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CLINICAL CHARACTERISTICS OF PATIENTS DIAGNOSED WITH GUILLAIN BARRÉ SYNDROME IN THREE SPECIALIZED INSTITUTIONS IN THE CITY OF MEDELLÍN, 2015-2020

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Abstract

Introduction: Guillain-Barré syndrome (GBS) is an autoimmune disease characterized by the presence of symmetrical weakness of the lower and upper limbs, alteration of osteotendinous reflexes, paresthesias and myopathic changes. In severe cases there is involvement of the respiratory bulbar musculature, which can cause death. In Colombia, an increase in GBS cases associated with the Zika virus epidemic from 2015 to 2017 was described, but little is known about the presentation of the disease and its behavior after the epidemic. **Methods**: descriptive cross-sectional research that identified the clinical and sociodemographic characteristics of patients with GBS in three specialized institutions located in the city of Medellin. The information was obtained from medical records with diagnosis code G61.0 from 2015 to 2020. **Results**: 120 clinical histories were included, registering a decrease of 80% of cases in the period analyzed. 57.5% of patients were male with a mean age of 50.29 +/- 20 years. Gastrointestinal and respiratory history prior to the onset of pathology was found in 55% of cases, without confirmation of infection. **The patients presented the following variants**: acute inflammatory demyelinating polyneuropathy (45.83%), acute sensory-motor axonal neuropathy (21.67%), acute motor axonal neuropathy (24.17%) and Miller Fisher syndrome (7.5%). Five patients died during the time span analyzed. **Conclusions**: Despite the lack of serological evidence, GBS diagnoses have decreased, which is related to the closure of the Zika virus epidemic in Colombia.

Keywords: *Guillain-Barré syndrome; autoimmunity; Miller Fisher syndrome; viral diseases; autoimmune diseases of the nervous system, neurology*.

Background

Guillain Barré syndrome (GBS) is of acute onset, affects the peripheral nervous system and can occur in any person regardless of age, sex or social status, however, there is a tendency in older males.[1] The syndrome is divided into electrophysiological subtypes, such as acute inflammatory demyelinating polyneuropathy (AIDP), acute motor axonal neuropathy (AMAN), acute sensory-motor axonal neuropathy (AMSAN) and other regional subtypes.[2,3] There is also a clinical classification: classic sensorimotor -the most common-, purely motor or sensory, Miller Fisher syndrome (MFS), parapegetic, bilateral facial palsy with paresthesias, Bickerstaff brainstem encephalitis and pharyngeal cervical brachial encephalitis.[2] Although the exact etiology of this syndrome is still unknown, it has been associated with some viral infections, since they cause an immune response of the organism and, in turn, antibodies such as immunoglobulin G (IgG), anti-ganglioside monosialic (GM1), disialic GD, trisialic (GT) or tetrasialic (GQ), which attack the myelin sheaths of the nerves.[4,5]

This myelin involvement results in axonal degeneration and poor electrical conduction to the muscles, which in severe cases causes extensive axonal loss and degeneration of motor neurons.[6,7]

The clinical presentation of the patient with GBS is characterized by the presence of symmetrical ascending muscle weakness of distal predominance, which generally starts in the lower limbs and extends to the upper limbs, and may even involve the cranial nerves, especially the seventh, causing a decrease or absence of osteotendinous reflexes.1 Similarly, in the case of patients over 55 years of age who are admitted with severe symptoms, the need for ventilatory assistance and the involvement of the cranial nerves are associated with a poor prognosis.8 The syndrome progresses for approximately two to four weeks and then reaches a nadir or plateau, followed by recovery for five to eight weeks thereafter.[1,9] However, inadequate treatment not only results in a slower recovery, but also produces sequelae such as permanent residual deficits and even death, when there is respiratory compromise.[1,10]

GBS is associated with infections produced by microorganisms such as Campylobacter jejuni, Haemophilus influenzae, Mycoplasma pneumoniae, herpevirus and arbovirus; 60% of cases are attributed to these infections.[5,11,12] From the beginning of 2015 to 2019, in Colombia there was an increase in the number of reported cases of this syndrome associated with Zika virus infection, reporting an incidence of four per 100,000 inhabitants.[12–15] GBS is the most frequent of the demyelination syndromes worldwide, with an incidence of 0.3 to 3 per 100,000 population-years, which rises with increasing age.[16,17]

Two recent studies on GBS have been carried out in Medellin. The first, carried out during the years 2001-2005 at the Hospital San Vicente Fundación, estimated an incidence of 5 per 10,000,000 inhabitants and included the description of 46 patients. The second was carried out at the Neurological Institute of Colombia and reported the cases of 25 patients attended between 2006 and 2012.[18,19] The present study identifies patients who developed GBS and describes the clinical characteristics of this pathology, as well as the treatment of patients in three specialized institutions in the city of Medellin.

