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A COVID-19 survivors and close contacts EEG dataset

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Abstract

This manuscript describes the characteristics of a dataset with EEG recordings of 173 participants: 87 confirmed COVID-19 cases (positive Reverse Transcription Polymerase Chain Reaction RT-PCR) and 86 healthy close contacts (negative PCR). EEG was acquired using a 10–20 standard montage. Resting EEG was recorded for 8 minutes in all participants with eyes closed. Afterwards, it was also recorded 2 minutes of alternating closed and open eyes, followed by 2 minutes of recovery. All participants underwent physical, neurological, and clinical evaluations, including a retrospective neurological survey and the Schedules for Clinical Assessment in Neuropsychiatry (SCAN) version 2.1.

Background & Summary

The electroencephalogram (EEG) serves as a crucial neuroimaging tool for assessing brain function[1]. During the past COVID-19 pandemic, the EEG has shown that can plays a significant role in evaluating and monitoring neurological sequelae in COVID-19 patients. The Global Brain Consortium conference held in 2022 initiated an international call for research focused on brain dysfunctions resulting from COVID-19. Several EEG studies have been carried out in this context.[1–5] The dataset described in this manuscript[6] has also supported related analyses of COVID-induced brain dysfunction, including qEEG mediation of infection severity, determinants of post-COVID neuropsychiatric symptoms, and EEG signatures in survivors compared with close contacts.[7–10]

This study focused on the quantitative analysis of EEG to identify subsequent brain dysfunctions associated with COVID-19. The study protocol also included data from two assessment batteries: the first, a self-developed Neurological Survey, and the second, the Schedules for Clinical Assessment in Neuropsychiatry (SCAN), version 2.1[11].

Here we present a dataset that includes an adult population in the age range of 20 to 85 years. The protocol included subjects with different levels of COVID-19 severity (see Table 1). All subjects were hospitalized, given the Cuban Public Health ministry protocol for dealing with the pandemic, whereas our cohort included only eleven participants requiring intensive care. Participants were evaluated at three-month post- epidemiological discharge.

Table 1

Severity	**N**
Asymptomatic	36
Mild symptomatic	38
Severe symptomatic	11
Missing	2

Methods

Participants

The dataset has 173 participants: 87 confirmed COVID-19 cases and 86 healthy close contacts (negative PCR). The inclusion criteria were: subjects aged 18 to 85 years, hospitalized with PCR results (positive or negative), a discharge period of 3 to 6 months, at least primary school education and no current or past history of neurological or psychiatric diseases. Participation in the assessment process was voluntary; all patients and controls signed an informed consent form prior to the study and the study was approved by the Ethics Committee of the Cuban Center for Neurosciences.

The total participants included in each measurement and the conjunction between modalities can be found in Table 2.

Table 2

Measurement	N
EEG	178
Neurological Survey	112
SCAN	178
EEG+ Neurological Survey	112
EEG+ SCAN	178
EEG+ Neurological Survey+ SCAN	112

Table 3

Table 3
details the COVID-19 and the close contacts of COVID-19 patient groups on demographic and clinical variables.

Variable	Covid Group n = 87	Control Group n = 86
Age	Mean = 48.85	Mean = 44.65
Gender (F/M)	N = 52/35	N = 46/40
Year of Education	Mean = 13.97	Mean = 14.79
History of psychiatric illness	N = 21	N = 11
COPD	N = 5	N = 0
Renal diseases	N = 6	N = 0
Immunosuppression	N = 6	N = 1
HBP	N = 33	N = 22
Cardiovascular diseases	N = 4	N = 0
Asthma	N = 10	N = 10
Diabetes	N = 7	N = 1
Neurological disease	N = 8	N = 5
Other diseases	N = 11	N = 11

COPD (Chronic obstructive pulmonary disease); History of psychiatric illness include neurotic spectrum, neurocognitive and psychotic spectrum, HBP (high blood pressure).

