COVID-19), has caused impacts on public health and health services operation⁽¹⁾. It should be recalled that the pandemic began in late 2019 in the central region of China, Wuhan city. As of January 19, 2021, 93,956,883 confirmed cases and 2,029,084 deaths have been reported in the six regions of the world⁽²⁾.

The pandemic has required the reorganization of health services in order to assist patients. Among these services, prehospital care stands out, whose teams perform on-site care and patient transport in contexts permeated by unpredictability, the need for speed of care and, in some situations, with precarious working conditions. These characteristics may confer greater risk to professionals during the pandemic of COVID-19⁽³⁾.

In the care of patients infected with COVID-19, prehospital care professionals may be potentially exposed to factors that favor cross-infection due to contact with patients' blood or body fluids, as well as positive patient or professional results⁽⁴⁻⁶⁾. Another likely risk to which individuals are exposed is that infected professionals may contaminate patients. In addition, during epidemics, infected healthcare workers contribute to decreasing the capacity of already overburdened healthcare systems. Therefore, it is important that agencies and/or organizations providing prehospital care have the necessary tools and protocols in place to adjust their capacity to respond to specific scenarios, such as COVID-19⁽⁷⁾.

In the current pandemic of COVID-19, searching for scientific evidence on prevention, transmission control and synthesis of the results through scientific evidence are essential for health establishments, because they promote knowledge about the importance of individual protection⁽¹⁾ through preventive actions and measures in order to minimize the risks to which these professionals are exposed⁽⁸⁾. In prehospital

care, preventive measures are essential in pandemics, because professionals are often unaware of the clinical picture of the patient being assisted. Based on this context, we aimed to identify measures to prevent transmission of COVID-19 for prehospital care health care workers.

Methods

An integrative review was adopted as a research strategy, aiming to seek knowledge on the subject and identify possible gaps in knowledge. The following steps were followed for this review: construction of the research question; sample or literature search; selection of studies; extraction of data from eligible studies; data evaluation and analysis; and synthesis of results⁽⁹⁾.

The research question was built based on the PICO strategy, in its three elements as a support strategy to the literature search: population (P), prehospital care professionals; phenomenon of interest⁽¹⁾ guidelines on preventing the transmission of COVID-19 and context (Co) prehospital. The study was guided by the question: what are the measures to prevent transmission of COVID-19 for prehospital care professionals?

We included original studies, reviews, case reports, editorials and letters to the editor that addressed guidelines on measures to prevent the transmission of COVID-19 for health professionals in prehospital care, published in 2020, in Portuguese, English or Spanish and full texts. The time frame is justified by being a milestone of the COVID-19 pandemic. We excluded: journalistic texts; congress abstracts; and dissertations and theses that did not discuss COVID-19 in prehospital care.

Data were collected in November 2020, in the online databases: Latin American and Caribbean Literature on Health Sciences (LILACS) and Nursing Database (BDENF) via Virtual Health Library, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Medical Literature Analysis and Retrieval System (MEDLINE), via PubMed, Web of Science,

EMBASE, Cochrane Library, and SCOPUS. The Health Sciences Descriptors (DECS) and Medical Subject Headings (MeSH Terms) were: Disease Prevention, Communicable Disease Control, Coronavirus Infections, Coronavirus, Middle East Respiratory Syndrome Coronavirus, Severe Acute Respiratory Syndrome,

Prehospital Care, Emergency Medical Services, Health Personnel, Patient Care Team and the addition of free terms: Prevention, 2019-nCoV and Healthcare Worker - Healthcare Workers. Search strategies were performed by associating AND and OR between the descriptors. The search expressions retrieved in each base are described in Figure 1.