Methods

This descriptive cross-sectional research identified the clinical and sociodemographic characteristics of patients with GBS during the period from 2015 to 2020 according to records from the Alma Mater Hospital of Antioquia, the General Hospital of Medellin and the Neurological Institute of Colombia, located in the city of Medellin. The study population was the total number of people diagnosed with diagnosis code G61.0. Patients with this code who were treated for a condition other than GBS were excluded.

According to resolution 008430 of 1993 and the evaluation issued by the bioethics committee, the present study is classified as non-hazardous. The protocol was submitted to and approved by the institutional ethics committee and the ethics and scientific committees of each institution to obtain access to information from the medical records of patients diagnosed with GBS. The medical records were evaluated to determine whether they met the Brighton criteria, which range from level 1, the highest certainty, to level 4, which represents a possible diagnosis of GBS.

For the statistical analysis, the data collected from these clinical histories were stored in an Excel database according to sociodemographic and clinical variables and subsequently analyzed in Jamovi 1.6.16. In the case of qualitative variables, absolute and relative frequencies were calculated, and the distribution of quantitative variables was determined using the Shapiro Wilk test. For variables with a normal distribution, the mean with standard deviation was used, and in the opposite case (non-normal distribution), medians and inter-quartile ranges were used. In addition, the correlation between the score obtained on the Hughes scale and the number of days on mechanical ventilation was evaluated by means of Spearman's correlation coefficient.

Results

In total, 282 clinical histories were identified with the diagnostic code of GBS, of which 162 were excluded for presenting a different diagnosis, outside the established dates, or lack of data associated with the disease. In total, 120 medical records were analyzed, with the male sex being slightly more frequent and the age range of 3-85 years. (Table 1). The municipalities in the department of Antioquia that recorded the highest number of clinical records with a diagnosis of GBS during the period examined were Medellín (39.81%) and Bello (10.62%). The highest number of GBS cases was recorded in 2015, while in 2019 and 2020 there were 9 cases per year, indicating an 80% decrease in cases (Table 1).

In 55% of the cases there was a history of gastrointestinal and respiratory symptoms in the four weeks prior to the onset

of symptoms, with a predominance of respiratory symptoms and diarrhea (Table 1). Viral infections in the last four weeks were reported in 9.17% of the patients. Two cases of zika virus were identified, one confirmed and one with symptoms but unconfirmed. There was also one unconfirmed case of chikungunya, one unconfirmed case of dengue, and one confirmed case of human immunodeficiency virus. In five cases no causal agent was identified. It was also found that surgical history and hypertension predominated in the diagnosed patients (Table 1).

The neurological characteristics are described in Table 2. The patients presented the following variants of GBS: AIDP (45.83%), AMSAN (21.67%), AMAN (24.17%) and MFS (7.5%) (Table 3). The mean time period from the onset of symptoms to the date of admission to the hospital for neurological assessment is 12.7 days SD 12.2. The length of hospital stay ranged from 1 to 77 days, with a mean of 12.3 days SD 7.74. Hughes scale scores on admission are described in Table 3, the most frequent were 4 (44.95%) and 3 (29.36%). Patients with a score of 1 or 2 did not receive therapy with plasmapheresis or immunoglobulin, in contrast to patients with a score greater than or equal to 3, since in these cases one of the two aforementioned therapies is necessary as treatment of GBS. A very important finding was the direct relationship between high levels of Hughes scale score and the requirement for mechanical ventilation, since the higher the score, the need for mechanical ventilation increases proportionally (rho=0.3941 $p<0.001$) (Figure 1).

