Cogent Education

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/oaed20

Circadian rhythms in the university community: perception of health (dis) synchronisation

María Fernández Hawrylak, Elena Garrachón-Gómez, Ana García-Rodríguez, Sol García-Rodríguez & Cristina Alonso Tristán

To cite this article: María Fernández Hawrylak, Elena Garrachón-Gómez, Ana García-Rodríguez, Sol García-Rodríguez & Cristina Alonso Tristán (2025) Circadian rhythms in the university community: perception of health (dis) synchronisation, Cogent Education, 12:1, 2476272, DOI: 10.1080/2331186X.2025.2476272

To link to this article: https://doi.org/10.1080/2331186X.2025.2476272

Published online: 16 Mar 2025.

COGENT EDUCATION
2025, VOL. 12, NO. 1, 2476272
https://doi.org/10.1080/2331186X.2025.2476272

EDUCATIONAL PSYCHOLOGY & COUNSELLING | RESEARCH ARTICLE OPEN ACCESS Check for updates

Circadian rhythms in the university community: perception of health (dis) synchronisation

María Fernández Hawrylak[a], Elena Garrachón-Gómez[b], Ana García-Rodríguez[b], Sol García-Rodríguez[b] and Cristina Alonso Tristán[b]

[a]Terapia, Familia y Salud, TFS. Department of Science of Education, Universidad de Burgos, Burgos, Spain; [b]Research Group Solar and Wind Feasibility Technologies, SWIFT. Electromechanical Engineering Department, University of Burgos, Burgos, Spain

ABSTRACT

The aim of this research is to analyze circadian typologies in the community of the University of Burgos (Spain). In this study, 1,067 participants from three groups (students (ST), administrative and service staff (AS) and teaching and research staff (TR)) from all the educational centers completed the Morningness-Eveningness Questionnaire (MEQ) adapted to Spanish. The majority of the circadian typology in the three groups was intermediate, with a percentage higher than 60% in each of them. With this in mind, certain socio-demographic factors were also evaluated, such as age and gender. Younger participants tended to have an evening circadian typology. In terms of gender, both male and female participants who were not in the middle of the day were more representative of the morning typology. To complement the study, 9 participants were interviewed to explore the health effects of chronotype synchronisation/(de)synchronisation in the different university groups, with a stronger influence observed in students and teaching and research staff.

ARTICLE HISTORY
Received 31 July 2024
Revised 4 December 2024
Accepted 2 March 2025

KEYWORDS
Circadian types; chronodisruption; chronotype; academic community; MEQ

SUBJECTS
General Psychology; Higher Education; Health & Society

1. Introduction

The term 'chronotype' refers to the synchronisation of circadian rhythms, an underlying 24-hour physiological cycle that occurs in most living organisms. This means that some individuals are more active during daylight hours, while others are more active at night. This so-called 'chronotype' is regulated by everyone's circadian clock, which is uniquely timed (Reiter et al., 2021; Roenneberg et al., 2019; Wittmann et al., 2006).

The term 'circadian typology' is used to describe inter-individual differences in the optimal times for performing mental or physical activities (Ana Adan et al. 2012). Circadian types exert a direct influence on sleep-wake patterns, performance, and mood. These implications have been subjected to empirical study and applied in several domains, including work schedules, (Khan et al., 2020), academic performance (Borisenkov et al., 2022), and health and psychological well-being (Foster, 2020).

The differences in circadian typology are dependent on genetics (Danielsson et al., 2019), but also on other physiological factors such as melatonin levels, cortisol levels, or body temperature (Panjeh et al., 2021). A reliable determination of circadian typology would necessitate the measurement of one or more parameters. Nevertheless, the investigation of these variables is a challenging and time-consuming endeavour, rendering it impractical to conduct in large samples. In order to circumvent this limitation, researchers have initiated the development of alternative metrics with the objective of identifying and evaluating circadian typology. The first published study was the Morningness-Eveningness Questionnaire (MEQ) (Horne & Ostberg, 1976). This study was followed by the development of other metrics, including

CONTACT Cristina Alonso Tristán catristan@ubu.es, cristinaalonso.tristan@gmail.com Research Group Solar and Wind Feasibility Technologies, SWIFT. Electromechanical Engineering Department. University of Burgos, Avda. Cantabria s/n., 09006 Burgos, Spain

the Circadian Type Questionnaire (CTQ) (Folkard et al., 1979), the Diurnal Type Scale (DTS) (Torsvall & Akerstedt, 1980), the Composite Scale of Morningness (CSM) (Smith et al., 1989), and the Munich Chronotype Questionnaire (Roenneberg et al., 2003).