Basis	Search expressions
LILACS and BDNF	("Prevenção de Doenças" OR "Disease Prevention" OR "Prevención de Enfermedades" OR "Prévention des Maladies" OR "Ações Preventivas contra Doenças" OR prevenção OR profilaxia OR "Controle de Doenças Transmissíveis" OR "Communicable Disease Control" OR "Control de Enfermedades Transmissible" OR "Contrôle des maladies transmissibles" OR "Controle das Doenças Transmissíveis" OR "Controle de Doenças" OR "Medida de Controle" OR "Prevenção de Doenças Transmissíveis") AND ("Infecções por Coronavirus" OR "Coronavirus Infections" OR "Infecciones por Coronavirus" OR "Infections à coronavirus" OR "COVID-19" OR coronavirus OR "Coronavírus da Síndrome Respiratória do Oriente Médio" OR "Middle East Respiratory Syndrome Coronavirus" OR "Coronavirus del Síndrome Respiratorio de Oriente Medio" OR "Coronavirus du syndrome respiratoire du Moyen-Orient" OR sars) AND ("Assistência Pré-Hospitalar" OR "Prehospital Care" OR "Atención Prehospitalaria" OR "Soins Préhospitaliers" OR "Serviços Médicos de Emergência" OR "Emergency Medical Services" OR "Servicios Médicos de Urgencia" OR "Services des urgences médicales" OR "Atendimento Pré-Hospitalar" OR "Atendimento de Emergência Pré-Hospitalar" OR "Centros de Emergência" OR "Pronto-Socorro" OR "SAMU" OR "Serviços de Atendimento de Emergência" OR "Equipe de Assistência ao Paciente" OR "Patient Care Team" OR "Grupo de Atención al Paciente" OR "Équipe soignante" OR "Equipe de Assistência Médica" OR "Equipe de Saúde" OR "Pessoal de Saúde" OR "Health Personnel" OR "Personal de Salud" OR "Personnel de santé" OR "Profissionais da Saúde" OR "Profissionais de Saúde" OR "Trabalhadores da Saúde" OR "Trabalhadores de Saúde" OR "Healthcare Worker" OR "Healthcare Workers") AND (db:("MULTIMEDIA" OR "LILACS" OR "IBECS" OR "coleccionaSUS" OR "BDNF" OR "PAHOIRIS" OR "PREPRINT-SCIELO" OR "BIGG" OR "SES-SP" OR "LIS" OR "BINACIS" OR "CUMED" OR "MINSAPERU" OR "PREPRINT-MEDRXIV" OR "SOF")).
CINAHL; Web of Science; COCHRANE and MEDLINE	("Disease Prevention" OR "Communicable Disease Control" OR Prevention) AND ("Coronavirus Infections" OR "COVID-19" OR Coronavirus OR "Middle East Respiratory Syndrome Coronavirus" OR "MERS Virus" OR "MERS-CoV" OR "Severe Acute Respiratory Syndrome" OR "SARS" OR "2019-nCoV") AND ("Prehospital Care" OR "Emergency Medical Services" OR "Health Personnel" OR "Healthcare Worker" OR "Healthcare Workers").
EMBASIS	Prophylaxis or 'prevention and control' and 'coronavirus disease 2019' and 'emergency care' and 'health care personnel'.
SCOPUS	("Disease Prevention" OR "Communicable Disease Control") AND ("Coronavirus Infections" OR "COVID-19" OR Coronavirus OR "MERS-CoV") AND ("Prehospital Care" OR "Emergency Medical Services" OR "Health Personnel" OR "Healthcare Worker").

Figure 1 – Search expressions used for study retrieval. Belo Horizonte, MG, Brazil, 2020

Eligible studies were selected by two independent researchers in two stages. In the first stage, the titles and abstracts were read in full, and in the second stage, the full text was read. The results were discussed, and disagreements between researchers were resolved by consensus.

The initial search resulted in 3,013 productions, of these, 10 were removed for being duplicates.

In the first phase, 3,003 studies were selected for reading of the titles and abstracts. Using the exclusion criteria, 1,720 were excluded. In the second phase, after reading the titles and abstracts, 1,283 studies were selected, and another 1,262 were excluded for not meeting the inclusion criteria. In this third phase, 21 productions were selected and read in their entirety, and 13 studies were excluded for not answering

the guiding question. Thus, 08 studies were eligible for analysis in this review.

Data from the studies were extracted descriptively, using an instrument previously prepared by the researchers in Microsoft Excel® 2010 software that included information regarding author, journal, country, study design, database, level of evidence, objectives and preventive measures, in order to synthesize the relevant data from the included studies. The evidence found was read, critically analyzed, discussed, and interpreted. The analysis and discussion of the data collected was carried out descriptively. A specific proposal⁽¹⁰⁾ for assessing the level of evidence was adopted. Figure 2 shows the flowchart of the search process, which followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