Regarding treatment, 40.83% of the patients underwent plasma exchange in an average of five sessions. No further data were obtained on plasmapheresis, since it was not specified in the clinical history; however, 3.33% of the patients had adverse reactions to this treatment. On the other hand, 56.67% of the patients received treatment with IV immunoglobulin, of which two received 1 g/kg, 20 received 2 g/kg and 46 received 400 mg/kg, for a mean of 5 days. Adverse reactions to immunoglobulin occurred in 4.2% of cases. Of the patients, 2.5% did not receive any immunoglobulin or plasmapheresis treatment and were only under observation. During the study period, five patients died (4.17%), 4 women and one man,

Table 1. Sociodemographic and clinical characteristics at admission of patients with GBS

Categories	n	%
Female/Male	51/69	42.5%/57.5%
Age (Mean / SD)	50,29	20.89
Year of diagnosis		
2015	46	38.33%
2016	32	26.67%
2017	12	10%
2018	12	10%
2019	9	7.5%
2020	9	7.5%
History prior to diagnosis		
Diarrhea	29	24.17%
Respiratory infection	37	30.83%
Viral infection	11	9.17%
Pathological history		
Neuropathies	6	5 %
Surgical	43	35.83%
Traumatic	18	15%
Systemic arterial hypertension	27	22.5%
Diabetes	12	10%
COPD	7	5.83 %

Note: SD: standard deviation; COPD: chronic obstructive pulmonary disease; GBS: Guillain Barré syndrome.

Table 2. Neurological and diagnostic characteristics at admission of patients with GBS

Categories	n	%
Weakness in extremities		
Upper	104	86.67%
Lower	118	97,13 %
Hyporeflexia in limbs		
Upper	30	25 %
Lower	38	31.67 %
Arreflexia in limbs		
Upper	53	44.17 %
Lower	60	65.83 %
Other alterations		
Facial paralysis	35	17.07%
Affection of other cranial nerves	10	8.33 %
Urinary and anal sphincter disorder	9	7.5 %
Brighton Criteria		
Bilateral flaccid muscle weakness in extremities	94	78.33 %
Hyporeflexia or areflexia in limbs with weakness	74	61.67 %
Monophasic disease pattern	86	71.67 %
Onset to nadir of weakness: 12h-28 days plus subsequent plateau	84	70 %
CSF albumin and cytological albumin dissociation	78	65.00%
Electrophysiological findings consistent with GBS	97	80.83 %
Absence of an identified alternative diagnosis of the weakness	14	11.76 %

Note: CSF: cerebrospinal fluid, GBS: Guillain Barré syndrome.

Table 3. Classification and evolution of patients with GBS

Categories	n	%
GBS classification		
Acute inflammatory demyelinating polyneuropathy	55	45.83%
Acute sensory-motor axonal neuropathy	26	21,67%
Acute motor axonal neuropathy	29	24,17%
Miller Fisher syndrome	9	7,5%
Hughes Scale		
1	2	1.83%
2	15	13.76%
3	32	29.36%
4	49	44.95%
5	11	10.09%
Treatment		
Immunoglobulin	68	56.67%
Plasmapheresis	49	40.83%
Follow-up		
Mechanical ventilation	17	14.17%
Death	5	4.17 %
Note: GBS: Guillain Barré syndrome.		

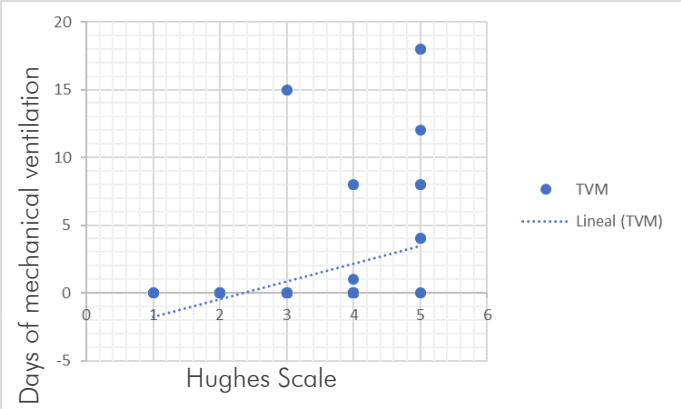

Figure 1. Positive correlation between days with mechanical ventilation and value obtained on the Hughes scale.
Note: MVT: mechanical ventilation time in days.

with an average age of 64 years; the women were over 67 years old and the man was 16 years old. Sixty percent of the patients presented previous respiratory infections and a history of hypertension and diabetes. All required mechanical ventilation.

