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DOI:
10.1111/ene.15867

Document Version
Publisher's PDF, also known as Version of record

Citation for published version (Harvard):
Cavanna, AE, Purpura, G, Riva, A, Nacinovich, R & Seri, S 2023, 'New-onset functional tics during the COVID -19 pandemic: Clinical characteristics of 105 cases from a single centre', *European Journal of Neurology*. https://doi.org/10.1111/ene.15867

Received: 6 April 2023 | Accepted: 11 May 2023

DOI: 10.1111/ene.15867

european journal of neurology
the official journal of the european academy of neurology

ORIGINAL ARTICLE

New-onset functional tics during the COVID-19 pandemic: Clinical characteristics of 105 cases from a single centre

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Abstract

Background and purpose: The COVID-19 pandemic has been associated amongst other things with a sharp increase in adolescents and young adults presenting acutely with functional tics. Initial reports have suggested clinically relevant differences between functional tics and neurodevelopmental tics seen in primary tic disorders such as Tourette syndrome. We aimed to provide confirmatory findings from the largest single-centre cohort to date.

Methods: In the present study we present data from 105 consecutive patients who developed functional tics during a 3-year period overlapping with the COVID-19 pandemic (April 2020–March 2023). All patients underwent a comprehensive neuropsychiatric assessment at a single specialist centre for tic disorders.

Results: Female adolescents and young adults accounted for 69% of our sample. Functional tics had an acute/subacute onset in most cases (75% with a peak of severity within 1 month). We found a disproportionately high frequency of complex movements (81%) and vocalizations (75%). A subset of patients (23%) had a pre-existing primary tic disorder (Tourette syndrome with functional overlay). The most common psychiatric comorbidities were anxiety (70%) and affective disorders (40%). Moreover, 41% of patients had at least one functional neurological disorder in addition to functional tics. Exposure to tic-related social media content was reported by half of the patients.

Conclusions: Our findings confirm substantial clinical differences between functional tics developed during the pandemic and neurodevelopmental tics. Both patient- and tic-related red flags support the differential diagnostic process and inform ongoing monitoring in the post-pandemic era.

KEYWORDS
functional neurological disorder, functional tics, neurodevelopmental tics, tic disorder, Tourette syndrome

INTRODUCTION

Functional tics are functional neurological symptoms characterized by a heterogeneous spectrum of repetitive movements and vocalizations that resemble neurodevelopmental motor and vocal tics, but have a different aetiology, course and outcome [1]. Possible descriptions of functional tics have been reported as early as 1884, 1 year before Gilles de la Tourette's original report of the eponymous condition characterized by multiple neurodevelopmental tics [2]. Functional tics have traditionally been classified as functional movement disorders, with a considerably lower prevalence compared with functional tremor and functional dystonia [3]. However, over the last few years there has been an increase of unprecedented magnitude in the number of adolescents and young adults presenting to health services with functional tics [4, 5]. A large population-based study recently conducted in England documented an increased incidence of tics in children and young people of all age groups and genders during the COVID-19 pandemic, with a differentially greater effect in teenage girls (more than four-fold increase) and an association with mental health disorders including anxiety. In addition to confirming early data from international reports, these findings suggested that this rise might have been driven by the emotional and social impact of the pandemic on teenage girls, and that functional tics should be considered as part of the differential diagnosis [6].

Most cases reported to date have been either female adolescents or young adults who experienced an acute or subacute onset of severe functional tics (often complex arm movements and/or socially inappropriate verbal outbursts) [7]. This contrasts with the gradual onset of tics in male children (rostro-caudal distribution), which characterizes neurodevelopmental tics in patients with a diagnosis of a primary tic disorder such as Tourette syndrome [8, 9]. Compared with neurodevelopmental tics, functional tics seem to be characterized by higher severity, complexity and variability, and by a different co-morbidity profile. Specifically, primary tic disorders are often associated with other neurodevelopmental conditions, whereas functional tics can merge into other types of functional neurological disorders, such as non-epileptic attack disorder and other functional movement disorders [4]. Moreover, it has been shown that functional tics can also co-exist with neurodevelopmental tics, as patients diagnosed with Tourette syndrome can present with a functional overlay (dual diagnosis) [4, 10–13].