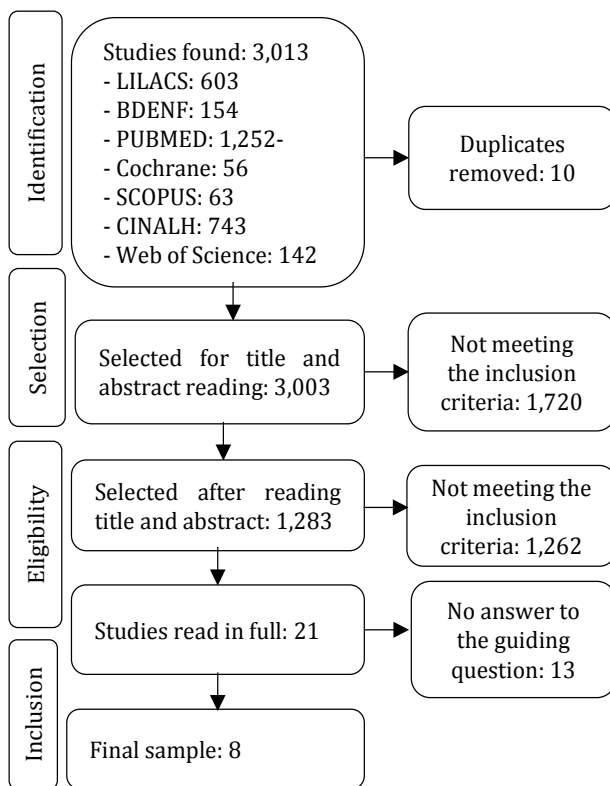


Figure 2 – Flowchart of the reference identification process, as recommended by PRISMA. Belo Horizonte, MG, Brazil, 2020

Since this is an integrative review, the present study was exempt from evaluation by the Research Ethics Committee. The authors ensured the authenticity of ideas and concepts of the texts analyzed in this review.

Results

Of the eight studies included in this review, four addressed guidelines on measures to be adopted by professionals during care to patients suspected or contaminated by COVID-19. Regarding the use of personal protective equipment⁽¹¹⁻¹⁴⁾, three presented strategies to reduce the risk of infection during invasive procedures^(11,13,15), and three provided guidance on the use of personal protective equipment during the transport of suspected and/or infected patients⁽¹⁶⁻¹⁸⁾. The countries of publication were USA⁽¹¹⁾, Switzerland⁽¹²⁾, France⁽¹³⁻¹⁴⁾, Taiwan⁽¹⁵⁾, Spain⁽¹⁶⁾ and Brazil⁽¹⁷⁻¹⁸⁾.

Regarding the level of evidence, level II⁽¹²⁾, level VI⁽¹⁴⁾ and level IV⁽¹⁸⁾ were found one each, and five for level VII^(11,13,15-17). Publications with high levels of evidence, such as randomized controlled trials, are still incipient. Regarding the objectives, the eight studies provided guidance on preventive measures to pre-hospital care professionals, related to the appropriate use of personal protective equipment and guidance on changes in practices of the management of patients suspected/contaminated by COVID-19, either during the performance of invasive procedures or during transport of these patients. Such guidance was presented to reduce the exposure of these professionals to COVID-19 during their care. The recommendations extracted from the studies selected in this review were grouped according to their content. To organize the data and make the analysis feasible, a synoptic table was built describing the final selection of studies according to authors, journals, country, level of evidence (LE), type of study, objective and synthesis of preventive measures for professionals in the management of COVID-19 (Figure 3).

Author/journal/ country/level of evidence	Type of study	Objective	Preventive measures
Hart et al. West J Emerg Med. EUA/VII ⁽¹¹⁾	Expert Comment	Recommend emergency medical providers to establish airway protection.	Use of personal protective equipment: N95 mask, gloves, lab coat, and eye and temple protection; intubation if video laryngoscopy; attach high efficiency air particle filters cover with surgical mask if using nasal cannula or venturi mask.
Suppan et al. J Med Internet Res. Switzerland/II ⁽¹²⁾	Randomized Clinical Trial	Evaluate use of gamified e-learning can improve staff choice of personal protective equipment in pandemic COVID-19.	Correct sequence of personal protective equipment placement meeting the recommendations of infection prevention and control guidelines; choice of appropriate personal protective equipment by staff when caring for COVID-19 patients.
Jost et al. Resuscitation. Paris/VII ⁽¹³⁾	Letter to the Editor	Balance the benefits of early resuscitation with the potential for harm to health care workers.	Instruct teams to wear gloves, N95 mask, eye protection, lab coats, and galoshes when attending; wear a hooded suit and protective mask during intubation; telephone guidance during cardiac arrest.
Ghazali et al. Prehosp Disaster Med. Paris/VI ⁽¹⁴⁾	Case Report	Guide prehospital management changes for patients with suspected COVID-19 infection.	Use of surgical mask, systematic hand washing or application of hydroalcoholic solution; use of isolation aprons for patients with suspected or confirmed COVID-19.
Yang et al. Resuscitation. China/VII ⁽¹⁵⁾	Letter to the Editor	Propose the use of pre-assembled supra-glottic filter sets and high-efficiency air particle filters for fast, easy, and safe airway management.	Attach high efficiency air particle filters to supraglottic device for infection control; pre-assemble i-gel® supraglottic device to Heat and moisture Exchanger Filter and store in closed bag for use in intubation.
Institute for Health Technology Assessment and Research. EsSalud Peru /VII ⁽¹⁶⁾	Guideline	Provide guidance on procedures to follow and biosafety conditions for the transfer of suspected or confirmed COVID-19 patients.	The ambulance driver must wear a surgical mask or N-95 and, in contact with the patient, all personal protective equipment; avoid touching the face during transport; turn off the air-conditioning system of the ambulance on the way; clean the ambulance using personal protective equipment after each care.
Bahia State Secretary of Health. CO-NASS Brazil/VII ⁽¹⁷⁾	Guideline	To guide measures to be adopted by the Mobile Emergency Care Service 192 during the care of confirmed or suspected cases of Covid-19.	Use of surgical mask by everyone in the ambulance; keeping a companion in the front seat and covering exposed equipment with plastic wrap; cleaning and disinfecting the vehicle after each care.
Marques et al. Text Context Nursing. Brazil/IV ⁽¹⁸⁾	Descriptive-reflexive study	Describe actions of mobile prehospital service nurses before, during, and after care and transfer of suspected or confirmed Covid-19 patients.	Sanitize the ambulance and the materials and equipment; clean the ambulance surfaces with detergent and disinfectant solutions; dispose of disposable materials in infectious waste; wrap the front seats with plastic bags and keep the windows open.