Discussion

GBS has a worldwide incidence of 0.3 to 3 cases per 100,000 population-years.[17] In Colombia, its annual incidence increased 4.4 times during 2015 and 2016, which was associated with Zika virus infection and other arboviruses, a circumstance described in detail in some departments such as Norte de Santander and Atlántico.[13,15] The department of Antioquia does not have updated epidemiological information to determine the effect of this epidemic on the presentation of GBS. In this study, 120 cases of GBS were identified in three specialized institutions in Medellín, the capital of that department, during the period from 2015 to 2020. The syndrome was divided into AIDP (45.83%), AMAN (24.17%), AMSAN (21.67%) and MFS (7.5%) subtypes. The subtypes presented by the patients are consistent with the percentages described in the literature, with AIDP being the most frequent.[3,11]

The history of gastrointestinal and respiratory symptoms, mainly in the four weeks prior to the onset of neurological symptoms, was found to be like that reported in other studies.[1,3,20] However, in this study the cause of these symptoms was not documented as virus or bacterial infection, since it is not common to request tests for their identification.

GBS is an acute polyneuropathy that manifests with flaccid paralysis, areflexia, and motor disability that worsens over four weeks, causes an immune system response against the peripheral nervous system, and has a highly variable outcome.[9,21] In comparison with what was reported in the medical literature, it was shown that, in the vast majority of patients, symptoms of limb weakness, hyporeflexia and areflexia also progressed over the course of four weeks.

This syndrome affects patients with and without comorbidities, mainly the elderly, and usually represents a great burden for the affected patient's family environment.[22–25] GBS presents acutely with a rapid deterioration of motor function, and can generate complications such as respiratory failure, permanent neurological sequelae and even lead to death, which is why it is considered a neurological emergency.[19,20,23,26] Several studies have shown that GBS does not occur in a specific age group but in several, causing from flaccid paralysis in

upper and lower extremities to death.[21,25,27] However, the population most affected by this syndrome are people over 60 years of age, since there is a poor prognosis of the disease due to the alterations of the immune system that occur with the aging process, in addition to the underlying comorbidities that can be found in this population.28,29 In addition, this prognosis can be affected by the rapid progression of the disease. In cases where diagnosis is late and, therefore, treatment is not early, there is a history of cardiorespiratory disease and axonal damage is severe.[22,25,28]

This study did not report an increase in cases according to the advanced age of the patients, as usually observed in other studies, which is due to the increase in the rate of viral infections in children that may be the cause of this syndrome.[12,13,30,31] Likewise, the frequency of the disease was 20 cases per year with a slight predominance in men. It should be noted that during 2015 there was a significant increase in GBS cases related to the Zika epidemic in Colombia; this same behavior was reported for infection with another arbovirus.[32,33] However, in this study only 3 cases of Zika linked to GBS were found in 2016, that is, during the epidemic period.