Reports of this unprecedented global phenomenon have been published since 2021 across several countries, in the form of clinical series from the United States [14], Canada [15], Australia [16], England [17, 18], Germany [19, 20], Hungary [21], Denmark [22], France [23] and Italy [23]. A multi-national registry has been set up as a result of a collaborative effort from 10 tertiary referral centres for tic disorders based in North America, Australia and Europe [23]. To date, however, case series from individual specialist centres have been relatively small, with sample sizes ranging from 4 (Strasbourg, France) to 66 (Calgary, Canada) [23]. In the present study, we report comprehensive demographic and clinical data from 105 patients who developed functional tics during the COVID-19 pandemic and were assessed at a single centre (national specialist clinic for tic disorders).

METHODS

In this cross-sectional study, we reviewed the medical records of all consecutive patients attending the specialist Tourette Syndrome Clinic, Department of Neuropsychiatry, National Centre for Mental Health, Birmingham, UK who developed functional tics between April 2020 and March 2023. Detailed demographic and clinical data were routinely collected for all patients who developed functional tics during the COVID-19 pandemic. Each patient underwent a comprehensive clinical assessment by a behavioural neurologist with more than 20 years of clinical experience with patients with tics (A.E.C.), who confirmed the diagnoses of functional neurological disorder (functional tics in patients without other tic symptoms) and functional overlay (in patients with co-morbid neurodevelopmental tics in the context of a pre-existing diagnosis of Tourette syndrome). The assessment was based on the National Hospital Interview Schedule for Tourette syndrome [24], a detailed semi-structured interview schedule originally developed for use in patients with neurodevelopmental tics and adapted for use in patients with functional tics by including key items relevant to functional movement disorders [25]. Demographic and clinical data about the patients with functional tics included sex at birth, age at assessment, family history of tic disorder, psychiatric co-morbidities, and treatment interventions. In addition to the clinical phenomenology, data about the characteristics of the functional tics included onset, triggers, course, and modulating factors. Data from patients with a limited understanding of the English language were excluded from our analysis.

This retrospective study was conducted using descriptive statistics to illustrate the demographic and clinical characteristics of the participants. We used Fisher's exact test for dichotomous variables and the *t*-test for continuous variables to assess possible differences between the groups of patients with and without co-morbid neurodevelopmental tics.

RESULTS

A total of 105 patients assessed at the specialist Tourette syndrome clinic developed functional tics during the COVID-19 pandemic (6 in 2020, 22 in 2021, 65 in 2022, 12 in 2023). The demographic and clinical characteristics of our sample are presented in Table 1.

The average age of the patients at the time of the assessment was 23 (range 13–63) years. The vast majority of patients (72%) were females, and female adolescents and young adults accounted for 69% of the whole sample. A family history of tic disorders was reported by 14% of patients. Of these, 73% presented with neurodevelopmental tics in addition to their functional tics. Overall, 23% of patients had a pre-existing primary tic disorder (Tourette syndrome with functional overlay). In this subgroup, the average age at onset of

TABLE 1 Demographic and clinical characteristics of patients with functional tics ($n = 105$).

Characteristic	Value
Female sex	76 (72.4%)
Age at assessment	23.2 (±10.7) years (range 13–63 years)
Family history (of tic disorder)	15 (14.3%)
Obsessive–compulsive disorder	10 (9.5%)
Obsessive–compulsive behaviours	24 (22.9%)
Attention-deficit and hyperactivity disorder	19 (18.1%)
Autism spectrum disorder	28 (26.7%)
Tourette syndrome	24 (22.9%)
Affective disorder	42 (40.0%)
Anxiety disorder	73 (69.5%)
Functional neurological disorder	43 (41.0%)
Non-epileptic attack disorder	34 (32.4%)
Other functional movement disorder	22 (21.0%)
Pharmacotherapy	58 (55.2%)
Psychotherapy	41 (39.0%)

TABLE 2 Clinical characteristics of functional tics ($n = 105$).