Figure 3 – Description of studies according to author, journal, country, level of evidence, type of study, objective, and synthesis of preventive measures for professionals in the management of COVID-19. Belo Horizonte, MG, Brazil, 2020

Discussion

As limitations of the study, the incipient number of articles and the lower level of evidence of the studies are considered, which does not prevent decision making⁽¹⁹⁾. It is believed that the results of the study may encourage reflection of health professionals, managers and health institutions on preventive measures for prehospital care professionals during care of patients suspected/contaminated by COVID-19. Future investigations may enhance the advancement of knowledge of the results of this study in order to broaden discussions on the topic and contribute to the prevention of COVID-19 transmission among prehospital care professionals.

Mobile prehospital care workers are more exposed to infections by handling biological materials and chemicals and transporting patients in the restricted space of the ambulance⁽²⁰⁾. In a context of uncertainties aggravated by the pandemic due to COVID-19, there were intense measures quickly established, as well as the inclusion of new protocols and tools to perform procedures in order to mitigate the risk of infections by professionals⁽²¹⁾. Regarding the practice changes in the management of patients with suspected COVID-19 infection, the Emergency Medical Service professionals were oriented toward the use of personal protective equipment⁽¹⁴⁾.

Virus transmission is multimodal and, in the scenario of a new pathogen with high lethality, without proven effective interventions, personal protective equipment that offers the best protection should be available to health professionals. Prehospital care professionals should be instructed on when and how to safely use, remove, change, dispose of, and disinfect this equipment⁽²²⁾. The availability of the equipment is as important as the correct use of each one.

The use of surgical mask, disposable coveralls, gloves, goggles, cap, apron, Filtering facepiece type P2 (FFP2) respirator, and foot protectors are among the personal protective equipment recommended for use during care. Hand washing or application of hydroal-

coholic solution should also be performed^(14,23-24). It is known that ambulances do not have sinks for washing hands with soap and water, and in many care centers there is no such resource either. Thus, each professional should have a 70% gel alcohol bottle that is easily accessible, and a dispenser should be posted inside the ambulance.

It is worth noting that the use of masks is a preventive measure to address the pandemic of COVID-19, because the virus is predominantly spread by droplets and the transmission of these droplets occurs through larger respiratory particles, usually above 5µm in diameter, the fluid-resistant surgical mask should be used to protect patients and healthcare teams⁽²⁵⁾.

In situations of patient transfer, guidance is given regarding the procedures and the necessary biosafety conditions, such as the use of disposable hoods, N-95 mask, goggles or protective shield, disposable gloves, cap and shoe protection⁽¹⁶⁾. The use of personal protective equipment is a way to reduce exposure to pathogens resulting from contact with suspected or contaminated patients⁽¹²⁾.

When transporting the patient, a policy of personnel screening (temperature screening) of the team should be instituted before presentation to work⁽²⁶⁾. This is an important monitoring barrier, which prevents a symptomatic or asymptomatic professional to work and end up exposing the team and users to the risk of contamination.

In the context of the pandemic, ambulances are often used to transport patients. With strict measures and recommendations for disinfection and cross-infection prevention, the ambulance can ensure the safety of patients and staff during transport.