Although the MEQ was the first to be published, it is still the most widely used and referenced tool for the study of circadian typology (A. Adan et al., 2005; Di Milia et al., 2013; Arrona-Palacios & Díaz-Morales, 2017). The MEQ posits that individuals may exhibit one of three types: morning (larks), evening (owls), or intermediate. The morning type is characterised by early morning alertness, while the evening type is defined by late-night wakefulness. The intermediate type represents a combination of the morning and evening types, exhibiting characteristics of both (Beşoluk et al., 2011). A further distinction can be made within the morning and evening types, differentiating between definite and moderate, based on the score obtained in the questionnaire. Nevertheless, these types exhibit age-related variability (Paine et al., 2006; Fárková et al., 2020).

There is a growing and widespread concern about the potential health consequences of the continuing misalignment between work and social activities with our internal circadian rhythms. The most recent evidence from chronobiology and chrono-psychology challenges the organization of work, social, and academic times, suggesting that they do not align with biological rhythms. In addition to the quality of life, which can be defined as everyone's perception of their well-being (or lack thereof). The discrepancy between workdays and days off, as well as between social and biological time, has been referred to as 'social jetlag' (Wittmann et al., 2006). The internal clock is synchronised with solar time, which allows us to achieve our highest level of well-being and, consequently, a greater sense of happiness and efficiency. The greater the synchronisation of the social clock with the internal clock, the greater the likelihood of achieving these benefits.

The discrepancy between social and internal clocks has been demonstrated to affect health and perceived life satisfaction (Roenneberg et al., 2019). The circadian rhythms play a pivotal role in both physical and mental health. They are associated with cardiovascular and metabolic disturbances, as well as an increased risk of certain diseases (Kervezee et al., 2020). Furthermore, they are linked to depression and anxiety (Au & Reece, 2017). It has been demonstrated that circadian mismatches are particularly enhanced in shift workers (Juda et al., 2013; Fabbian et al., 2016). The relationship between shift work, irregular working hours and psychological health has been demonstrated in several studies (Ahmad et al., 2020; Rodríguez et al., 2020; Chellappa et al., 2020). This is evidenced by the fact that individuals engaged in such work tend to have shorter sleep duration and higher variability of sleep-wake times (Gao et al., 2019; Marqueta et al., 2017). This, in turn, has been shown to influence mood and even regional brain activity (Chellappa, 2020).

A review of published studies in this area reveals that few have been carried out in a university setting. The majority of these studies analyze students (Beşoluk et al., 2011; Natale et al., 2009) rather than workers. For this reason, the objective of this research is to investigate the schedule synchronisation of the entire university community. In particular, we wish to examine the health effects of the synchronisation or desynchronisation of chronotype in the different university groups (students, teaching and research staff and administrative and service staff), mediated by the cycles of alertness/activation and fatigue and self-perceived well-being. The research question, therefore, is to what extent there is an adjustment between the work or academic tasks and internal activity clocks of the university community, and how they perceive their health according to the established schedules. The study objectives are twofold: firstly, to ascertain the circadian types of the different groups within a Spanish university; and secondly, to investigate the impact of the institution's timetables on the health of workers and students, according to their circadian types.

This work is structured as follows: once the scientific framework of the research has been established and the main objectives and contributions of the work have been identified in the Introduction Section, the methodology employed in the study is outlined in Section 2. This section also describes the sociodemographic characteristics of the participants, and the mathematical techniques applied. The primary findings resulting from the quantitative and qualitative analysis of the surveys and interviews are presented in Section 3. Section 4 analyses critically the obtained results and, finally, main conclusions and future lines are summarised in Section 5.

