Data in Brief 41 (2022) 107956

Contents lists available at ScienceDirect

Data in Brief

journal homepage: www.elsevier.com/locate/dib

Data Article

Neuroimaging of chronotype, sleep quality and daytime sleepiness: Structural T1-weighted magnetic resonance brain imaging data from 136 young adults

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ARTICLE INFO

Article history:
Received 1 November 2021
Revised 4 February 2022
Accepted 9 February 2022
Available online 15 February 2022

Dataset link: Structural (t1) images of 136 young healthy adults; study of effects of chronotype, sleep quality and daytime sleepiness on brain structure (Original data)

ABSTRACT

The dataset contains structural T1-weighted magnetic resonance brain imaging data from 136 young individuals (87 females; age range from 18 to 35 years old) along with questionnaire-assessed measurements of trait-like chronotype, sleep quality and daytime sleepiness. The recruitment criteria excluded individuals with self-reported history of psychiatric or neurological conditions and current medication use. All the brain imaging sessions were performed between 5:20 PM and 8:55 PM in order to control the effect of time of day on acquired images. The data is mostly useful to

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https://doi.org/10.1016/j.dib.2022.107956

Keywords:
Circadian preference
Circadian amplitude
Eveningness
Morningness
MRI
Pittsburgh sleep quality index
Epworth sleepiness scale
Daytime sleepiness

scientists interested in circadian rhythmicity. It can be deployed in large-scale multicenter meta-analyzes investigating the structural brain correlates of chronotypes in humans. Additionally, the data could be of use in investigations into the effects of sleeping habits and latitude on brain anatomy.

Specifications Table

Subject	Neuroscience: General
Specific subject area	Structural neuroimaging in the context of chronotype and sleep quality
Type of data	Table Brain imaging data
How the data were acquired	Circadian preference and the subjective amplitude of the circadian rhythms for each participant was assessed using the Chronotype Questionnaire (ChQ) [2,3], whereas daytime sleepiness and sleep quality were tested with, respectively, Epworth Sleepiness Scale (ESS) [4] and Pittsburgh Sleep Quality Index (PSQI) [5]. All the questionnaire measurements were collected prior to acquiring the brain imaging data. Magnetic resonance imaging (MRI) data was acquired with a 3T scanner (Magnetom Skyra, Siemens) using a 20-channel or 64-channel head/neck coil. The high resolution structural brain images were collected with a T1 MPRAGE sequence (176 sagittal slices; 1 × 1 × 1.1 mm3 voxel size; TR = 2300 ms, TE = 2.98 ms, flip angle = 9 , GRAPPA acceleration factor 2)
Data format	Raw (BIDS)
Description of data collection	All participants were right-handed, had normal or corrected to normal vision, no self-reported neurological and psychiatric disorders, and were drug-free. The additional inclusion criteria comprised: regular time-of-day schedule without sleep debt; no shift work; not having been on a flight passing more than two time zones within the past two months.
Data source location	• Institution: Brain Imaging Core Facility, Malopolska Centre of Biotechnology, Jagiellonian University • City: Krakow • Country: Poland • Latitude and longitude: 50.026813 N, 19.900716 E
Data accessibility	Repository name: OpenNeuro Data identification number: ds003826 Direct URL to data: https://openneuro.org/datasets/ds003826/versions/3.0.0
Related research article	M. R. Zareba, M. Fafrowicz, T. Marek, E Beldzik, H Oginska, A Domagalik. Late chronotype is linked to greater cortical thickness in the left fusiform and entorhinal gyri. Biol. Rhythm Res. 10.1080/09291016.2021.1990501

Value of the Data

- The data is mostly useful to scientists interested in circadian rhythmicity.
- The dataset enables studying the relationship between various aspects of human brain structure and chronotype in a relatively large sample of young adults.
- The data could be deployed together with other widely available datasets, such as UK Biobank [6], in large-scale multicenter meta-analyzes assessing the volumetric and cortical sheet correlates of chronotypes. Additionally, it enables studying the anatomical basis of the subjective amplitude of the circadian rhythms.

- The presented data could also be of use in studies interested in the structural brain correlates of sleep quality and daytime sleepiness.
- This data, combined with other datasets, warrants investigations into the effects of latitude on brain anatomy.

1. Data Description

Dataset_description.json contains general information about the dataset, including the funding agency and ethics approvals. Participants.tsv contains demographic information of the study's cohort, i.e. their age, sex, chronotype (both as a continuous measurement and a factor), subjective amplitude of the circadian rhythms, sleep quality and daytime sleepiness. Participants.json provides a more detailed description of the characteristics provided in participants.tsv. The magnetic resonance imaging data in BIDS format is stored within folders containing 'sub' in their names. Each directory is dedicated to one participant. Structural brain data in .nii format are stored in anat subdirectories along with respective .json files containing information about scanning sequence parameters. The data of 113 out of 136 participants included in the current dataset was used in a manuscript correlating the indices of brain structure with continuous chronotype score [1]. These participants are marked in the participants.tsv file.

2. Experimental Design, Materials and Methods

The dataset contains data from 136 young adults, which was collected in the course of two functional MRI (fMRI) projects (National Science Centre, Poland grants: Symfonia 2013/08/W/NZ3/00700 and Harmonia 2013/08/M/HS6/0004). The recruitment for the studies was done through online advertisements at Jagiellonian University's website and social media, and thus the vast majority of the described cohort consisted of students. All participants were right-handed, aged between 19 and 35, had normal or corrected to normal vision, and reported no neurological or psychiatric disorders and medication use. Additionally, the participants had a regular time-of-day schedule without any sleep debt (from 6 to 9 hours of sleep each night), no shift work and had not been on a flight crossing more than two time zones within the two months prior to enrolling in the study.

