SYSTEMATIC REVIEW

COVID-19 and Guillain-Barre Syndrome: a systematic review of case reports [version 1; peer review: 1 approved, 1 not approved]

Rodrigo M. Carrillo-Larco[1,2], Carlos Altez-Fernandez[3], Sabrina Ravaglia[4], Joaquín A. Vizcarra[5]

[1]Department of Epidemiology and Biostatistics, School of Public Health, Imperial College London, London, United Kingdom of Great Britain and Northern Ireland, W2 1PG, UK
[2]CRONICAS Centre of Excellence in Chronic Diseases, Universidad Peruana Cayetano Heredia, Lima, Peru
[3]Facultad de Medicina Alberto Hurtado, Universidad Peruana Cayetano Heredia, Lima, Peru
[4]IRCCS C., Mondino Foundation, Pavia, Italy
[5]Department of Neurology, Emory University, Atlanta, USA

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Abstract

Background: Guillain-Barre Syndrome (GBS) is a neurological autoimmune disease that can lead to respiratory failure and death. Whether COVID-19 patients are at high risk of GBS is unknown. Through a systematic review of case reports, we aimed to summarize the main features of patients with GBS and COVID-19.
Methods: Without any restrictions, we searched MEDLINE, Embase, Global Health, Scopus, Web of Science and MedXriv (April 23rd, 2020). Two reviewers screened and studied titles, abstracts and reports. We extracted information to characterize sociodemographic variables, clinical presentation, laboratory results, treatments and outcomes.
Results: Eight reports (n=12 patients) of GBS and COVID-19 were identified; one was a Miller Fisher case. Overall, the median age was 62.5 (interquartile range (IQR)=54.5-70.5) years, and there were more men (9/102). GBS symptoms started between 5 and 24 days after those of COVID-19. The median protein levels in cerebrospinal fluid samples was 101.5 mg/dl (IQR=51-145). None of the cerebrospinal fluid samples tested positive for COVID-19. Six patients debuted with ascendant weakness and three with facial weakness. Five patients had favourable evolution, four remained with relevant symptoms or required critical care and one died; the Miller Fisher case had successful resolution.
Conclusions: GBS is emerging as a disease that may appear in COVID-19 patients. Although limited, preliminary evidence appears to suggest that GBS occurs after COVID-19 onset. Practitioners and investigators should have GBS in mind as they look after COVID-19 patients and conduct research on novel aspects of COVID-19.

Open Peer Review

Approval Status ✓ ✓

	1	2
version 2 (revision) 21 Sep 2020		✓ view
version 1 28 May 2020	✓ view	✗ view

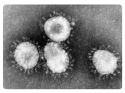
1. **Hugh J Willison**, University of Glasgow, Glasgow, UK

2. **Maria Regina Fernandes de Oliveira**, University of Brasília, Brasilia, Brazil

Any reports and responses or comments on the article can be found at the end of the article.

Comparison with GBS patients in the context of another viral outbreak (Zika), revealed similarities and differences that deserves further scrutiny and epidemiological studies.

Keywords
COVID-19, Guillain-Barre Syndrome, neurological complications, pandemic



This article is included in the Coronavirus (COVID-19) collection.

Corresponding author: Rodrigo M. Carrillo-Larco (rcarrill@ic.ac.uk)

Author roles: Carrillo-Larco RM: Conceptualization, Data Curation, Investigation, Writing – Original Draft Preparation, Writing – Review & Editing; **Altez-Fernandez C**: Data Curation, Investigation, Visualization, Writing – Review & Editing; **Ravaglia S**: Investigation, Writing – Review & Editing; **Vizcarra JA**: Investigation, Visualization, Writing – Review & Editing

Competing interests: No competing interests were disclosed.

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Introduction

COVID-19 is a disease for which practitioners and researchers are still learning signs/symptoms, risk factors, co-morbidities and outcomes. Although COVID-19 research is rapidly evolving, novel findings deserve in-depth scrutiny to formulate new hypothesis and make solid conclusions. This is the case of COVID-19 presenting along Guillain-Barre Syndrome (GBS), for which there are a few case reports[1–6].