Ethics statement

This study was conducted in accordance with the Declaration of Helsinki. The experimental protocol was approved and reviewed by the ethics committee of the Cuban Neuroscience Center. The documents submitted for review included the consent form that participants signed before the start of the study. This form included the participants' approval of the publication of the data, guaranteeing the anonymization and privacy of their personal information.

Recruitment and exclusion criteria

The sample selection procedure took into account the following inclusion criteria:

To be included, the convalescent subjects have to meet the following criteria: i) age 18–80 years; ii) diagnosis of COVID-19 by PCR test; iii) after discharge period of 3–6 months; iv) at least primary school education. The exclusion criteria are i) diagnosis of neurologic or psychiatric disorders before the COVID-19 infection; ii) diagnosis of severe organ-specific disease (e.g., cancer, hepatopathy, cardiomyopathy, advanced renal disease) iii) alcohol or drug abuse.

The neurological survey

The Institute of Neurology and Neurosurgery (INN) and the Cuban Center for Neuroscience (Cneuro) developed a questionnaire to screen for neurological symptoms associated with COVID-19. The questionnaire was used in the form of a mobile device application and included 10 modules of questions to screen for: demographic data, pathological history, information about the acute stage of COVID-19, and neurological symptoms associated with COVID-19. The survey was administered by clinical neurologists.

The questionnaire was composed of 10 modules:

- General demographic data (age, gender, education level, phone number), 14 questions
- Characterization of the acute COVID-19 stage (e.g., number of days of admission), 14 questions
- Characterization of headache (pre- and post-COVID), 12 questions
- Characterization of taste and smell disorders, 9 questions
- Characterization of vision and eye movement disorders, 13 questions
- Characterization of balance and hearing disorders, 9 questions
- Characterization of sensory symptoms, 10 questions
- Characterization of motor symptoms, 13 questions
- Characterization of language, consciousness, and sleep disorders, 9 questions
- Characterization of autonomic nervous system symptoms, 14 questions

In the selection of the questions to be included, symptoms that had already been reported by other authors (headache, fatigue, insomnia) were considered, but other less common neurological alterations that could also be present in these patients were also added, such as impairments of eye movements, hearing, balance, neuromuscular coordination, and autonomic reflexes, whose incidence has been minimal or nonexistent in previous reports. The symptoms that were included are detailed in Appendix 1.

Neuropsychiatry assessment

All subjects will be interviewed with the Schedules for Clinical Assessment in Neuropsychiatry (SCAN), version 2.1. It is a semi-structured interview developed by the World Health Organization for the assessment of psychiatric disorders that consists of 1,872 items distributed in 28 sections (World

Health Organization. Division of Mental Health., 1994). In the present study, the following SCAN (version 2.1) sections were selected for assessment: Section 0 (sociodemographic items), Section II (somatoform and dissociative symptoms), Section IV (panic, anxiety, and phobias), Section VI (depressed mood and ideation), Section VII (thinking, concentration, energy, and interest), and Sections VIII and XIII (bodily functions, and interference and attributions, respectively).

EEG recordings.

EEG was recorded using a 21-channel digital EEG hardware and software package from Neuronic S.A. (MEDICID 5, Cuba). Nineteen Ag/AgCl electrodes were placed on the scalp according to the international 10/20 electrode placement, using the linked earlobes as the reference and keeping electrode impedance below 5 kOhm. The EEG was amplified 1000 times, with a bandwidth of0.5 to 30 Hz. All subjects were instructed to remain relaxed during testing to minimize artifacts caused by eye movements and to avoid excessive blinking. During the EEG recording, subjects were awake with their eyes closed, seated in a reclining chair. All recordings were performed in the morning. Resting EEG was recorded for 8 minutes in all participants with eyes closed. Afterwards, it was also recorded 2 minutes of alternating close and open eyes, followed by 2 minutes of recovery. Visual inspection of the EEG recordings was performed by three clinical neurophysiologists under blinded conditions and according to the International Federation of Clinical Neurophysiology IFCN guidelines for resting state EEG analysis. Extraction of artifact-free EEG segments was carried out by these neurophysiologists for further quantitative analyses. Further details on EEG visual inspection, qEEG, and source-density analyses are available in related reports.[7,10]