2. Methodology

2.1. Research design

An explanatory, sequential, mixed methods (DEXPLIS) research design (Teddlie & Tashakkori, 2006; Hernández et al., 2014; Creswell & Clark, 2018) was conducted. This entailed a preliminary stage, during which quantitative data were gathered and analyzed, followed by a subsequent stage, during which qualitative data were collected and evaluated.

2.2. Participants

In the quantitative stage, the total sample, representative of the University of Burgos (Spain), is 1,067 subjects. The sample comprises Teaching and Research Staff (TR), Administration and Services Staff (AS), and students (ST). The representativeness of the sample was calculated using an online calculator http://www.raosoft.com/samplesize.html, n.d. A 95% confidence interval, a 5% error margin and a response distribution of 50% were chosen on a total population of 8,071 students, 1,052 Teaching and Research Staff and 409 Administrative and Service Staff. The Teaching and Research Staff and Students groups belong to seven educational centres (Faculties of Sciences, Health Sciences, Economics and Business Sciences, Law, Education, Humanities and Communication, and the Higher Polytechnic School) and the R&D&I/CIBA. In addition, the Administrative and Service Staff also work in the Administration and Services Building, the Rector's Office, and the University Library. The sample is composed of members of the three collectives, 579 students, 288 Teaching and Research Staff, and 200 Administrative and Service Staff between the ages of 18 to over 65 (Table 1).

In the qualitative stage, 9 participants from the University of Burgos were recruited, representing three groups (ST, AS and TR) with circadian types categorized as moderately morning, moderately evening and intermediate. The field was accessed naturally, through convenience sampling, whereby PhD students, teaching and research staff, and administrative and service staff were interviewed as they agreed to participate in the study. Three individuals from each group were selected to ensure representation of the intermediate circadian types, excluding extreme types (definitely morning and definitely evening) due to their low representation, falling outside the confidence interval. The participants were recruited on a voluntary basis, in accordance with the ethical criteria of confidentiality, informed consent, recording, and the finality of the results (Table 2).

2.3. Instruments and procedure

Upon approval from the Bioethics Committee of the University of Burgos (Ref. UBU 44/2021, June 15-2021), this stage entailed the distribution of an initial survey comprising questions pertaining to both socio-demographic data (such as age, sex, group affiliation, and occupational sector) and the Morningness-Eveningness Questionnaire (MEQ) by Horne and Ostberg (1976) validated in Spanish by Adan and Almirall (1990). The reliability of the MEQ in the sample belonging to the University of Burgos

Table 1. Description of the participants in the quantitative study.

	Collective			Gender			
Age	ST	AS	TR	Male	Female	Prefer not to answer	Other
18–24	398	8	6	215	195		2
25–34	89	20	61	60	107	1	2
35–44	51	18	61	53	74	3	
45–54	26	80	86	74	115	3	
55–64	10	73	64	60	86	1	
>65	5	1	10	10	6		

Collective	Male	Female	Prefer not to answer	Other
ST	295	280	1	3
AS	58	140	2	0
TR	119	163	5	1

Note: ST: Student, AS: Administration and Services Staff, TR: Teaching and Research Staff.

Table 2. Description of the participants in the qualitative study.

Subjects (S) - Collective	MEQ mark Circadian type	Gender	Age	Centre	Active years/Academic year
S1 – AS 1	68 Moderately Morning	M	55	Education	26
S2 – TR 1	37 Moderately Evening	F	53	Education	23
S3 – ST 1	40 Moderately Evening	F	27	Higher Polytechnic School	2nd PhD year
S4 – ST 2	42 Neither Type	F	30	Higher Polytechnic School	2nd PhD year
S5 – AS 2	51 Neither Type	F	40	Higher Polytechnic School	4
S6 – TR 2	47 Neither Type	F	37	Higher Polytechnic School	10
S7 – AS 3	39 Moderately Evening	F	42	Higher Polytechnic School	1
S8 – ST 3	63 Moderately Morning	M	35	Higher Polytechnic School	1st PhD year
S9 – TR 3	60 Moderately Morning	F	51	Higher Polytechnic School	27

Note: S1-S9: Participant 1-9, ST: Student, AS: Administration and Services Staff, TR: Teaching and Research Staff, M: Male, F: Female.