The ambulance should be cleaned with a clean cloth soaked in water and neutral detergent; the cleaning should start from the ceiling and bottom, followed by side walls and fixed structures, towards the door and from top to bottom, with unidirectional movements; it is recommended to clean the inside of the vehicle doors; it is necessary to remove excess soap with a cloth dampened in water; the site should be

dried with a clean cloth, discarded in infectious waste. After cleaning, disinfection is carried out⁽²³⁻²⁴⁾.

The disinfection process of the ambulance should be performed every time the patient is treated by using disinfectant, hypochlorite, or 70% alcohol systematically, starting from the ceiling and ending on the floor of the ambulance, with special attention to the seats^(16,25). The use of disinfectants and the optimization of ultraviolet sterilization devices are crucial for disinfection⁽²⁷⁾. It is essential that ambulances have a specific place to perform terminal and concurrent cleaning before returning to the base for new occurrences and that, after each service, all personal protective equipment used is immediately discarded.

Regarding the organization of the ambulance, only the essential items for care should be kept and the air-conditioning unit should remain off during the entire trip. The turning off the air-conditioning and the use of personal protective equipment may hinder the practice of care by professionals, but it is an effective way to contain the spread of the virus⁽¹⁶⁾. It is also recommended to place plastic sheeting over the equipment that is exposed in the ambulance, such as mechanical ventilator, cardiac monitor, syringe pump, front seats, and the disinfection of the materials used in the care, remembering that professionals should wear appropriate vestments⁽¹⁷⁻¹⁸⁾.

It was evidenced the need for separation between the area of health professionals and the driver, in order to avoid unnecessary exposure and, thus, divide the space of the ambulance in two, in which one is intended for care (area of medical procedures) and the other for the ambulance driver (transportation area)⁽²⁸⁾. Professionals should maintain adequate hand hygiene with 70% alcohol gel or soap and water⁽²⁹⁾.

It is also important to highlight that ensuring orotracheal intubation becomes a challenge for the prehospital care team due to the restricted physical space of the ambulance, which may increase the possible risk of contamination of professionals during the care of patients with suspected/confirmed Coronavirus infection⁽²⁹⁾. Thus, it developed a fast, easy and

safe alternative to be used at the time of intubation. It is an i-gel[®] supraglottic device which is coupled with a proven high efficiency Heat and Moisture Exchanger Filter (HMEF). This pre-assembly optimizes time and speeds up the procedure, reducing the professionals' exposure to aerosols⁽³⁰⁾.

A study on recommendations for prehospital airway management pointed out that first responders should perform endotracheal intubation at the scene if they have access to a video laryngoscope and are able to perform the intubation in rapid sequence. Another recommendation refers to the use of nasal cannula or reservoir mask in pre-oxygenation, checking that the nasal cannula is in place after the intubation attempt⁽¹¹⁾. In addition, it is recommended that when using supraglottic devices such as laryngeal mask, it should be coupled to the High Efficiency Particulate Air (HEPA) filter preferably pre-mounted for quick, easy and safe airway management. It is also advisable to suspend cardiopulmonary resuscitation during placement of the device⁽¹⁵⁾.

A study on cardiac arrest in the prehospital environment pointed out as a precaution the use of a mechanical chest compressor to replace manual chest compressions and perform orotracheal intubation using an apron with hood, mask and videolaryngoscopy, considering the difficulty of the Basic Life Support teams to instantly differentiate patients with or without COVID-19 in cardiac arrest⁽¹³⁾.

In the pandemic, the prehospital emergency system of the fire department needed to adapt the rescue chain of cardiac arrest in an out-of-hospital environment, requiring the limitation of the referral of Basic Life Support teams, in order to limit the viral exposure of the teams and keep the teams available to provide assistance in the face of the increased number of cardiac arrests in an out-of-hospital environment, which requires measures capable of providing a balanced adaptation of the rescue procedures for victims in cardiac arrest, based on the evolution of the pandemic⁽¹³⁾.

Conclusion

The preventive measures for the transmission of COVID-19 to prehospital care professionals refer to the use of personal protective equipment by professionals during care and transport of patients suspected/contaminated by the coronavirus, such as the use of mask, gloves, goggles, cap, apron, and respirator type Filtering facepiece P2. In addition, the cleaning and disinfection of ambulances and their equipment are fundamental. In addition to these, there is evidence of changes in the management of patients suspected/contaminated by COVID-19 and in invasive procedures or transportation of these patients.

Collaborations

Souza MS, Silva MAC, Silva DM, and Lieberenz LVA collaborated to the conception, design, analysis and interpretation of the data. Maia MA, and Alves M participated in the writing of the article, relevant critical review of the intellectual content, and final approval of the version to be published.

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