GBS is a neurological autoimmune disease that can deteriorate hastily, thus requiring high clinical suspicion, early identification and appropriate management. In the past, also in the context of a viral disease outbreak, it has been pinpointed that Zika virus may be a risk factor for GBS[7–10]. Whether COVID-19 patients are also at high risk of GBS, is largely unknown. However, the extensive evidence between Zika virus and GBS[7–10], makes it relevant to study and decipher if COVID-19 is also associated with GBS. Consequently, to understand the characteristics of patients with COVID-19 and GBS, and to identify potential patterns, we conducted a systematic review of case reports of COVID-19 and GBS.

Methods

Protocol and eligibility criteria

We conducted a systematic review (protocol registration: CRD42020182015) and adhered to the PRISMA guidelines (*Extended data*: Table S1[11]). We searched case reports of COVID-19 and GBS, both as defined by case report. There were no exposures, interventions, comparison groups or specific outcomes, as we aimed to summarize and describe all case reports of COVID-19 and GBS. The patients could have been studied from any healthcare facility.

Information sources and search

We used six data sources (searched on April 23rd, 2020): MEDLINE, Embase, Global Health, Scopus and Web of Science (the first three through OVID); we also searched MedRxiv. The search terms are available in *Extended data*: Table S2[11]. The search did not include any restrictions. Active surveillance of key neurological journals and academic news helped identify additional sources after the search was conducted.

Study selection and data collation

Titles, abstracts and full-texts were studied by two reviewers independently (RMC-L and CA-F). Two authors (RMC-L and CA-F) agreed on a data extraction form and piloted it with one report. Extracted information included epidemiological background; disease onset and initial signs/symptoms; laboratory tests and case resolution. The extraction form was not modified during data collection. Data was collected by one reviewer (CA-F) and complemented by others (SR and JV-P).

Synthesis of results

The extracted information was synthesized qualitatively. Because of the limited number of reports and patients, we did not conduct a quantitative synthesis (e.g., meta-analysis).

Ethics

This is a systematic review of published case reports. The original reports, nor this work, provided any personal information of the patients. No human subjects were involved in this research. We did not seek authorization by an Ethics Committee.

Results

Selection process

We found 4 reports in OVID and 1 in MedXriv (Figure 1)[1–4,12]. We did not find any results in Scopus or Web of Science (Figure 1). In addition, we included 4 reports not yet available in the search results[5,6]. Finally, we selected 8 reports (n=12)[1–6,13,14]. Notably, one patient was a GBS variant: Miller Fisher[5].

Evidence synthesis

The patients were from China (n=1)[4], France (n=1)[14], Iran (n=1)[1], Italy (n=7)[2,6,13], Spain (n=1)[5], and US (n=1)[3]; the Spanish team reported the Miller Fisher case[5].

The median age across the 12 patients was 62.5 (interquartile range (IQR)=54.5-70.5) years, and there were more men (9/12) than women; the median age in men was 61 (IQR=54-65) whereas in women this was 70 (IQR=61-77) years (Table 1).

In all but one patient, COVID-19 was diagnosed with molecular tests; one patient had the diagnosis made with serological tests (Table 1)[2]. In all but one patient, GBS was confirmed with cerebrospinal fluid tests or electromyography (Table 1). The Miller Fisher case was diagnosed with serum GD1b-IgG (Table 1)[5].

GBS symptoms started between 5–24 days after those of COVID-19 in all but one patient; conversely, in one case, COVID-19 symptoms started 7 days after GBS onset (Table 1)[4]. In the Miller Fisher case, COVID-19 symptoms began 5 days before (Table 1)[5].

The earliest cerebrospinal fluid protein levels ranged from 40 mg/dl to 193 mg/dl (median=101.5, IQR=51-145); protein levels in the Miller Fisher patient was 80 mg/dl (Table 1)[5]. All patients whose cerebrospinal fluid was tested for COVID-19, received a negative result (Table 1).