The chronotype of the subjects was measured with ChQ [2,3]. It consists of 8 questions regarding the morningness-eveningness preference and 8 items probing the subjective strength of circadian variation in mood and cognition. Example items assessing circadian preference are "I feel sluggish in the morning and I warm up slowly during the day" and "I am usually in an excellent mood in the morning". The subjective amplitude of circadian rhythms is measured with objects like "I feel substantial variations of my mood during the day" and "When my usual sleep time comes, I can hardly overcome sleepiness". Full ChQ has been attached to the submission in the Supplementary Material. Depending on how much a participant agrees with a statement, they rank the item from 1 to 4. Individual results in the morningness-eveningness and amplitude scales are calculated as sums of points from all the questions belonging to the given category, the theoretical range being 8-32 points. In the described dataset, participants' scores on the morningness-eveningness scale ranged from 11 to 32. The greater the score, the more evening-oriented the person. The scores on the amplitude scale ranged from 11 to 29. The greater the score, the more intense the diurnal variation in mood and cognition. Apart from providing the raw scores in the morningness-eveningness scales, the participants have also been divided into two groups with individuals scoring up to 21 points classified as early chronotypes, and those with higher scores deemed late chronotypes. The decision not to create the intermediate chronotype group was guided by the distribution of the morningness-eveningness scale scores, which favoured a two group division. Nevertheless, the researchers may divide the dataset into three

groups should it fit their research goals. Raw continuous chronotype scores are provided in order to enable that.

Alike the widely deployed Morningness-Eveningness Questionnaire (MEQ) [7], ChQ perceives chronotype as a trait rather than a state. Individual scores in the morningness-eveningness scale of ChQ showed a high extent of reproducibility in two-week ($r = 0.88$) and seven-year ($r = 0.77$) test-retests [2]. The tool was also positively validated against MEQ (r = -0.81) [8]. The utility of ChQ was further proven by positive and significant correlations with the external sleep criteria, i.e. the mid-sleep points calculated from reported sleeping habits ('real sleep' on regular weekdays) and sleep preferences ('ideal sleep') [2].

Daytime sleepiness was measured with the Epworth Sleepiness Scale [4]. The tool consists of 8 items describing certain daytime activities, and participants are asked to grade each from 0 ('I would never doze [during this activity]' to 3 ('high chance of dozing [during this activity]'). The examples include sitting and reading or being a passenger in a car for an hour without a break. The total result in ESS is a sum of grades from all questions, and scores higher than 10 indicate excessive daytime sleepiness.

In turn, sleep quality was assessed with the Pittsburgh Sleep Quality Index [5]. The questionnaire probes sleep quality through questions regarding the latency to falling asleep, the number of hours spent asleep, as well as the frequency of various events disrupting sleep, such as feeling too hot or too cold and awakenings in the middle of the night. The tool is divided into 7 components, the sum of which gives the final score. Individuals with results higher than 5 are perceived to have deteriorated sleep quality.

Similarly to ChQ, ESS and PSQI have also been made available in the supplementary material. Nevertheless, the use of ESS and PSQI data presented in this manuscript suffers a limitation. As the main goal of the projects the data had been collected for was to investigate the chronotype-related brain differences, ESS and PSQI were treated during the recruitment process as tools to exclude participants with circadian- and sleep-related problems from entering the final analyzes. Thus, the distributions of the scores in both tools may substantially differ from those found in the general population. Nevertheless, especially if combined with other datasets, our data could be a valuable asset to researchers interested in sleep quality and daytime sleepiness.

MRI data was acquired with a 3T scanner (Magnetom Skyra, Siemens) using a 20-channel or 64-channel head/neck coil. The high resolution structural brain images were collected with a T1 MPRAGE sequence (176 sagittal slices; $1 \times 1 \times 1.1$ mm3 voxel size; TR = 2300 ms, TE = 2.98 ms, flip angle = 9 , GRAPPA acceleration factor 2) All scanning sessions were performed between 5:20 PM and 8:55 PM. This approach was meant to prevent the time-of-day effects from impacting the structural brain metrics [9]. All of the brain imaging data is in the participants' native space.

Ethics Statements

The anonymised data was taken from two projects that had been approved by the Research Ethics Committee at the Institute of Applied Psychology at the Jagiellonian University and the Bioethics Commission at the Polish Military Institute of Aviation Medicine. Each participant was provided with information about the procedures and goals of respective study, and gave their written consent. The studies adhered to the ethical standards presented in the Declaration of Helsinki.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability

Structural (t1) images of 136 young healthy adults; study of effects of chronotype, sleep quality and daytime sleepiness on brain structure (Original data) (OpenNeuro)

CRediT Author Statement

Michal Rafal Zareba: Conceptualization, Methodology, Validation, Data curation, Writing – original draft; **Magdalena Fafrowicz:** Conceptualization, Investigation, Resources, Funding acquisition; **Tadeusz Marek:** Conceptualization, Funding acquisition; **Ewa Beldzik:** Conceptualization, Methodology; **Halszka Oginska:** Conceptualization, Methodology, Resources; **Anna Beres:** Investigation; **Piotr Faba:** Investigation; **Justyna Janik:** Investigation, Resources; **Koryna Lewandowska:** Investigation, Resources; **Monika Ostrogorska:** Investigation; **Barbara Sikora-Wachowicz:** Investigation, Resources; **Aleksandra Zyrkowska:** Investigation, Resources; **Aleksandra Domagalik:** Conceptualization, Methodology, Validation, Investigation, Resources, Data curation, Writing – review & editing, Supervision.

Acknowledgments

Funding: This work was supported by the National Science Centre, Poland (NCN) grants no. 2013/08/M/HS6/00042 and 2013/08/W/NZ3/00700.

Supplementary Materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.dib.2022.107956.

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