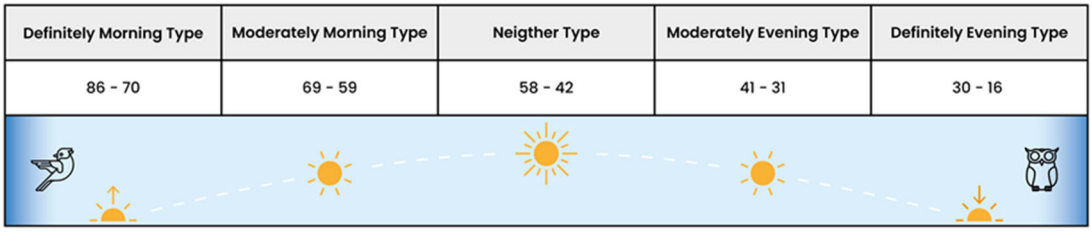

Figure 1. Circadian type classification according to the Morningness-Eveningness Questionnaire (MEQ) (*Source:* Own elaboration).

was evaluated with Cronbach's alpha (Cronbach, 1951), with a value of 0.81 obtained, indicating that the test internal consistency is good. This value is comparable to that obtained by other authors in their studies of the MEQ. The reliability of the MEQ was evaluated in several studies, with Cronbach's alpha values of 0.77 (Beşoluk et al., 2011; Li et al., 2011), 0.825 (Caci et al., 2009), 0.83 (Paine et al., 2006; Tonetti & Natale, 2019) and 0.84 (Fárková et al., 2020).

The MEQ consists of 19 questions with four or five multiple-choice answers. The questions cover sleep and wake times, preferred times for various mental or physical activities, alertness at different times of the day, etc. The circadian type of assessment is a self-assessment, as the final score is calculated by adding up the loadings assigned to the answers to each question. The final value obtained in this sum is the one that determines the circadian type obtained, according to the range of scores described below and summarized in Figure 1:

16-30: Definitely Evening Type
31-41: Moderately Evening Type
42-58: Neither Type
59-69: Moderately Morning Type
70-86: Definitely Morning Type

The questionnaire was disseminated to the university community through different channels: institutional e-mail, social networks of research groups and informative posters in the faculties and work centres of the University of Burgos. After explaining the objectives of the study, the participants signed the informed consent form included in the questionnaires.

Subsequently, in a second phase, in July and September 2023, interviews were conducted with the following semi-structured, open-ended questions, designed according to the existing literature (Gao et al., 2019; Roenneberg et al., 2019; Chellappa, 2020) to explore the health implications of chronotype synchronisation/(de)synchronisation of different groups of the university community:

- What changes do you notice in your body when you go to sleep at a different time than you are used to? How do you feel the next day?
- How does getting up earlier than usual change your daily routine?
- How does your daily routine change if you get up later than usual?

- How do you reconcile your work/academic schedule with your social schedule? How do social activities affect your biological clock? Has it always been like this?
- What challenges do you face in your work/academic schedule based on your sleep habits?
- If you have an important event the next day, does it change any patterns in your sleep routine the night before?
- Does sunlight influence you in any way?

Informed consent was required for participation, recording and transcription of the study interviews. Each participant chose the time and place of the interviews. Participants' behaviour was also observed during the interviews to take field notes. Each interview lasted between 15 and 20 minutes.

2.4. Data analysis

The statistical software package Statgraphics Centurion 19 licensed by the University of Burgos processed all the data from the questionnaires. Firstly, descriptive statistics were used, through the study of frequencies and percentages to describe the variables and inferential statistics (Pearson correlation coefficient, Pearson's chi-squared test, analysis of covariance (ANCOVA), Kolmogorov-Smirnov test and Student's t-test).

For the analysis of the information from the interviews, an inductive process was used following thematic and grammatical criteria, and categorical-thematic criteria considering the presence and absence of terms or concepts independently of each other, their frequency, intensity, and direction (Braun & Clarke, 2006, 2019). The data were analysed by the authors, university professors with different educational backgrounds focused on pedagogy and engineering, considering that the researchers' qualifications would enrich the data analysis. The analysis was carried out manually without prior categorisation by developing an initial coding framework based on in-depth reflection on the dataset as it was collected (Table 3). Thus, the conceptual structure derives from a naturalistic categorisation emerging from the data, which is structured around two themes.