Among GBS patients, 6 debuted with ascendant weakness and 3 with facial weakness (Table 1); in addition, 7 patients evolved to respiratory failure between 4 and 6 days after GBS onset (Table 1).

GBS patients received intravenous immune globulin at 400 mg/kg, and so did the Miller Fisher patient (Table 1). Regarding COVID-19 treatment, three patients received hydroxychloroquine or other medications, including lopinavir and azithromycin (Table 1).

Five patients had a favourable outcome with symptoms remission or mild persistent symptoms, four remained with relevant

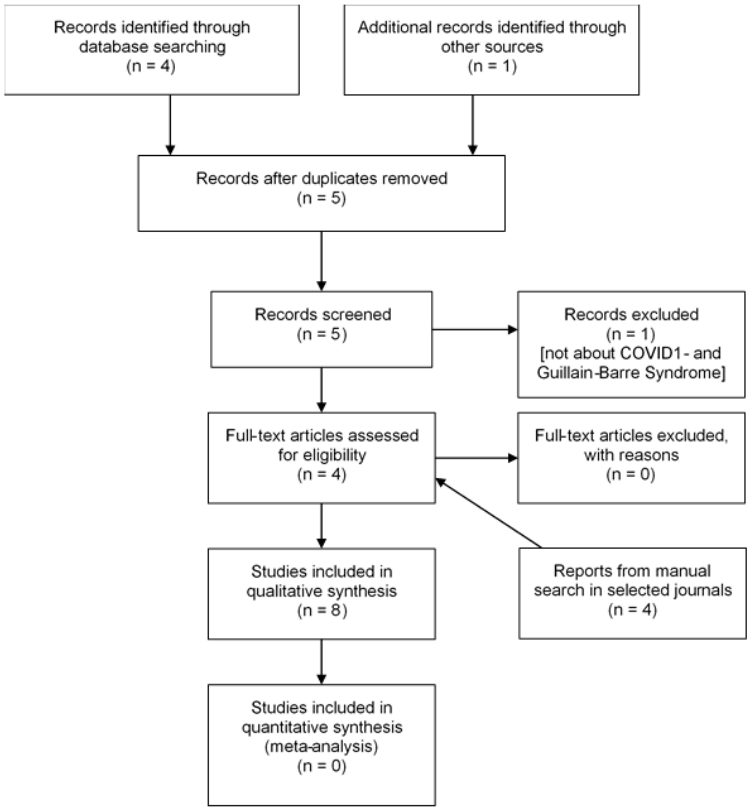

Figure 1. Selection process.

symptoms or required critical care, and one patient died (Table 1). The Miller Fisher case had successful resolution (Table 1).

Discussion

Main findings

GBS is emerging as a relevant disease that may appear in COVID-19 patients. Male predominance of GBS in COVID-19 patients seems to follow reports about more severe presentation versus its female counterparts. GBS in COVID-19 patients shows heterogeneous presentations both clinical (e.g., ascending or cranial nerve paralysis) and electrophysiological (e.g., axonal or demyelinating). Temporal correlation of GBS seems to occur after COVID-19 onset. Unlike individual case reports, this synthesis of several cases appears to suggest that GBS occurs after COVID-19 onset; nonetheless, this hypothesis deserves further verification with strong epidemiological evidence. Finally, it is too early to determine if the association between GBS and COVID-19 is related to direct viral neurotoxicity, autoimmunity, or both since no validated serological or polymerase chain reaction cerebrospinal fluid tests are commercially available.

GBS in the context of other viral disease

Although the viral characteristics differ greatly, it is still relevant to make initial comparisons with cases of GBS and Zika virus (Table 2), where there also appears to be a male predominance and the age profile seems similar[15,16]. In both contexts – COVID-19 and Zika – GBS variants with bilateral facial paralysis. On the other hand, cerebrospinal fluid protein levels seem higher in COVID-19 (Table 2).

