The impact of training shifts in dancers' chronotype and sleep patterns

Natalia Coirolo [1,2]
Ana Silva [1]
Bettina Tassino [2*]

[1] Laboratorio de Neurociencias, Facultad de Ciencias, Universidad de la República, Montevideo, Uruguay.
[2] Sección Etología, Facultad de Ciencias, Universidad de la República, Montevideo, Uruguay.

ABSTRACT

Circadian preferences (chronotypes) as well as human sleep patterns depend on internal and environmental factors including social demands. School and work shifts are advantageous tools for studying the way social pressures impact on the biological clock. We took advantage of the Uruguayan public professional training in dance organized in two different shifts (morning, 8:30 to 12:30, and night, 20:00 to 24:00) to evaluate the influence of shifts on sleep timing and individual circadian preferences of dancing trainees (n=56) from data obtained by questionnaires (Munich Chronotype Questionnaire, MCTQ, and Morningness-Eveningness Questionnaire, MEQ) and sleep logs (SL). Although the outputs of MEQ and MCTQ significantly correlated, nocturnal dancers reported later chronotypes (measured by MCTQ) than morning dancers, but no differences in their circadian preferences measured by MEQ. Both MCTQ and SL showed that nocturnal dancers scheduled their sleep significantly later than morning ones during work and free days.

Keywords: Chronotypes; Sleep Patterns; Circadian Preferences; Questionnaires; Sleep Logs Training Shift

Corresponding author:
Bettina Tassino
E-mail: tassino@fcien.edu.uy

DOI: 10.5935/1984-0063.20200010

INTRODUCTION

In humans, the intrinsic period of the circadian cycle is slightly greater than 24 h on average with individual variations that depend on both genetic and environmental factors[1]. Individual differences in the phase of the circadian rhythms are known as circadian preferences or chronotypes[1]. Chronotypes depend on the expression of several genes[2], and vary with other biological factors such as age and sex[3]. Chronotypes also depend on the intensity, quality and timing of light exposure[4] and on a diversity of social demands such as school, work, or entertainment schedules[5].

The sleep-wake cycle is the most conspicuous human circadian rhythm, which is well-known to depend on social demands. Latin American high school students attending school in the morning shift have advanced and shorter sleep compared to those attending the afternoon-shift[6-9]. Night shift work has also been associated to sleep disorders[10]. Shifts not only affect sleep timing but also circadian preferences. For example, night-shift nurses have significantly later chronotypes than day-shift nurses[11]. Moreover, afternoon-shift high school students from Mexico and Uruguay have significantly later chronotypes than morning-shift ones[7,12]

Individual circadian preferences can be inferred by universally validated questionnaires[13,14]. However, different questionnaires survey different aspects of sleep habits and might not be consistent in typifying chronotype. MCTQ, for example explores sleep timing and assumes that the mid sleep point on free days corrected for sleep debt on workdays (MSFsc) is a good proxy of individual chronotype[3]. MEQ score, in turn, represents the self-reported time preference to perform different activities[13]. Therefore, while MEQ and MSFsc usually correlate, it is not surprising to find discrepancies as both questionnaires have different aims and are not interchangeable. A more objective way of evaluating sleep habits is provided by sleep logs (SL), which despite being self-reported, are more accurate, providing information about actual daily sleep timing, which in turn, might be (or not) in accordance with circadian preferences[15]. An integration of all these instruments is required to have a reliable picture of individual sleep habits and circadian preferences of a given population.

In people with demanding physical or athletic training, sleep patterns and rest times as well as the time in which training is scheduled, are relevant to their performance. Athletes with long training days, extended working periods, and irregular rest in weekends, frequently have impaired sleep duration and efficiency[16]. As a particular case, dancers are competitive athletes who undergo extreme physical and mental stress and usually work according to an irregular schedule. However, the relationship between circadian preferences, sleep patterns, and performance in dancers has not been thoroughly evaluated so far. To our knowledge, only one previous study reports the decrease in sleep quality and the cognitive impairment ballet dancers suffer during training[17].

In this study, we took advantage of the Uruguayan public professional training in dance which is organized in two different shifts (morning and night). We aimed to evaluate the influence of these contrasting shifts on sleep timing and individual circadian preferences of dancing trainees from data obtained by questionnaires and SL. Both types of instruments showed that nocturnal dancers scheduled their sleep later than morning ones. In addition, nocturnal dancers reported later circadian chronotypes (measured by MSFsc) than morning dancers, with no differences in their circadian preferences measured by MEQ.