To ensure neutrality in the findings and achieve trustworthiness, we endeavoured to adhere to the criteria of rigorous credibility or authenticity, presented by Lincoln and Guba and Guba and Lincoln for qualitative research (Lincoln & Guba, 1985; Guba & Lincoln, 1989). To ensure credibility or authenticity, study participants were selected according to the inclusion criteria (morning, evening, and intermediate circadian types). The interviews were transcribed by the authors and compared with the recordings. To ensure applicability or transferability, data were collected until theoretical saturation, where no new categories or themes emerged. To ensure coherence or consistency, all authors analysed the data simultaneously and agreed on disagreements. To ensure neutrality, epoché was practised during data collection and analysis of results to minimise author bias and reflect participant perceptions.

3. Results

3.1. Questionnaire results

After processing all responses from the MEQ, the results were classified by group, gender and age (Tables 4-7). The intermediate circadian type was the most common in the study sample, accounting for 66.5% of the total. The percentages of the other circadian typologies are much lower, moderately

Table 3. Analysis categories.

Categories: definition	Subcategories
Sleep effects in daily routines and organisms. It includes a description and some assessments in sleep habits, activities/tasks, and mood changes.	Bedtime.
	Effects on work routines (task focus).
	Effects on mood.
	Effects on the organism.
Reconciliation of timetables. It includes the explanation and exemplification of situations that have an impact on the work/academic timetable.	Discord between social activities and the biological clock.
	Background to the biological clock.
	Light effects on the organisms and the working environment.

Note: The table shows the two categories and the meanings that emerge in the study.
Source: Own elaboration.

Table 4. Circadian typology of the whole study sample (number of participants in each one and the percentage of the total sample).

	Definitely morning	Moderately morning	Neither Type	Moderately evening	Definitely evening
Total	19 (1.8%)	171 (16%)	710 (66.5%)	148 (13.9%)	19 (1.8%)

Table 5. Circadian typology by collective (number of participants in each one and the percentage of the total sample).

	Definitely morning	Moderately morning	Neither Type	Moderately evening	Definitely evening
ST	6 (0.6%)	51 (4.8%)	395 (37%)	115 (10.8%)	12 (1.1%)
AS	5 (0.5%)	56 (5.2%)	129 (12%)	8 (0.8%)	2 (0.2%)
TR	8 (0.8%)	64 (6%)	186 (17.4%)	25 (2.3%)	5 (0.5%)

Note: ST: Student, AS: Administration and Services Staff, TR: Teaching and Research Staff.

Table 6. Circadian typology by gender (number of participants in each one and the percentage of the total sample).

	Definitely morning	Moderately morning	Neither Type	Moderately evening	Definitely evening
Female	9 (0.8%)	92 (8.6%)	396 (37.1%)	78 (8.1%)	8 (0.7%)
Male	10 (0.9%)	78 (7.3%)	306 (28.6%)	67 (6.2%)	11 (1%)
Other	0 (0%)	0 (0%)	3 (0.2%)	1 (0%)	0 (0%)
Prefer not to answer	0 (0%)	1 (0%)	5 (0.4%)	2 (0.1%)	0 (0%)

Table 7. Circadian typology by age (number of participants in each one and the percentage of the total sample).

	Definitely morning	Moderately morning	Neither Type	Moderately evening	Definitely evening
18-24	1 (0%)	26 (2.4%)	285 (26.7%)	92 (8.6%)	8 (0.8%)
25-34	2 (0.2%)	20 (1.9%)	126 (11.8%)	19 (1.8%)	3 (0.3%)
35-44	1 (0%)	17 (1.6%)	91 (8.5%)	18 (1.7%)	3 (0.3%)
45-54	8 (0.8%)	50 (4.7%)	115 (10.8%)	15 (1.4%)	4 (0.4%)
55-64	7 (0.7%)	52 (4.9%)	83 (7.8%)	4 (0.4%)	1 (0%)
>65	0 (0%)	6 (0.6%)	10 (0.9%)	0 (0%)	0 (0%)

Table 8. Circadian typology by Faculty (number of participants in each one and the percentage of the total sample).

