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Extreme late chronotypes and social jetlag challenged by Antarctic conditions in a population of university students from Uruguay

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ABSTRACT

In humans, a person's chronotype depends on environmental cues and on individual characteristics, with late chronotypes prevailing in youth. Social jetlag (SJL), the misalignment between an individual's biological clock and social time, is higher in late chronotypes. Strong SJL is expected in Uruguayan university students with morning class schedules and very late entertainment activities. Sleep disorders have been reported in Antarctic inhabitants, that might be a response to the extreme environment or to the strictness of Antarctic life. We evaluated, for the first time in Uruguay, the chronotypes and SJL of 17 undergraduate students of the First Uruguayan Summer School on Antarctic Research, using Munich Chronotype Questionnaire (MCTQ) and sleep logs (SL) recorded during 3 phases: pre-Antarctic, Antarctic, and post-Antarctic. The midsleep point of free days corrected for sleep debt on work days (MSFsc,) was used as proxy of individuals' chronotype, whose values (around 6 a.m.) are the latest ever reported. We found a SJL of around 2 h in average, which correlated positively with MSFsc, confirming that late chronotypes generate a higher sleep debt during weekdays. Midsleep point and sleep duration significantly decreased between pre-Antarctic and Antarctic phases, and sleep duration rebounded to significant higher values in the post-Antarctic phase. Waking time, but not sleep onset time, significantly varied among phases. This evidence suggests that sleep schedules more likely depended on the social agenda than on the environmental light–dark shifts. High motivation of students towards Antarctic activities likely induced a subjective perception of welfare non-dependent on sleep duration.

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1. Introduction

The sleep–wake cycle, whose neuroendocrine mechanisms have been well studied, is the most conspicuous cyclic behavior in humans. As any other activity–rest circadian rhythm in the animal kingdom, sleeping habits in humans depend on an endogenous biological clock daily entrained by environmental changes of the light–dark cycle [1,2]. However, humans are subjected to complex social and environmental pressures that compromise and restrict their otherwise natural sleep schedule [3]. Modern chronobiological studies attempt to study how human biological clocks are entrained by real life conditions, rather than studying their performance in isolation or in artificial conditions of illumination and social cues as pioneering studies did [3].

Individual chronotypes, i.e., an individual's propensity to sleep at a particular time during a 24-h period, can be easily assessed using the Munich Chronotype Questionnaire (MCTQ, online since 2000, www.theWeP.org/documentations/mctq) by computing the midsleep of free days (MSF) [4,5]. Along with genetic factors, chronotype depends on different environmental cues, such as light exposure [6], and on individual characteristics, such as age or gender [7–10]. Late chronotypes predominate in adolescents and young adults [9,11,12]. The distribution of chronotypes in different European populations is quasi normal, with an average midsleep point of around 04.50 h [5,13–15]. On the other hand, Uruguay has no systematic database of the distribution of chronotypes or of sleep habits within its population.

There is no need to fly across time zones to experience a discrepancy between the endogenous clock and external time (jetlag). When this misalignment arises between an individual's biological clock and social time, it is called social jetlag [16]. Social jetlag, calculated as the absolute difference between midsleep on workdays (MSW) and midsleep on free days (MSF), tends to be higher in late chronotypes; and therefore more dramatically observed in young people characterized not only by their lateness but also by their strict and fixed school schedules [4]. Though there are no previous reports of chronobiological evaluations of this population, it is predictable that Uruguayan teenagers and young adults are subject to a strong social jetlag. With morning class schedules and late entertainment habits, Uruguayan youth seem to be a very advantageous population for the study of the impact of extreme swings in their sleep schedule.

During summers and winters in Antarctica, the most extreme and isolated continent on earth, the human circadian clock cannot rely on changes of photoperiod and temperature to entrain the clock day after day, and circadian rhythms might tend to free run [17]. Sleep disorders reported in Antarctic crewmembers are probably also related to this dysregulation of the external time cues [18–23]. However, it has been hard to establish to what extent these disorders respond to the external environment rather than to the strictness of social cues and the conditions of isolation inherent to living in an Antarctic base station [24,25].

In 2014, the School of Sciences (Facultad de Ciencias, Universidad de la República, Uruguay) organized the First Uruguayan Summer School on Introduction to Antarctic Research with the participation of 17 undergraduate students. In this study, which constitutes the first attempt to perform a chronobiological characterization in Uruguay, we evaluated the chronotypes and social jetlag of this sample of university students, and confirmed the extreme lateness of the study population as well as a strong social jetlag. Further, we analyzed the impact of the trip to Antarctica on their sleep habits and sleep quality.

2. Method

2.1. Participants

Seventeen healthy students (6 males, 11 females) from the Facultad de Ciencias, Universidad de la República, Uruguay, were selected to participate in the First Uruguayan Summer School on Introduction to Antarctic Research held from February 4 to 14, 2014 in the Uruguayan Antarctic Scientific Base Artigas, King Georges Island (62° 11' S; 58° 52' W). The five week long study was performed from January 21 to February 24, 2014, and was divided into three phases: pre-Antarctic (15 days before departure); Antarctic (9 days); and post-Antarctic (11 days after return). All participants were clinically assessed in order to ensure they met the required health conditions. The mean age of the participants was 23.12 years (ranging from 21 to 26 years); 16 out of 17 were normal weight adults (average BMI=22.56, ranging from 18.58 to 27.37); none showed sleep disturbances or signs of depression (Beck Depression Inventory score <10, [26]).

All procedures were approved by the ethics committee at the Hospital de Clínicas de Porto Alegre, Universidad Federal de Rio Grande do Sul, Brazil and at the Instituto de Investigaciones Biológicas Clemente Estable, Ministerio de Educación y Cultura, Uruguay (CEP/HCPA 14-0057). All participants signed an informed consent form stating that they have been told about: the aims and procedures of the study, their right to end participation without any explanatory statement at any time, their data being coded so that data evaluation could occur on an anonymous basis, and their data being communicated for scientific purposes only.

2.2. Instruments

2.2.1. Munich Chronotype Questionnaire (MCTQ)

Chronobiological parameters were assessed using the Spanish version of the Munich Chronotype Questionnaire – MCTQ [4], available on line at www.bioinfo.mpg.de/mctq/core_work_life/core/introduction.jsp?language=esp. The questionnaires were answered individually by all participants during the first day of the study (January 21, 2014). The MCTQ was used to assess the midsleep phase and sleep duration for both work (MSW, SDW, respectively) and free days (MSF, SDF, respectively) as shown in Table 1 [4,27]. To avoid the effect of sleep debt accumulated over the workweek on midsleep phase estimates, we calculated the midsleep point sleep-corrected (MSFsc, MSF corrected for sleep debt on work days), which was used as a reliable proxy for chronotype [11,27]. The social jetlag was calculated as the value of the difference between MSF and MSW [16].