The experience and management of Zika virus and GBS has provided relevant evidence. It taught us that GBS can be a potential complication during or (shortly) after a viral disease onset. As clinicians receive COVID-19 patients, a neurological examination should not be overlooked at admission and thereafter. Moreover, acknowledging that GBS can be a potential complication of COVID-19 should allow to secure resources (e.g., treatment) to successfully meet the needs of a GBS and COVID-19 patient.

Research needs

It is still premature to determine a predominance of any of the sociodemographic and clinical features herein summarized. Studies with larger samples and more rigorous design (e.g., retrospective cohorts) are needed to explore this potential association in greater detail to advance the evidence on sociodemographic profiles, clinical presentation and laboratory tests regarding GBS and COVID-19. This way, prognostic factors could be pinpointed so that people at greater risk can be timely managed.

Research comparing GBS associated with COVID-19 and GBS free of COVID-19[15], will also be relevant. We encourage

Table 1. Data extracted from the original case reports.

First Author	Virani[3]	Zhao[4]	Sedaghat[1]	Toscano[2]	Toscano[2]	Toscano[2]	Toscano[2]	Toscano[2]	Gutierrez-Ortiz[5]	Padroni[8]	Camdessanche[14]	Alberti[13]
Country / City	Pittsburgh / USA	Jingzhou / CHINA	Sari/ IRAN	Pavia / ITALY	Alessandria / ITALY	Brescia / ITALY	Brescia / ITALY	Pavia / ITALY	Madrid/ SPAIN	Romagna/IATLY	Saint-Etienne/ FRANCE	Monza/ITALY
Sex	Male	Female	Male	Female	Male	Male	Male	Male	Male	Female	Male	Male
Age	54	61	65	77	23	55	76	61	50	70	64	71
Previous comorbidities	*Not reported*	*Not reported*	Type 2 DM on metformin therapy.	Previous ischemic stroke, diverticulosis	None	Gastric bypass due to obesity	Arterial hypertension, atrial fibrillation on oral anticoagulants	Pericarditis of presumed tubercular origin, 27 years before	Asthma	*Not reported*	*None*	Hypertension, abdominal aortic aneurysm treated with endovascular repair in 2017, and lung cancer treated with surgery only
Concurrent diseases	Clostridium difficile colitis 2 days before GBS onset	*Not reported*	*Not reported*	Arterial hypertension, atrial fibrillation	*Not reported*	Arterial hypertension, OSAS, metabolic syndrome	Arterial hypertension, atrial fibrillation on oral anticoagulants	Arterial hypertension, thalassaemic trait	*Not reported*	None	None	Severe drug resistant hypertension
Drugs used before GBS onset	Short course amoxicillin + steroids	*Not reported*	HCQ; Lopinavir/ Ritonavir, Azithromycin	Apixaban, bisoprolol, atorvastatin, amlodipine, ramipril	None	*Not reported*	Warfarin; other not reported	Lisinopril	*Not reported*	*Not reported*	*None*	
COVID-19 symptoms onset	10 days before GBS onset	7 days after GBS onset	14 days before GBS onset	7 days before GBS onset	10 days before GBS onset	10 days before GBS onset	5 days before GBS onset	7 days before GBS onset	5 days before Miller Fisher variant onset	24 days before GBS onset	11 days before GBS	7 days before GBS without resolution when GBS started
GBS diagnosis	Clinical diagnosis only	Clinical + CSF analysis + Nerve conduction studies	Clinical + Nerve conduction + Electromyography	Clinical + CSF analysis + Electrophysiological studies	Clinical + CSF analysis + Electrophysiological studies	Clinical + CSF analysis + Electrophysiological studies	Clinical + CSF analysis + Electrophysiological studies	Clinical + CSF analysis + Electrophysiological studies	Miller Fisher variant: Clinical + Serum GD1b-IgG	Clinical + CSF analysis + Electrophysiological studies	Clinical + CSF analysis + Electrophysiological studies	Clinical + CSF analysis + Electrophysiological studies
Method of COVID-19 diagnosis	RT-PCR	RT-PCR + CT	RT-PCR	RT-PCR	RT-PCR	RT-PCR	RT-PCR	RT-PCR negative in nasopharyngeal swab and BAL; diagnosed by serology	RT PCR	RT-PCR	RT-PCR	RT-PCR
Autonomic symptoms	Urinary retention	*Not reported*	None	None	None	None	None	None	None	None	None	None
Blood count	WBC: $8.6x10^3$; HB: 15.4g/dl; PC: $211 x 10^3$	Lymphocyte count :0.52 $x10^9$; Platelet count :$113x10^9$/L	WBC: $14.6x10^3$ (Neutrophils:82.7%, Lymphocytes: 10.4%); HB: 11.6g/dl	WBC: $6.7x10^3$ (Lymphocyte: 5.7%)	WBC: $6.32x10^3$ (Lymphocyte: 14.7%)	Reported lymphocytopenia (exact value unavailable)	Reported lymphocytopenia (exact value unavailable)	WBC: $10.4x10^3$ (Lymphocyte: 13.4%)	Lymphocyte count: 1000cells/UI	WBC: $10.49x10^3$	*Not reported*	*Not reported*
Other lab values	Procalcitonin: 0.15ng/ml	CSF analysis: Cell count = $5x 10^6$/L; protein level= 124mg/dl	Glucose: 159; BUN: 19mg/dl; Creatinine: 0.8mg/dl; ALT: 35UI/L; AST: 47IU/L; Na: 135mmol/L; K: 3.9 mmol/L; ESR: 72mm/hour, CRP: 2+; Urine: negative ketones and glucose	CSF: Day 2: normal protein; no cells; negative PCR for Covid-19 Day 10: protein 101 mg/dl; white-cell count, 4 per mm3; negative PCR assay for COVID-19	CSF: protein level, 123 mg/dl; no cells; negative PCR assay for COVID-19	CSF: protein level, 193 mg/dl; no cells; negative PCR assay for COVID-19	CSF day 5: normal protein level; no cells; negative PCR assay for COVID-19	CSF day 3: protein level, 40 mg/dl; white-cell count, 3 per mm3; negative PCR assay for COVID-19	Serum GD1b-IgG positive. CSF: Opening pressure 11cmH2O, no cells, protein 80mg/dl, glucose 62mg/dl; negative PCR assay for COVID-19	D-dimer, Glucose, Creatinine phosphokinase, hepatic and renal function: All normal CSF: Protein 48mg/dl, cells $1x10^6$L. Herpes simplex, varicella zoster, Ebstein Bar virus, CMV, HIV: All negative	CSF: protein level: 166mg/dl, normal cell count Serum: Negative Anti-gangliosides antibodies	CSF: protein level: 54mg/dl; Negative PCR assay for COVID-19, cell count: 9cell/ul