	Definitely morning	Moderately morning	Neither Type	Moderately evening	Definitely evening
R&D&I /CIBA Center	0 (0%)	0 (0%)	1 (0.2%)	0 (0%)	0 (0%)
Faculty of Sciences	2 (0.4%)	0 (0%)	22 (3.8%)	6 (1%)	0 (0%)
Faculty of Health Sciences	0 (0%)	3 (0.5%)	18 (3.1%)	4 (0.7%)	0 (0%)
Faculty of Economic and Business Sciences	0 (0%)	6 (1%)	21 (3.6%)	13 (2.3%)	2 (0.4%)
Faculty of Law	0 (0%)	3 (0.5%)	26 (4.5%)	7 (1.2%)	0 (0%)
Faculty of Education Sciences	0 (0%)	7 (1.2%)	54 (9.3%)	16 (2.8%)	1 (0.2%)
Higher Polytechnic School	1 (0.2%)	17 (2.9%)	196 (33.9%)	55 (9.5%)	6 (1%)
Faculty of Humanities and Communication	3 (0.5%)	15 (2.6%)	57 (9.8%)	14 (2.4%)	3 (0.5%)

morning (16%), moderately evening (13.9%) and definitely morning and definitely evening represent 1.8% of the total responses (Table 4).

Regarding to the university community (Table 5), the general trend is an intermediate circadian typology (neither type), but if morning and evening trends are grouped together, it shows that students are more evening (21.9% compared to 9.8%) and the AS and TR staff are more morning (30.5% compared to 5% and 25% compared to 10.4%, respectively).

In the case of gender (Table 6), for both males and females the highest percentage was for the intermediate circadian typology (64.8% and 67.9%, respectively). Few differences can be established between the morning and evening of the male and female, as the responses obtained from both were very similar. The mean MEQ value for the male gender was 49.33 and 49.95 for the female gender.

The questionnaire analysis according to age (Table 7) shows that the intermediate circadian typology is again predominant in all age ranges. It is worth highlighting the 18–24 age range, where 24.3% of the participants have an evening circadian typology compared to 6.6% with a morning type, and the 45–54 and 55–64 age ranges, where 30.2% and 40.1% of the participants have a morning tendency compared to 9.9% and 3.4% with an evening tendency, respectively.

Finally, the tendency of the students according to their faculty was analyzed (Table 8). 71.3% of students at the Higher Polytechnic School have an intermediate circadian typology, compared to 50% who have the same typology at the Faculty of Economics and Business Studies. In the same faculty, the

percentage of students with an evening typology is 35.7%, compared to 18.5% in the Faculty of Humanities and Communication and 16% in the Faculty of Health Sciences. The percentages are lower for morning students. For example, in the Faculty of Education Sciences, only 9% of the students have a morning circadian typology, and in the Faculty of Law, 8.3%.

3.2. Statistics

The first part of the statistical treatment of the data was based on descriptive statistical tests as shown below (Table 9). Descriptive statistics were applied to the entire dataset.

As for the inferential statistics, we began by performing the Least Significant Difference (LSD) analysis to study the difference in means between the three collectives (Table 10). As can be seen, there is a significant difference between the students (ST) and the other two groups (AS and TR). Therefore, AS and TR are homogeneous groups as they do not have statistically significant differences between their means.

After that, the Pearson correlation coefficient and the p-values for the total score obtained according to gender, age and collective (Table 11). This test shows that the variables gender and collective have an insignificant relationship with circadian typology. On the other hand, age has a value between 0.3-0.5, so its relationship with circadian typology is weak.

Then, the chi-square test was performed for the male and female genders obtaining a value of 2.4 and a p-value of 0.663. This indicates that gender does not influence the final MEQ score obtained. The options of prefer not to answer and other gender represent 1.12% of the total sample. For this reason, they have not been considered for this statistical test.

After analysis of covariance (ANCOVA), it was found that age had a very significant effect on chronotype (F-ratio = 34.62; p-value = 0.00) while having the participant's gender as a covariate had no influence on the final score (F-ratio = 0; p-value = 0.9760) (Table 12).