Characteristic	Value
Age at onset	21.4 (±10.8) years (range 11–61 years)
Simple motor tics	91 (86.7%)
Complex motor tics	85 (81.0%)
Blocking vocal tics	10 (9.5%)
Throwing tics	16 (15.2%)
Simple vocal tics	83 (79.0%)
Complex vocal tics	79 (75.2%)
Coprolalia	51 (48.6%)
Copropraxia	21 (20.0%)
Forced touching	12 (11.4%)
Tic-related self-injurious behaviour	41 (39.0%)
Rostro-caudal distribution	16 (15.2%)
Acute/subacute onset	79 (75.2%)
Psychological trigger	76 (72.4%)
Intermittency	84 (80.0%)
Tic attacks	34 (32.4%)
Suppressibility	59 (56.2%)
Premonitory urges	50 (47.6%)
Distractibility	62 (59.0%)
Exposure to tic-related content on social media	52 (49.5%)

neurodevelopmental tics was 6.7 (range 2–14) years. Most patients presented with co-morbid anxiety (70%) and a considerable proportion fulfilled diagnostic criteria for an affective disorder (40%). Co-morbid neurodevelopmental conditions were considerably less common, with autism spectrum disorder and attention-deficit and hyperactivity disorder affecting 27% and 18% of patients, respectively. Likewise, obsessive–compulsive disorder was present in 10% of our sample, with sub-threshold obsessive–compulsive behaviours being reported by a further 14% of the patients. Of note, the majority of patients with co-morbid attention-deficit and hyperactivity disorder and obsessive–compulsive disorder also had a pre-existing primary tic disorder (58% and 70%, respectively). Moreover, 41% of patients had at least another functional neurological disorder in addition to functional tics: non-epileptic attack disorder (32%) and other functional movement disorders or functional weakness (21%). Treatment interventions at the time of the assessment included both pharmacotherapy (55%) and psychotherapy (39%). Pharmacotherapy was as follows: serotonergic agents (36%), anti-dopaminergic agents (21%), benzodiazepines (11%), alpha-2 agonists (7%), pregabalin (5%), beta-blockers (4%) and other agents (9%). Psychotherapy included a range of cognitive-behavioural therapy interventions, mainly directed at underlying anxiety and affective symptoms.

The clinical characteristics of the spectrum of functional tics reported by the patients are shown in Table 2.

In three-quarters of cases (75%), the onset of functional tics was acute or subacute (peak of severity reached within 1 week or 1 month, respectively), with a specific psychological trigger such as stress or anxiety in 72% of patients. Exposure to tic-related social media content was reported by half of the sample (50%). The average age of our patients at the onset of their functional tics was 21 (range 11–61) years. The distribution of age at onset of functional tics showed a marked peak in age groups between 12 and 26 years (Figure 1).

The rostro-caudal gradient of distribution over time, often seen in neurodevelopmental tics, was reported in only 15% of patients with functional tics. Overall, functional tics were characteristically intermittent (80%), but inconsistently suppressible (56%) and distractible (59%) during examination. Premonitory urges were reported by less than half of the sample (48%). Clusters of severe functional tics referred to as 'tic attacks' were reported by about one-third (32%) of patients.

With regard to the clinical characteristics of individual functional tics, patients reported a wide range of motor (92%) and vocal (89%) manifestations. A combination of both simple and complex functional tics was reported by 86% of the sample. Simple functional motor tics, mainly affecting the cephalic district, were reported by 92% of patients, whereas complex functional motor tics, mostly involving the upper limbs, were present in 89% of our sample. Among complex motor manifestations, throwing movements and functional blocking tics (sustained isometric muscle contractions arresting voluntary body movements) were reported by 15% and 10% of patients, respectively. Forced touching of objects/self/others was present in 11% of the sample. A considerable proportion of patients (39%) reported self-hitting or other complex functional motor tics resulting in self-injury. Simple functional vocal tics (meaningless sounds) were reported by 79% of patients, whereas complex functional vocal tics