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First Author	Virani[3]	Zhao[4]	Sedaghat[1]	Toscano[2]	Toscano[2]	Toscano[2]	Toscano[2]	Toscano[2]	Gutierrez-Ortiz[5]	Padroni[6]	Camdessanche[14]	Alberti[13]
GBS course	Ascendant weakness with respiratory failure.	Ascendant weakness with no respiratory failure.	Ascendant weakness and facial bilateral palsy with no respiratory failure.	Flaccid areflexic tetraplegia evolving to facial weakness, upper-limb paraesthesia (36 hr), and respiratory failure (day 6)	Facial diplegia and generalized areflexia evolving to lower limb paraesthesia with ataxia (day 2)	Flaccid tetraparesis and facial weakness evolving to areflexia (day 2) and respiratory failure (day 5)	Flaccid areflexic tetraparesis and ataxia (day 4)	Facial weakness, flaccid areflexic paraplegia (days 2–3), and respiratory failure (day 4)	Miller Fisher variant: right internuclear ophthalmoparesis and right fascicular oculomotor palsy; gait ataxia and loss of tendon reflexes	Ascendant weakness with respiratory failure	Ascendant weakness with respiratory failure	Ascendant weakness with respiratory failure complicated by COVID-19 pneumonia
Neuropathy type	*Not reported*	Demyelinating	Axonal	Axonal	Axonal	Axonal	Demyelinating	Demyelinating	*Not reported*	Demyelinating	Demyelinating	Demyelinating
GBS Management	ICU: Mechanical ventilation (4 days) + 400mg/kg IVIG (5 days)	IVIG (dosing not reported)	400mg/kg IVIG (5 days)	400mg/kg IVIG (2 cycles) + temporary mechanical non-invasive ventilation	400mg/kg IVIG	400mg/kg IVIG (2cycles) + mechanical ventilation	400mg/kg IVIG	400mg/kg IVIG + Plasma exchange	400mg/kg IVIG for 5 days.	Not reported	400mg/kg IVIG for 5 days.	400mg/kg IVIG for 5 days.
COVID-19 management	HCQ 400 mg bid for first 2 doses, then 200mg bid for 8 doses	Arbidol, Lopinavir, Ritonavir	HCQ, Lopinavir, Ritonavir, Azithromycin.	Azithromycin (no severe lung disease)	None, no pneumonia	Azithromycin	None, no pneumonia mild respiratory symptoms	None, no pneumonia, symptoms already resolved	*Not reported*	*Not reported*	Acetaminophen, Low molecular weight heparin. lopinavir/ ritonavir 400/100 mg twice a day for ten days	Lopinavir+ Ritonavir and HCQ
Outcome	Upper extremities symptoms resolved. Lower extremities weakness persisted; patient was sent to a rehabilitation facility	Symptoms from both GBS and COVID-19 resolved slowly over a 30-day course. Discharged home in day 30	*Not reported*	At week 4: had poor outcomes, including persistence of severe upper-limb weakness, dysphagia, and lower-limb paraplegia	At week 4 had improvements, including decrease in ataxia and mild decrease in facial weakness	At week 4: had poor outcomes, including ICU admission owing to neuromuscular respiratory failure and flaccid tetraplegia	At week 4: had mild improvement but unable to stand 1 month after onset	At week 4: flaccid tetraplegia, dysphagia (enteral nutrition), mechanical invasive ventilation	Complete resolution of Miller Fisher symptoms	At day 8 patient remained in ICU with mechanical invasive ventilation	*Not reported*	The patient died because of progressive respiratory failure.