Table 13 shows the results of the ANCOVA analysis of gender on the final score. Gender does not influence the final chronotype (F-ratio = 0.55; p-value = 0.6470) but age as a covariate is a determinant of the final score (F-ratio = 169.61; p-value = 0.00) (Table 13).

Table 9. Descriptive statistical analysis of the participants' total score.

Count	1067
Average	50.5
Median	51.0
Mode	
Variance	79.1
Standard deviation	8.9
Minimum	17.0
Maximum	81.0
Range	64.0
Lower Quartile	44.0
Upper Quartile	56.0
Interquartile Range	12.0

Table 10. Least Significant Difference analysis between the three collectives.

Contrast	Significance	Difference
ST - AS	*	−2.47296
ST - TR	*	−1.69921
AS - TR		0.77375

Note: ST: Student, AS: Administration and Services Staff, TR: Teaching and Research Staff. * indicates significant difference.

Table 11. Pearson correlation coefficients and *p*-values for the total score obtained according to gender, age and collective.

	Pearson's coefficients	*p*-values
Gender	−0.03	0.3711
Age	0.37	0.0000
Collective	0.09	0.0023

Table 12. ANCOVA analysis for age as the main factor and gender as a covariate.

	Sum of squares	Degrees of freedom	Mean square	F-ratio	*p*-value
COVARIATE					
Gender	0.0619167	1	0.0619167	0.00	**0.9760**
MAIN EFFECTS					
Age	11831.8	5	2366.35	34.62	0.0000
RESIDUALS	72443.7	1060	68.3431		
CORRECTED TOTAL	84338.7	1066			

Table 13. ANCOVA analysis for gender as the main factor and age as a covariate.

	Sum of squares	Degrees of freedom	Mean square	F-ratio	*p*-value
COVARIATE					
Age	11601.4	1	11601.4	169.61	**0.0000**
MAIN EFFECTS					
Gender	113.246	3	37.7487	0.55	0.6470
RESIDUALS	72642.9	1062	68.402		
CORRECTED TOTAL	84338.7	1066			

Table 14. P-values obtained in the Kolmogorov-Smirnov test.

Total sample	0.1091					
Gender	**Female**	**Male**				
	0.2694	0.5100				
Collective	**ST**	**AS**	**TR**			
	0.2113	0.4091	0.2328			
Age	**18-24**	**25-34**	**35-44**	**45-54**	**55-64**	**> 65**
	0.2534	0.6802	0.5404	0.2202	0.3119	0.8723

Note: ST: Student, AS: Administration and Services Staff, TR: Teaching and Research Staff.

The Kolmogorov-Smirnov test was carried out to study the normality of the large sample size. Table 14 shows all the *p*-values obtained in this test. As can be seen, all values are higher than 0.05, so the MEQ score is not significantly different from a normal distribution by gender, age or collective.

The final statistical test performed was the Student's t-test for independent samples. The resulting t-value was 0.1993, with a corresponding p-value of 0.3078. These values indicate that the mean scores of the male and female genders are equal.

3.3. Results of the interviews

Through the analysis of the interview data, two themes or axes were identified about the perception of the different university groups about their health and well-being concerning chronotype synchronisation/(dis)synchronisation:

3.3.1. Describing alterations in the body and routines

All the participants reported difficulties in regulating their sleep due to changes in their sleep schedule, either by going to bed earlier or later than usual. Most of them reported physical and emotional changes in their bodies (tiredness, mood changes, stress, tension problems, etc.) when they did not sleep a certain number of hours, both for those with a morning and evening circadian rhythm and for those with a circadian rhythm in between [S1,2,3,4,5,6,8]. Among the logical consequences of changing sleep habits, those with a morning circadian rhythm [S1,8,9] report being less alert or less concentrated and feeling underperformed when they go to bed late:

> […] I find it more difficult to be alert. [Subject1- AS-1].

> […] I find it more difficult to concentrate on tasks that require some attention; I am more tired physically and mentally […][Subject8 - ST-3].

> Generally, I am very sleepy and tired when I have been up late […]. [Subject9 - TR-3].

Those with an evening circadian rhythm (S2, 3, 7) report a sense of disorientation and inefficiency when waking up early:

> However, from the moment the alarm clock goes off, which I have to set super loud […], it takes me at least two or three hours to have a clear head […]. [Subject2 -TR-1].