References

1. Doets AY, Verboon C, van den Berg B, Harbo T, Cornblath DR, Willison HJ, et al. Regional variation of Guillain-Barré syndrome. Brain. 2018;141(10):2866-77. doi: 10.1093/brain/awy232
2. Leonhard SE, Mandarakas MR, Gondim FAA, Bateman K, Ferreira MLB, Cornblath DR, et al. Diagnosis and management of Guillain–Barré syndrome in ten steps. Nat Rev Neurol. 2019;15(11):671-83. doi: 10.1038/s41582-019-0250-9
3. Mahecha MP, Ojeda E, Vega DA, Sarmiento-Monroy JC, Anaya JM. Guillain-Barré syndrome in Colombia: where do we stand now? Immunol Res. 2017;65(1):72-81. doi: 10.1007/s12026-016-8816-8
4. Laman JD, Huizinga R, Boons GJ, Jacobs BC. Guillain-Barré syndrome: expanding the concept of molecular mimicry. Trends Immunol. 2022;43(4):296-308. doi: 10.1016/j.it.2022.02.003
5. Jacobs BC, Rothbarth PH, van der Meché FG, Herbrink P, Schmitz PI, de Klerk MA, et al. The spectrum of antecedent infections in Guillain-Barré syndrome. Neurology. 1998;51(4):1110-5. doi: 10.1212/WNL.51.4.1110
6. Wanschitz J, Maier H, Lassmann H, Budka H, Berger T. Distinct time pattern of complement activation and cytotoxic T cell response in Guillain-Barré syndrome. Brain. 2003;126(9):2034-42. doi: 10.1093/brain/awg207
7. Yuki N, Yamada M, Koga M, Odaka M, Susuki K, Tagawa Y, et al. Animal model of axonal Guillain-Barré syndrome induced by sensitization with GM1 ganglioside. Ann Neurol. 2001;49(6):712-20. doi: 10.1002/ana.1012
8. González-Suárez I, Sanz-Gallego I, Rodríguez de Rivera FJ, Arpa J. Guillain-Barré syndrome: natural history and prognostic factors: a retrospective review of 106 cases. BMC Neurol. 2013;13(1):95. doi: 10.1186/1471-2377-13-95
9. Fokke C, Van Den Berg B, Drenthen J, Walgaard C, Van Doorn PA, Jacobs BC. Diagnosis of Guillain-Barré syndrome and validation of Brighton criteria. Brain. 2014;137(1):33-43. doi: 10.1093/brain/awt285
10. van der Meché FGA, Schmitz PIM. A randomized trial comparing intravenous immune globulin and plasma exchange in Guillain–Barré syndrome. N Engl J Med. 1992;326(17):1123-9. doi: 10.1056/NEJM199204233261705
11. Shahrizaila N, Lehmann HC, Kuwabara S. Guillain-Barré syndrome. Lancet. 2021;397(10280):1214-28. doi: 10.1016/S0140-6736(21)00517-1
12. Parra B, Lizarazo J, Jiménez-Arango JA, Zea-Vera AF, González-Manrique G, Vargas J, et al. Guillain–Barré syndrome associated with Zika virus infection in Colombia. N Engl J Med. 2016;375(16):1513-23. doi: 10.1056/nejmoa1605564
13. Salinas JL, Walteros DM, Styczynski A, Garzón F, Quijada H, Bravo E, et al. Zika virus disease-associated Guillain-Barré syndrome—Barranquilla, Colombia 2015–2016. J Neurol Sci. 2017;381:272-7. doi: 10.1016/j.jns.2017.09.001
14. Méndez N, Oviedo-Pastrana M, Mattar S, Caicedo-Castro I, Arrieta G. Zika virus disease, microcephaly and Guillain-Barré syndrome in Colombia: Epidemiological situation during 21 months of the Zika virus outbreak, 2015-2017. Arch Public Heal. 2017;75(1):1-11. doi: 10.1186/s13690-017-0233-5
15. Anaya JM, Rodríguez Y, Monsalve DM, Vega D, Ojeda E, González-Bravo D, et al. A comprehensive analysis and immunobiology of autoimmune neurological syndromes during the Zika virus outbreak in Cúcuta, Colombia. J Autoimmun. 2017;77:123-38. doi: 10.1016/j.jaut.2016.12.007
16. Sipilä JOT, Soilu-Hänninen M, Ruuskanen JO, Rautava P, Kytö V. Epidemiology of Guillain-Barré syndrome in Finland 2004-2014. J Peripher Nerv Syst. 2017;22(4):440-5. doi: 10.1111/jns.12239
17. Papri N, Islam Z, Leonhard SE, Mohammad QD, Endtz HP, Jacobs BC. Guillain–Barré syndrome in low-income and middle-income countries: challenges and prospects. Nat Rev Neurol. 2021;17(5):285-96. doi: 10.1038/s41582-021-00467-y
18. Isaza S, Pérez A UC. Descripción de los casos de síndrome de Guillain Barré en el Hospital San Vicente de Paúl entre los años 2001 y 2005. Acta Neurol Colomb. 2009;25(3):123-9.
19. González P, García X, Guerra A, Arango JC, Delgado H, Uribe CS, et al. Experience with Guillain-Barré syndrome in a neurological Intensive Care Unit. Neurologia. 2016;31(6):389-94. doi: 10.1016/j.nrl.2014.09.004
20. López-Hernández JC, Galnares-Olalde JA, Gutiérrez A, Estrada SA, García-Grimshaw M, Vargas-Cañas ES. Síndrome de