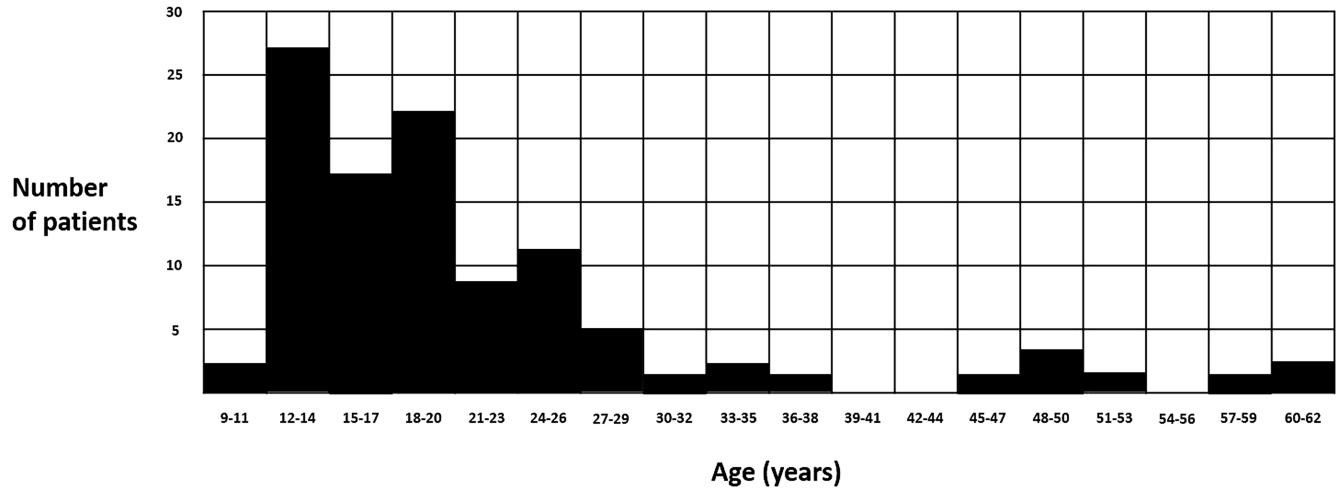

FIGURE 1 Histogram graph of the distribution of age at onset of functional tics in our patient population ($n = 105$) showing the peak in age groups between 12 and 26 years.

(words or short sentences) were reported by 75%. Coprolalic utterances were documented in almost half of the sample (49%), whereas rude gestures as functional tics were comparatively less common, having been documented in 20% of patients.

Overall, the majority of our patients (74%) qualified for a clinically definite diagnosis of functional tics, by fulfilling all three major criteria proposed by the experts of the European Society for the Study of Tourette Syndrome (age at symptom onset, rapid evolution of symptoms, phenomenology) [26]. A further 10% of patients qualified for a clinically probable diagnosis of functional tics, by fulfilling two major criteria and one minor criterion (co-morbidity profile, other functional neurological symptoms or somatic symptom disorders). The remaining 16% of patients fulfilled two of the three major criteria, but none of the two minor criteria. Compared with patients with co-morbid neurodevelopmental tics ($n = 24$), patients with functional tics only ($n = 81$) were significantly less likely to have a family history of primary tic disorders ($p < 0.001$) and a diagnosis of obsessive–compulsive disorder/behaviours ($p < 0.001$) and attention-deficit and hyperactivity disorder ($p < 0.001$). With regard to tic phenomenology, they were less likely to report premonitory urges ($p < 0.001$), tic suppressibility ($p < 0.001$) and intermittency ($p = 0.003$).

DISCUSSION

To the best of our knowledge, the present report provides a systematic description of the largest single-centre sample of patients who developed functional tics during the COVID-19 pandemic. Previously published single-centre case series were characterized by relatively small sample sizes and considerable heterogeneity in the type of information collected [14–23]. In order to facilitate their direct comparison, cases assessed at different centres were pooled in an international registry using a shared data collection procedure, thus allowing for the clinical characterization of patients with newly developed functional tics during the COVID-19 pandemic [23]. Overall, our report corroborates the collated findings from this international registry and promotes the consolidation of the functional tic phenotype.

The age at onset of functional tics in our sample was 21 years, slightly higher than the age reported in previous studies [14–23]. Our figure is likely to reflect the specificity of the criteria for access to our service, which covers the whole lifespan. Almost three-quarters of our patients were females, in stark contrast to the 3–4:1 male:female ratio that is consistently reported in patients with neurodevelopmental tics [27]. Our results are broadly in line with findings from previous case series on functional tics from different countries, although in the pooled sample from the international registry the predominance of female gender was even more pronounced (87%) [23]. To our knowledge, the only exception reported so far is the German site of Hannover, where a 1:1 male:female ratio was documented and linked to a social modelling paradigm (contrary to English-speaking countries, the most popular German social media influencer publishing tic-related video material is male [28]). A family history of tic disorders was reported by 14% of our patients, in accordance with previous findings [23]. Of note, almost three-quarters of these patients had a diagnosis of Tourette syndrome with functional overlay. In our sample, a considerable proportion of patients (23%) developed functional tics a few years after the onset of their neurodevelopmental tics, suggesting that the prevalence of patients with a dual diagnosis might have recently increased – or might have been previously underestimated. The emerging picture from the available evidence is that the co-occurrence of neurodevelopmental tics and functional tics in the same patient is a clinically relevant, albeit under-investigated, phenomenon [4, 10–13].