Also, all participants underwent physical, neurological, and clinical evaluations, including a retrospective neurological survey and the SCAN version 2.1. Neurological symptoms were assessed using a structured questionnaire based on the WHO epidemiological protocol[12] and quantified using the Neurological Impairment Scale (NIS)[13]. A more detailed description of the neurological and psychiatric evaluation and their use in modelling COVID-induced brain dysfunctions can be found elsewhere.[9]

GTE scale

We used the global scoring scale (GTE) to quantify the group differences in the observed EEG abnormalities [14,15]. The original scale consisted of 5 items: frequency of rhythmic background activity, diffuse slow activity, paroxysmal activity, focal abnormality, sharp wave activity, and a total score summarizing all 5 items. For this research we modified the original GTE score specifically, in the assessment of background activity, taking into account the amplitude and modulation of the alpha rhythm.

Data Records

The dataset described in this manuscript was organized using the BIDS standard. BIDS (Brain Imaging Data Structure) is a simple and standardized way to organize and describe neuroimaging,

electrophysiological, and behavioral data using uniform folder hierarchies, file naming rules, and plain text metadata [16]. The data was processed using the following steps:

- EEG recordings anonymization

In order to guarantee anonymity in the dataset published, the Windows application anomplg.exe was used to strip all personally identifiable information (subject's name, birth date, record date, etc.) from the raw EEG recordings (acquired via the Neuronic Medicid 5 digital electroencephalograph). Gender and age at recording were the only demographic variables preserved, owing to the strong dependence of EEG features on age during processing and interpretation. Before deleting these details, the application automatically created a secure backup of the personal data.

- Conversion of EEG recordings to BIDS

EEG recordings in Neuronic format were converted to BIDS using plg2bids.exe. The tool supports single-file or folder-level processing and can dynamically update existing BIDS structures with additional data.

Annotations made by expert neurophysiologists were included in the dataset to mark artifact-free EEG segments for subsequent quantitative processing. Per BIDS guidelines for post-collection data, these files are located in the \derivatives folder. Individual subject files follow the naming convention sub-CUCOVXXX_task-COVID_annotations.tsv and include:

- onset: Start time of the window (seconds).
- duration: Duration of the window (seconds).
- label: Classification/type of the selected window.

The neurological assessment for every participant was stored in the '\phenotype' folder of the BIDS dataset.

- Validation of the BIDS dataset

As a final step, the dataset's BIDS structure was validated via the web tool available at https://bids-standard.github.io/bids-validator/.

The dataset is publicly accessible on the OpenNeuro repository (https://openneuro.org/datasets/ds008082). Figure 1 illustrates the characteristic file and folder hierarchy for this dataset, with the left panel showing the subject-level directories and the right panel displaying the contents of the \eeg folder. All file and folder naming conventions follow the official BIDS specification guidelines.

A brief overview of the primary file types is provided below:

- *_coordsystem.json: Specifies the coordinate system, units, and anatomical landmarks/fiducials used for electrode locations.

- *_electrodes.tsv: Lists the spatial coordinates of the EEG electrodes.
- *_channels.tsv: Contains channel-specific metadata and recording parameters.
- *_eeg.edf: Stores the raw EEG signal data in European Data Format (EDF).
- *_eeg.json: Contains general metadata regarding the EEG recording parameters.
- *_events.tsv: Details the timing, duration, and properties of experimental events recorded during acquisition.

Technical Validation

For quality control, all EEG recordings were visually inspected by three experienced clinical neurophysiologist co-authors (AC, TV, and LC) to verify data quality and select 2.56-second artifact-free windows for subsequent quantitative analyses.