COVID-19, coronavirus 2019 disease; CSF, cerebrospinal Fluid; EMG, Electromyography, ICU, intensive care unit; IVIG, intravenous immune globulin; RT-PCR, real-time polymerase chain reaction; GBS, Guillain-Barre syndrome; WBC, White blood cell count; PC, platelet count; HB, hemoglobin; BUN, blood urea nitrogen; AST, aspartate transaminase; ALT, alanine transaminase; ESR, erythrocyte sedimentation rate; CRP, c-reactive protein; HCQ, hydroxychloroquine; DM, diabetes mellitus; OSAS, obstructive sleep apnea syndrome; CT, computed tomography; BAL, bronchoalveolar lavage.

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Table 2. Comparison of GBS in the context of COVID-19 and Zika virus infections.

Characteristics	GBS and Zika virus	GBS and COVID-19
Temporal relationship	Zika symptoms paralleled GBS in 48% of cases[16].	In all but one case, COVID-19 symptoms preceded GBS by 5–24 days.
Possible mechanism	Other periinfection mechanisms may be present.	Possible post-inflammatory syndrome.
GBS phenotype	GBS variants with bilateral facial paralysis[15,16].	GBS variants with bilateral facial paralysis.
CSF testing	In 10% of patients RT-PCR was positive in cerebrospinal fluid[16].	All cases had a negative RT-PCR in cerebrospinal fluid.
CSF protein levels	Median cerebrospinal fluid protein level: 116mg/dl (IQR=67-171).	Cerebrospinal fluid protein level ranged from 40mg/dl to 193mg/dl (median=101.5; IQR= 51-145)
Prognosis	Disability at 6 months: mainly facial[16].	Not reported.
Other body fluids	Related to long periods of viriuria[16].	Not reported.