With regard to co-morbidities, both anxiety and affective disorders were highly prevalent (70% and 40%, respectively). These rates are slightly higher than the ones reported in the international registry, and provide further support to recently proposed pathophysiological models of functional tics, which highlight the potential role of anxiety and affective symptoms as predisposing factors [7, 29].

Other functional neurological disorders were confirmed to be commonly reported, especially non-epileptic attack disorder, which was documented in one-third of patients. The slightly higher prevalence of functional neurological disorders in our sample (41%) compared with the pooled data from the international registry (32%) could be explained by their more frequent occurrence among adults [30]. Conversely, co-morbid neurodevelopmental conditions were less frequent, with the exception of the subset of patients presenting with both functional tics and neurodevelopmental tics. Specifically, our prevalence figures for autism spectrum disorder (27%) and attention-deficit and hyperactivity disorder (18%) were comparable to those reported in the international registry [23]. Neither of these conditions was diagnosed in more than one-third of patients. The rate of co-morbid obsessive–compulsive disorder was also markedly different from what is seen in patients with primary tic disorders: this figure was close to 1 in 10 patients both in our sample and in the international registry. Again, patients with neurodevelopmental tics and functional tics were significantly more likely to have a diagnosis of obsessive–compulsive disorder/behaviours compared with patients with functional tics only. Overall, the co-morbidity profile of our patients with functional tics showed important differences from the typical co-morbidity profile of neurodevelopmental tics [31–33]. Anxiety and affective symptoms (rather than co-morbid neurodevelopmental conditions) were the main targets of both pharmacological and non-pharmacological treatment interventions – with the exception of the subset of patients diagnosed with Tourette syndrome and functional overlay.

The onset and course of functional tics were confirmed to be defining feature of the natural history of this condition. Both in our sample and in the international registry, about three-quarters of patients reported an acute or subacute onset, with a very rapid progression to the peak of clinical severity within 1 month. Such a rapid time course has been associated, in selected cases, with emergency service attendance or fast-track referrals to specialist clinics [23]. This is in marked contrast with neurodevelopmental tics, which typically peak in severity several years after their onset [34]. Both stress/anxiety and exposure to tic-related social media content were confirmed to be common environmental contingent factors triggering functional tics, in three-quarters and half of the patients, respectively. After onset, in the majority of cases functional tics did not follow the rostro-caudal gradient of body distribution, which is typical of neurodevelopmental tics, and were characteristically intermittent (80%), but inconsistently suppressible (56%) and distractible (59%), with functional 'tic attacks' being reported by approximately one-third of patients. Overall, our data confirm the practical usefulness of the European Society for the Study of Tourette Syndrome criteria for clinical diagnosis of functional tics [26]: the criteria developed by the international consensus from experts in tic disorders showed high sensitivity (84%).