MATERIAL AND METHODS

Dancers from the Uruguayan public school for professional training in contemporary and folkloric dance (Escuela Nacional de Danza, END-SODRE, Ministerio de Educación y Cultura) were recruited to participate in this study (Table 1). To maximize school infrastructure usage, the END-SODRE is organized as a 4-year training program with classes taught from Monday through Friday in two shifts. First and second grade students attend the night shift (20:00 to 24:00) while students of the third and fourth grade attend the morning shift (8:30 to 12:30). Fifty-six dancers (29 from the morning shift and 27 from the night shift), mostly females, with age ranging from 18 to 30 years old met the inclusion criteria as participants of this study (Table 1). Dancers under self-reported treatment with psycho-active drugs, with missing data in questionnaires, and reporting the use of alarm clock during weekends were excluded from this study. Data were globally analyzed with no distinction among genders.

During August 2019, informational flyers and informed consent forms were distributed . Enrolled participants answered questionnaires during school-time. This study was evaluated by the Ethics Committee of the School of Psychology, Universidad de la República, and complied with the principles outlined by the Declaration of Helsinki (World Medical Association, 2013).

Table 1. Number of participants, gender, age and chronobiological characterization of the dancers training in morning-shift and night-shift.

		Total	Morning-shift	Night-shift	p
Participants (n)		56	29	27	
Gender (n)	Female	45	24	21	
	Male	7	3	4	
	Other	4	2	2	
Age (mean ± SD)		22.07 ± 2.49	22.55 ± 2.69	21.56 ± 2.19	0.1785
MSFsc (mean ± SD)		6:10 ± 1:52	5:43 ± 1:47	6:40 ± 1:52	0.0472
MEQ score (mean ± SD)		46.91±8,88	48.83±8.51	44.85±8.96	0.1092

The chronobiological characterization was assessed using the Spanish version of both the Munich Chronotype Questionnaire (MCTQ,[14] and the Morningness-Eveningness (MEQ, [13]). Validated MCTQ reports were used to assess the mid-sleep point on free days corrected for sleep debt on workdays (MSFsc) as a proxy of individual chronotype[3], and the social jetlag as the absolute difference between the mid-points of sleep on work and free days[5]. The MEQ score, calculated from the answers about preferred sleep time and daily performance inquired in the MEQ, was also considered as a proxy for individual circadian preference, with higher scores indicating greater morningness tendencies[13]. Participants were also instructed to answer daily WhatsApp messages every morning for 19 days (August 10-28, 2019, 13 workdays and 6 free days) to record their actual sleep timing. Sleep logs (SL) allowed us to measure the average individual midsleep point of work (MSW) and free days (MSF) (Table 2).

Data are expressed as mean values ± standard deviation throughout. As data did not comply with normality and/or homoscedasticity, statistical comparisons were analyzed by non-parametric tests: the Wilcoxon signed-rank test for comparisons between work and free days in the same individuals, the Mann–Whitney *U* test for comparisons across participants between shifts.

RESULTS

Twenty-nine dancers of the END-SODRE trained in the morning shift and 27 dancers trained in the night shift fulfilled the inclusion criteria to participate in this study (Table 1). Although earlier grades of the END-SODRE are scheduled in the night shift and last grades in the morning shift, the age of participants did not differ significantly across shifts (p=0.17; Mann-Whitney *U* test, Table 1).

The chronobiological characterization of the studied population was achieved using two largely validated questionnaires (MEQ and MCTQ), whose outputs were significantly correlated (R = -0.415, p = 0.0014; Fig. 1A). Average chronotype corresponded to an MSFsc of 6:10 ± 1:52, being significantly later in dancers attending the night shift (6:40 ± 1:52) than in morning-shift dancers (5:43 ± 1:47; Table 1). Mean social jetlag was 2.03 ± 1.71 h and correlated with MSFsc as expected (R = 0.464, p = 0.0003; Fig. 1B).