Guillain-Barré en México : características clínicas y validación de los criterios de Brighton. Rev Neurol. 2022;74(8):258-64. doi: 10.33588/rn.7408.2021437

21. Gómez Á, Díaz A, Carrión-Penagos J, Reyes J, Reyes S. Clinical and electrophysiological characteristics of Guillain-Barré syndrome in Colombia. J Peripher Nerv Syst. 2019;24(3):268-71. doi: 10.1111/jns.12340
22. Al-Hakem H, Sindrup SH, Andersen H, de la Cour CD, Lassen LL, van den Berg B, et al. Guillain–Barré syndrome in Denmark: a population-based study on epidemiology, diagnosis and clinical severity. J Neurol. 2019;266(2):440-9. doi: 10.1007/s00415-018-9151-x
23. Forsberg A, Press R, Holmqvist LW. Residual disability 10 years after falling ill in Guillain–Barré syndrome: A prospective follow-up study. J Neurol Sci. 2012;317(1–2):74-9. doi: 10.1016/j.jns.2012.02.026
24. Pollak TA, Lennox BR, Müller S, Benros ME, Prüss H, Tebartz van Elst L, et al. Autoimmune psychosis: an international consensus on an approach to the diagnosis and management of psychosis of suspected autoimmune origin. Lancet Psychiatry. 2020;7(1):93-108. doi: 10.1016/S2215-0366(19)30290-1
25. Benedetti MD, Pugliatti M, D'Alessandro R, Beghi E, Chiò A, Logroscino G, et al. A multicentric prospective incidence study of Guillain-Barré syndrome in Italy. The ITANG Study. Neuroepidemiology. 2015;45(2):90-9. doi: 10.1159/000438752
26. Kobori S, Kubo T, Otani M, Muramatsu K, Fujino Y, Adachi H, et al. Coexisting infectious diseases on admission as a risk factor for mechanical ventilation in patients with Guillaine-Barré syndrome. J Epidemiol. 2017;27(7):311-6. doi: 10.1016/j.je.2016.07.003
27. Delannoy A, Rudant J, Chaignot C, Bolgert F, Mikaeloff Y, Weill A. Guillain-Barré syndrome in France: a nationwide epidemiological analysis based on hospital discharge data (2008-2013). J Peripher Nerv Syst. 2017;22(1):51-8. doi: 10.1111/jns.12202
28. Aragonès JM, Altimiras J, Alonso F, Celedón G, Alfonso S, Roura P, et al. Incidencia y características clínicas del síndrome de Guillain-Barré en la comarca de Osona (Barcelona, España) (2003-2016). Neurología. 2021;36(7):525-30. doi: 10.1016/j.nrl.2018.03.021
29. Walgaard C, Lingsma HF, Ruts L, Van Doorn PA, Steyerberg EW, Jacobs BC. Early recognition of poor prognosis in Guillain-Barré syndrome. Neurology. 2011;76(11):968-75. doi: 10.1212/WNL.0b013e3182104407
30. Márquez Rosales BA, Vargas Rodríguez LJ, Guerra Guerra LI. Caracterización del síndrome de Guillain-Barré en pacientes atendidos en un hospital en Colombia entre el año 2009 y el 2019. Neurol Argentina. 2022;14(4):208-14. doi: 10.1016/j.neuarg.2021.10.003
31. Millán S, Díaz C, David Pardo DG, Castro Guzmán G. Clinical and neurophysiological characteristics of patients with Guillain-Barré syndrome at Hospital Universitario San Ignacio, Bogotá, Colombia between 2009 and 2017. J Peripher Nerv Syst. 2019;24(3):272-5. doi: 10.1111/jns.12345
32. Lynch RM, Mantus G, Encinales L, Pacheco N, Li G, Porras A, et al. Augmented zika and dengue neutralizing antibodies are associated with Guillain-Barré syndrome. J Infect Dis. 2019;219(1):26-30. doi: 10.1093/infdis/jiy466
33. Charniga K, Cucunubá ZM, Walteros DM, Mercado M, Prieto F, Ospina M, et al. Descriptive analysis of surveillance data for Zika virus disease and Zika virus-associated neurological complications in Colombia, 2015–2017. PLoS One. 2021;16(6):e0252236. doi: 10.1371/journal.pone.0252236