RT-PCR, real-time polymerase chain reaction; GBS, Guillain-Barre Syndrome; CSF, Cerebrospinal fluid; IQR, Interquartile range.

clinicians looking after patients with GBS and COVID-19 to report their experiences; furthermore, we invite them to build networks with colleagues and those whose reports were herein summarized, so that they can conduct more robust studies.

Limitations

Despite searching six databases, we found few case reports. As it was the case with Zika virus[8,17], more cases may appear later in the pandemic. As the COVID-19 pandemic progresses, clinicians should be aware that GBS and other variants are possible and relevant complications. Our review provides an important first step to better understand the presentation, clinical characteristics and outcomes of COVID-19 and GBS. Epidemiological studies can build on the evidence herein summarised to conduct more robust research.

Conclusions

GBS is emerging as a relevant neurological disease in COVID-19 patients. Its pathophysiology and both clinical and electrophysiological characteristics remain to be further studied. The GBS onset appears to occur after the COVID-19 presentation by several days. Practitioners and investigators should have GBS in mind as they look after COVID-19 patients and conduct further research on novel aspects of COVID-19.

Data availability

Underlying data

All data underlying the results are available as part of the article and no additional source data are required.

Extended data

Figshare: COVID-19 and Guillain-Barre Syndrome: A systematic review of case reports, https://doi.org/10.6084/m9.figshare.12317486.v2[11].

This project contains the following extended data:

- Table S1: PRISMA checklist.
- Table S2: Search terms.

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Open Peer Review

Current Peer Review Status: ✔ ✘

Version 1

Reviewer Report 08 September 2020

https://doi.org/10.21956/wellcomeopenres.17533.r40016

✘ **Maria Regina Fernandes de Oliveira**
Centre for Tropical Medicine, University of Brasília, Brasilia, Brazil

Paper: COVID-19 and Guillain-Barre Syndrome: a systematic review of case reports.

The research question is truly relevant because of the epidemiological scenario in all the world.

Methods:
The paper conducted a review of eight reports which describe 12 patients from six countries. The authors summarize some results from 12 patients as median and IQR (ex: median age; median CSF protein levels).
Given that the reports came from different populations and different countries, and not represent a homogeneous data set, It's a methodological mistake to summarize the data in this way.
Summarizing the data using these measures could be misleading.
The data must be presented individually, report by report. The most acceptable is presenting the data range among the reports for the numerical variables or proportions.

Are the rationale for, and objectives of, the Systematic Review clearly stated?
Yes

Are sufficient details of the methods and analysis provided to allow replication by others?
Yes

Is the statistical analysis and its interpretation appropriate?
No

Are the conclusions drawn adequately supported by the results presented in the review?
No

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Health Tecnology Assessment; Epidemiology; Infectious diseases.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to state that I do not consider it to be of an acceptable scientific standard, for reasons outlined above.

Author Response 09 Sep 2020

Rodrigo M Carrillo-Larco, Imperial College London, London, UK

Dear reviewer,

Thank you very much for taking time and reviewing our work; your input and suggestions are much appreciated.

I appreciate your major comment and understand your concern; however, may I please gently disagree on the following grounds?