Our findings on the clinical phenomenology of functional tics consolidate the emerging picture from both the smaller single-centre series and the international registry. Premonitory urges, which are one of the hallmarks of neurodevelopmental tics (especially in adolescents and adults) [35], were reported in less than half of the sample – but were reported by a significantly higher proportion of patients with Tourette syndrome and functional overlay. The vast majority of patients presented with complex functional motor and/or vocal tics, which are considered a less frequent phenomenon in neurodevelopmental tics [36], as well as in functional tics described before the pandemic [37, 38]. Only 8% of patients in our sample did not have any complex motor or vocal functional tics. Among complex functional motor tics, we were able to document significant percentages of repetitive movements that are considered to be relatively rare in patients with primary tic disorders: self-hitting or other complex functional motor tics resulting in self-injury (1 in 2–3 patients), ballistic movements (1 in 6–7 patients), functional blocking tics and forced touching (1 in 10 patients). Complex functional vocal tics were reported by three-quarters of the sample, with coprolalic utterances being produced by almost half of the patients. Reports of functional coprolalia have been relatively rare before the COVID-19 pandemic [39, 40]. The frequency of functional coprolalia in our sample was in line with data from the international registry [23] and considerably higher than the prevalence rate (33%) reported at the same specialist clinic in patients with a diagnosis of Tourette syndrome [41]. Non-obscene utterances, including both out-of-context and/or nonsensical words and short sentences, matched the vocal repertoire documented in the international registry [23]. Finally, copropraxia as a complex neurodevelopmental motor tic is rarely reported in patients with Tourette syndrome (about 5%, according to data from specialist clinics) [42], whereas rude gestures as functional tics were reported by one-fifth of our patients with functional tics.

The peculiarity of the clinical course and phenomenology of functional tics developed during the COVID-19 pandemic (with manifestations not previously documented in the context of Tourette syndrome or other primary tic disorders) raises questions about their aetiological mechanisms. Since March 2020, the UK Government enforced three prolonged periods of lockdown restrictions, interspersed with relaxations of rules. Restriction policies included limiting social contact and home confinement for all but essential activities. Concerns were raised about the impact of these necessary measures on vulnerable children and young people's mental health: for example, it was documented that young people turned increasingly online for both education and social support [43]. Almost three-quarters of our patients indicated stress or anxiety as psychological triggers for their functional tics, whereas half of the sample reported exposure to tic-related social media content. Interestingly, some of the most popular social media influencers with tic-like behaviours portray symptoms which overlap only partially with the clinical phenomenology of primary tic disorders [44], and often present with other functional neurological symptoms including non-epileptic attacks or functional weakness [28]. Based on similar findings both in the international registry [23] and across single-centre descriptions of clinical series [14–23], social modelling has been proposed as the most relevant factor contributing to what has been referred to as "a pandemic within a pandemic" [45] or "TikTok Tourette's" [46]. It

has recently been suggested that social modelling could account for a specific subtype of functional tics [47]; however, further investigation of this phenomenon might prove difficult, as social media use may be generally under-reported by adolescents [48]. Overall, further research is needed to explore the natural history of different phenotypic presentations of functional tics, as well to develop evidence-based treatment approaches.

Our study has limitations. Although the number of patients with newly developed functional tics was the largest ever reported from a single centre, our sample included native English speakers only. Hence, our findings cannot be considered representative of all the world regions in which this clinical phenomenon has been reported. All patients were recruited from the same specialist clinic, where more severe and/or complex cases tend to be seen (referral bias). This might somewhat limit the generalizability of our results. Moreover, despite consistency in clinical data acquisition and use of standardized diagnostic protocols (high inter-rater reliability), a potentially relevant limitation was intrinsic to the retrospective nature of our chart review. Recall bias might have resulted in under-reporting of certain clinical features, as well as sensitive information such as exposure to tic-related material on social media. Finally, our study followed a cross-sectional protocol with a focus on the diagnostic challenges posed by functional tics, and therefore we did not collect longitudinal data, including long-term outcomes. Future research should include prospective studies with follow-up of patients with functional tics.

Notwithstanding these limitations, our findings from the largest single-centre study to date contribute to the characterization of the clinical phenomenology of functional tics developed during the COVID-19 pandemic. Taken together with data from the international registry [23], these data confirm substantial clinical differences from neurodevelopmental tics and highlight the presence of both patient- and tic-related red flags that support the diagnostic process, thus informing ongoing monitoring in the post-pandemic era.

AUTHOR CONTRIBUTIONS

Giulia Purpura: Validation. **Stefano Seri:** Supervision.

FUNDING INFORMATION

No specific funding was received by any author to execute this study.

CONFLICT OF INTEREST STATEMENT

No disclosures related to the content of this research are reported.

DATA AVAILABILITY STATEMENT

The data supporting the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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How to cite this article: Cavanna AE, Purpura G, Riva A, Nacinovich R, Seri S. New-onset functional tics during the COVID-19 pandemic: Clinical characteristics of 105 cases from a single centre. *Eur J Neurol*. 2023;00:1-7. doi:10.1111/ene.15867