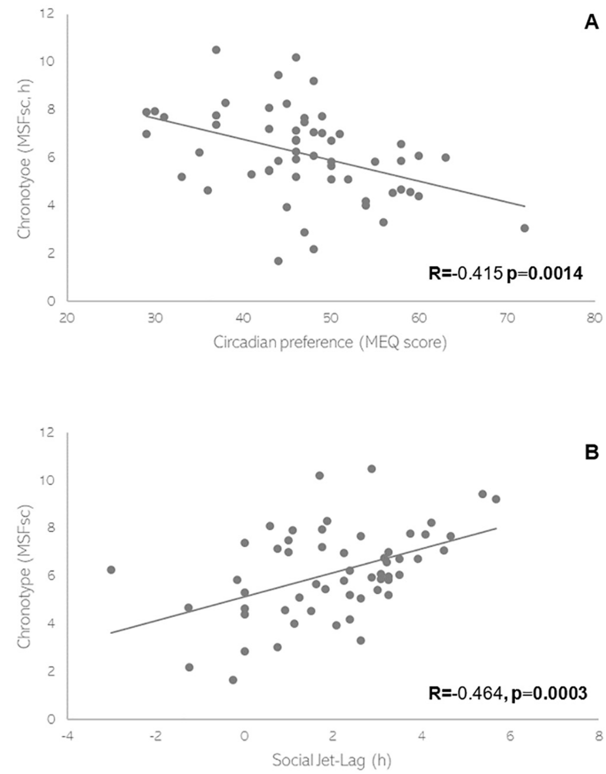

Figure 1. Linear regressions between midsleep point on free days corrected for sleep debt on workdays (MSFsc) and A) the score obtained from Morningness-Eveningness Questionnaire (MEQ); B) the social jet lag (SJL).

On the other hand, average circadian preferences corresponded to a MEQ score of 46.91 ± 8.88, with no significant differences between students attending the morning shift (48.83 ± 8.51) and the night shift (44.85 ± 8.96; Table 1).

Sleep timing was evaluated from the midsleep point calculated from data reported in MCTQ and SL, whose values were significantly correlated for both work (R = 0.889, p < 0.0001; Fig. 2A) and free days (R = 0.534, p < 0.0001; Fig. 2B). Both approaches consistently showed that sleep timing was significantly delayed in the free days respect to workdays in all the participants, being this delay longer in morning-shift dancers than in night-shift ones (Table 2). In addition, both MCTQ and SL data show that sleep is scheduled significantly later in night-shift dancers than in morning-shift ones in both work and free days (Table 2).

Table 2. Mid sleep point calculated using Munich Chronotype Questionnaire (MCTQ) and Sleep Logs for work (MSW) and free days (MSF), for dancers who attended morning-shift and night-shift.

	MCTQ n=56			Sleep Logs n=50		
	MSW	MSF	p[1]	MSW	MSF	p[1]
Morning-shift	3:38 ± 0:34	6:26 ±1:40	<0.0001 n=29	3:34 ±0:34	6:33 ±1:26	<0.0001 n=25
Night-shift	6:08 ±1:21	7:20 ±1:29	0.0027 n=27	5:55 ±1:05	7:07 ±1:08	<0.0001 n=25
p[2]	<0.0001	0.0221		<0.0001	0.0407	