Usage Notes

Each participant was assigned one ID with the structure CUCOVxxx, 5 characters identifying “CUban COVid” and three digits indicating the number or order of the participant in the dataset. In the \derivatives folder of the BIDS dataset, information relevant to quantitative analysis is stored as annotations.

Code Availability

The software used is at https://github.com/eduardo-aubert/BIDS-Conversion-Code. The applications are:

1) Anomplg.exe: to anonymize the EEG records, all the personal information stored in the EEG recordings, which could facilitate the identification of the participants, was deleted.

2) Plg2bids.exe: to read the original EEG recordings in NEURONIC format and convert them to BIDS structure.

Declarations

Competing Interests

The authors report no declarations of interest.

Author Contribution

Ana Calzada–Reyes, Eduardo Aubert-Vázquez and Lidice Galán-Garcia made substantial contributions to all aspects of this research, including conceptualization, data collection, analysis, prepared, designed

and formatted the manuscript according to the journal's requirements. Maria Luisa Bringas-Vega, Visualization, interpretation of results and manuscript review. Trinidad Virués-Alba and Lidia Charroó-Ruiz: Data collection, analysis, interpretation of results. Yanely Acosta-Imás and Laura Perez-Mayo: Data collection, analysis. Mitchell Valdés-Sosa: Data analysis and manuscript review. Antonio Caballero-Moreno, Miguel Angel- Alvarez, Norge Santiesteban, Javier Vicente Sánchez-Lopez, Annette Valdés-Virués, Elba Elvira Varona-Galindo, Leyanis Ramos –Hernández, Mabel Whilby-Santiesteban, Thelma Luz Carrillo-Alfonso and Elizabeth Méndez- Parra: Data collection, interpretation of results. Shahwar Yasir and Yu Jin: Analysis, interpretation of results. Peng Ren: Visualization, interpretation of results. Dezhong Yao, Contributed to the critical revision of the manuscript. Luo Cheng, Provided manuscript review. Roberto Rodriguez-Labrada: Conceptualization and manuscript review. Pedro Valdés-Sosa made substantial contributions to all aspects of this research, including conceptualization, data collection, analysis, and manuscript review.

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Data Availability

The dataset is available at the OpenNeuro repository (https://openneuro.org/datasets/ds008082) and, as stated in the previous section, is formatted as a BIDS dataset.The software used is at https://github.com/eduardo-aubert/BIDS-Conversion-Code. The applications are:1) Anomplg.exe: to anonymize the EEG records, all the personal information stored in the EEG recordings, which could facilitate the identification of the participants, was deleted.2) Plg2bids.exe: to read the original EEG recordings in NEURONIC format and convert them to BIDS structure.

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Figures

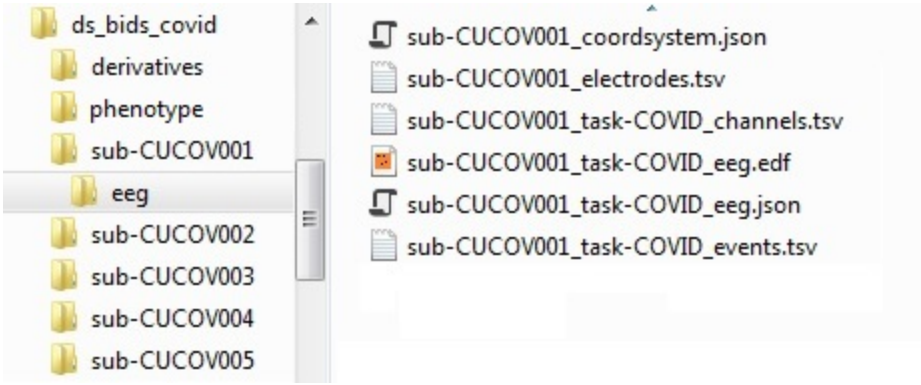


Figure 1

Dataset folder structure.

Supplementary Files

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- Appendix.pdf
- sdatasensitivedatachecklistJuly29.docx