1. Your major reservation suggested that our "statistical" approach was not correct, and that we should have not "pooled" the estimates and report means/medias but rather just describe the results (narratively). I think this is a very interesting comment. Nonetheless, we took sort of a "data pooling" approach, in which we summarised, using basic statistics, the main features of the patients. Notably, the individual results were also presented in tables so that the reader could have both, our summaries (means/medians) to have a broad picture of the findings, as well as the results for each patient. We argue that our approach would be similar as if we had accessed the individual-level data of these patients and delivered an individual-level meta-analysis. In that sense, we do not feel our approach was incorrect.
1. Our approach is not new in the literature, and a quick search of published systematic reviews of case reports in the last few months shows the following:
    1. https://pubmed.ncbi.nlm.nih.gov/32840686/ - this work is an updated version of our research question. And they followed a similar approach reporting, for example: *"...the classical albuminocytological dissociation (cell count < 5/µl with elevated CSF proteins) was detected in 71.2% of the cases (42/59) with a median CSF protein of 100.0 mg/dl..."* As we did, they presented summary measures (median).
    2. https://pubmed.ncbi.nlm.nih.gov/32888662/ - this systematic review of case reports conducted a "*...exploratory factor analysis of the symptoms was performed.*" This is, arguably, a more complex statistical approach than ours. This could also suggest that one can be more flexible on how to handle the statistical analysis of a systematic review of case reports, with plenty of more options than describing the findings narratively.
    3. https://pubmed.ncbi.nlm.nih.gov/32880011/ - like our work, this review also provided pooled results: "*...the mean age at presentation was 69.8 years.*"
    4. https://pubmed.ncbi.nlm.nih.gov/32856065/ - this work also provided pooled proportions across all reviewed patients: "*...with respiratory symptoms being the predominant manifestation (70%).*"
    5. https://pubmed.ncbi.nlm.nih.gov/32871559/ - similarly, this work also provided

pooled means: "*...The mean age of this population was 25 years (range 2–85 years).*"

I am sure there may be plenty of examples in which the authors decided to conduct a systematic review of case reports and only describe the findings, with no "statistical analysis". However, we opted for a different approach, in which we gently summarised the findings with simple statistics to provide a broad picture of the overall findings. In addition, the individual findings are provided in tables so that the reader have both: i) a summary of the findings expressed with the aid of basic statistics; and ii) the individual results for each reviewed case (i.e., patient). I believe you raised an interesting point, but I argue that our approach is not incorrect. Moreover, we have provided a few examples suggesting that one can be flexible and conduct some statistical analysis with systematic reviews of cases reports, and this does not invalid the findings. Following these arguments, and if possible, we kindly ask for a reconsideration of your decision.

Again, thank you very much for time in reviewing this work, it is much appreciated. Wish you and your family/friends all the best in these uncertain times.

Competing Interests: No competing interests.

Reviewer Response 15 Sep 2020

MARIA OLIVEIRA, University of Brasília, Brasilia, Brazil

Dear authors,
In your response you argue "that our approach would be similar as if we had accessed the individual-level data of these patients and delivered an individual-level meta-analysis", but the work didn't perform an individual-level meta-analysis. For such an aproach, please see: Richard D Riley, Paul C Lambert, Ghada Abo-Zaid, "Meta-analysis of individual participant data: rationale,conduct, and reporting". For this rationale, the authors highlight "it is inappropriate to simply analyse individual participant data as if they all came from a single study". On the other hand, there are very few patients from different countries in the reviewed reports, so I suggest not summarize the data as presented. Suppressing medians will not diminish the relevance and quality of the report.

Competing Interests: I declare no competing interests.

Reviewer Report 25 June 2020

https://doi.org/10.21956/wellcomeopenres.17533.r38881

Hugh J Willison
Institute of Infection, Immunity and Inflammation, College of Medical, Veterinary and Life Sciences, University of Glasgow, Glasgow, UK

This review represents a summary of the cases published to date of GBS following COVID-19 infection. The methodology is simply descriptive as the literature in this area is still emerging and case control studies have not been published. It does seem likely from the available reports that typical GBS can follow COVID-19 but that the frequency of this association is uncommon.

Are the rationale for, and objectives of, the Systematic Review clearly stated?
Yes

Are sufficient details of the methods and analysis provided to allow replication by others?
Yes

Is the statistical analysis and its interpretation appropriate?
Not applicable

Are the conclusions drawn adequately supported by the results presented in the review?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: GBS and other autoimmune neuropathy.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.