[1] Wilcoxon Matched-Pairs test
[2] Mann-Whitney U test

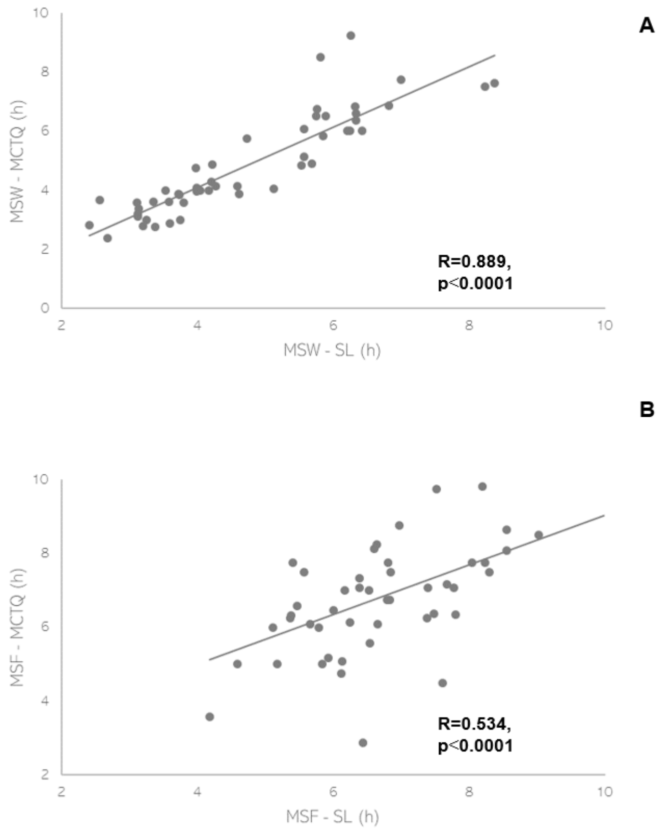

Figure 2. A) Workdays. Linear regression between midsleep point obtained from Munich Chronotype Questionnaire (MSW-MCTQ) and midsleep point obtained from Sleep logs (MSW-SL). B) Free days. Linear regression between midsleep point obtained from Munich Chronotype Questionnaire (MSF-MCTQ) and midsleep point obtained from Sleep logs (MSF-SL).

DISCUSSION

We present the chronobiological characterization of a group of young Uruguayan dancers being trained at the END-SODRE in two shifts, morning and night. Interestingly, although morning and night-shift dancers did not differ in their circadian preferences (measured by the MEQ score), individual chronotypes (estimated by MSFsc) were later in night shift-dancers respect to morning-shift ones.

The high quality of our data allows us to support our conclusions. First, as an internal validation of MCTQ, we found a significative correlation between MSFsc and social jet lag (Fig. 1A), indicating that later chronotypes are subjected to a significantly higher desynchronization as expected[5]. Secondly, we used two standard validated questionnaires (MCTQ and MEQ[13,14] to do the chronobiological characterization of the study population, whose results were, as expected, significantly correlated (Fig. 1B)[18]. Moreover, comparable data obtained from either the MCTQ questionnaire or the 19-days SL significantly correlated (Fig. 2), indicating the reliability of the self-reported information provided by the participants. Although age and gender differences in MSFsc have been previously reported[3], we did not attempt to discriminate these effects given that all participants were over 18 years old, their age was constrained into a narrow range, and the study population was mostly composed by females.

As previously reported in Uruguayan youngsters[6,19], chronotypes measured by MSFsc were very late in average while MEQ scores were not suggestive of lateness. This discrepancy is not surprising as both questionnaires explore different aspects of circadian preferences and was also evinced in a similar-age Uruguayan population[20]. Therefore, as the classification of circadian typologies depends on age, geographic, and cultural differences[3], it is important to combine the use of different instruments to actually assess the chronobiological characterization of a given population.

Self-reported data either from MCTQ forms or from daily WhatsApp messages (SL), were very consistent in showing differences between the sleep patterns of morning and night shift dancers (Table 2; Fig. 2). Differences in dancers' sleep schedules between the morning and the night shift resemble those observed in Latin American adolescents attending different high school shifts[6–9]. In particular, this study is in accordance with these previous reports by showing that chronotypes (measured by MCTQ) are affected by the training shift, being later in the night shift than in the morning one; and that sleep is more advanced during workdays in morning-shift dancers compared to night-shift ones. Interestingly, to our knowledge, no previous studies have taken advantage of training in shifts to explore its chronobiological impact in young adults as most studies of this kind have been focused on high school adolescents.

Social demands impose a chronic misalignment between the inner and social clocks, particularly in adolescents and young adults, resulting in sleep deficiency during workdays and sleep compensation during weekends[5,14]. Although sleep duration was not analyzed in this study, it is evident that both morning and night-shift dancers followed the expected changes between work and free days, delaying the occurrence of sleep during weekends.

In conclusion, dancers being trained in morning and night shifts offer the opportunity to test the impact of these contrasting shifts on circadian preferences and sleep patterns. In this first study of this advantageous population, we confirm that sleep schedules show the expected differences between shifts and between work and free days. More interestingly, the indicator of chronotype that relies on self-reported sleep patterns is extremely late and delayed in night-shift dancers with respect to morning-shift ones; while the indicator of circadian preference does not report differences across shifts.

ACKNOWLEDGMENTS

We wish to thank very specially the dancers of the END-SODRE who kindly volunteered as participants of this study. We are specially thankful to the Director of the School of Performing Arts-SODRE, Martín Inthamoussou, and to the Coordinators of the END-SODRE, Andrea Salazar and Emiliano D'Agostino for their support and logistic help. We also thank Micaela De Mori, Agustín Laguardia, Betania Martínez, and Luna Perla for their help in data collection and Adriana Migliaro for her suggestion and comments that help us to improve the manuscript.

REFERENCES

1. Adan A, Archer SN, Hidalgo MP, Di Milia L, Natale V, Randler C. Circadian typology: A comprehensive review. Chronobiol Int. 2012;29(9):1153–75.
2. Vink JM, Groot AS, Kerkhof GA, Boomsma DI. Genetic analysis of morningness and eveningness. Chronobiol Int. 2001;18(5):809–22.
3. Roenneberg T, Kuehnle T, Pramstaller PP, Ricken J, Havel M, Guth A, et al. A marker for the end of adolescence. Curr Biol. 2004;14(24):1038–9.
4. Roenneberg T, Kantermann T, Juda M, Céline V, Allebrandt K. Light and the Human Circadian Clock. In: Kramer A, Merrow M, editors. Circadian Clocks, Handbook of Experimental Pharmacology. Springer-Verlag Berlin Heidelberg; 2013. p. 311–31.
5. Wittmann M, Dinich J, Merrow M, Roenneberg T. Social jetlag: Misalignment of biological and social time. Chronobiol Int. 2006;23(1–2):497–509.
6. Estevan I, Silva A, Vetter C, Tassino B. Short sleep duration and extremely delayed chronotypes in Uruguayan youth: The role of school start times and social constraints. J Biol Rhythm. 2020;
7. Arrona-Palacios A, García A, Valdez P. Sleep-wake habits and circadian preference in Mexican secondary school. Sleep Med. 2015;16(10):1259–64.
8. Anacleto TS, Adamowicz T, Simões da Costa Pinto L, Louzada FM. School Schedules Affect Sleep Timing in Children and Contribute to Partial Sleep Deprivation. Mind, Brain, Educ. 2014;8(4):169–74.
9. Valdez P, Ramírez C, García A. Delaying and extending sleep during weekends: Sleep recovery or circadian effect? Chronobiol Int. 1996;13(3):191–8.
10. Hittle BM, Gillespie GL. Identifying Shift Worker Chronotype Implications for Health. Ind Health. 2018;56(6):512–23.
11. Gamble KL, Motsinger-Reif AA, Hida A, Borsetti HM, Servick S V., Ciarleglio CM, et al. Shift work in nurses: Contribution of phenotypes and genotypes to adaptation. PLoS One. 2011;6(4):1–12.
12. Estevan I, Silva A, Tassino B. School start times matter, eveningness does not. Chronobiol Int. 2018;35(12):1753–7.
13. Horne JA, Ostberg O. A self assessment questionnaire to determine Morningness Eveningness in human circadian rhythms. Int J Chronobiol. 1976;4(2):97–110.
14. Roenneberg T, Wirz-Justice A, Merrow M. Life between clocks: Daily temporal patterns of human chronotypes. J Biol Rhythms. 2003;18(1):80–90.
15. Genzel L, Ahrberg K, Roselli C, Niedermaier S, Steiger A, Dresler M, et al. Sleep timing is more important than sleep length or quality for medical school performance. Chronobiol Int. 2013;30(6):766–71.
16. Fischer FM, Nagai R, Teixeira LR. Explaining sleep duration in adolescents: The impact of socio-demographic and lifestyle factors and working status. Chronobiol Int. 2008;25(2–3):359–72.
17. Fietze I, Strauch J, Holzhausen M, Glos M, Theobald C, Lehnkering H, et al. Sleep quality in professional ballet dancers. Chronobiol Int. 2009;26(6):1249–62.
18. Zavada A, Gordijn MCM, Beersma DGM, Daan S, Roenneberg T. Comparison of the Munich Chronotype Questionnaire with the Horne-Östberg's morningness-eveningness score. Chronobiol Int. 2005;22(2):267–78.
19. Tassino B, Horta S, Santana N, Levandovski R, Silva A. Extreme late chronotypes and social jetlag challenged by antarctic conditions in a population of university students from Uruguay. Sleep Sci. 2016;9(1):20–8.
20. Silva A, Simón D, Pannunzio B, Casaravilla C, Díaz Á, Tassino B. Chronotype-Dependent Changes in Sleep Habits Associated with Dim Light Melatonin Onset in the Antarctic Summer. Clocks & Sleep. 2019;1(3):352–66.