> […] I don't know if it would be the word concentration, but I can say that I am more absent-minded or I overlook things that I would normally take into account. [Subject3 - ES-1].

> […] I feel disorientated, and I find difficult to follow the usual rhythm of my tasks. Subject7 – AS-3].

Three participants exhibited an intermediate type [S4, 5, 6], and two of them reported difficulties in performance when waking up later than usual:

> The day already starts stressful because I feel like I have a backlog of tasks because I overslept. My performance goes down because I am upset, and things don't go well for me that day. [Subject4 - ST-2].

> […] if I get up later on weekdays I feel out of place, and it is difficult for me to followthe usual rhythm of my tasks. [Subject6 - TR-2].

while a third person pointed out that the time is more profitable:

> […], but by making better use of the time because I have been able to rest a little longer in the morning, I manage to do the same amount of work as if I had got up earlier. [Subject5 - AS-2].

Three participants from the teaching and research staff and students reported experiencing difficulties in falling asleep before an important event the following day. 'But I also try not to commit myself to activities that are too early because, besides, I sleep terribly in case I don't wake up'. [Subject2 - TR-1].

> If I have an important event, the previous night I don't usually sleep, my brain won'tlet me, and I am overthinking. [Subject4 - ST-2].

> […] And also, I usually wake up during the night several times and before the alarmclock goes off, because of the feeling that I'm going to fall asleep and not make it to the event in time. [Subject9 - TR-3].

3.3.2. Reconciling schedules

Regardless of circadian and collective type, most participants revealed difficulties in trying to reconcile their social and work/academic clock with their biological clock. One participant state that they are incompatible [S1], and a majority have seen social activities significantly reduced [S1, 2, 3, 4, 5, 6] and relegated to weekends [S3, 6, 7, 8]. Nevertheless, the majority of respondents indicated a preference for engaging in social activities such as meeting friends or family [S3, 4, 6, 7, 7, 8, 9].

In contrast to the relatively stable timetable for Administration and Services Staff, Teaching and Research Staff and students experience greater variation and irregularity in their timetables, with a lengthening of the working/academic day. Consequently, their experiences are expressed with greater discomfort.

> Having early classes is a challenge for me, but being at the faculty all day is worse; […] And if I go out at night because I have classes late in the afternoon, it accentuates that feeling of discomfort, of coming in at night and going out at night. [Subject2- TR-1].

> At University, the timetable is more constant, as I try to come in at the same time every day; the time I leave depends on other factors […]. [Subject3 – ST-1].

> […] although in winter it is strange to go into class during the day and leave at night. [Subject8 - ST-3].

> It does affect me a lot to start the day when it's still dark: going to work in the dark makes me quite depressed. And those days when you go in at night and the day is so long that you go out again at night, it makes me very tired, it feels like I have not experienced anything that day. [Subject9 - TR-3].

The lengthening and variation in working hours about arrival and departure affect the timing of meals [S1, 2]. This in turn, implies the need to take a nap for those who have the habit or the possibility to do so [S2, 3, 4, 7, 8].

The modification of sleep routines, such as an earlier bedtime in anticipation of a subsequent activity or an earlier departure from an evening social gathering on weekdays, is a practice observed across all

circadian types [S2, 3, 5, 6, 7, 8]. Two respondents indicated that they prioritized work [S2, 3], while two others indicated that they prioritized rest [S5, 9]. Three respondents indicated that they incorporate physical activity into their daily routines [S6, 8, 9]. Despite experiencing difficulties in waking up early, one of the participants with an evening circadian rhythm expressed a preference for activities with more nocturnal schedules [S2, 3, 7]:

> [...] The best times for my social activities and when I feel most comfortable are from 18:00 until dinner. [Subject4 - ST-2].

This idea was also expressed by a participant with an intermediate type:

> I prefer social activities in the late afternoon or even at night because that is the time of the day when I feel the best. [Subject7 - AS-3].

Finally, in relation to sunlight, two respondents indicated that they were not affected by the brightness to fall asleep [S1, 3], while participants [S2, 4, 7, 8, 9] were disturbed by the light to sleep. On the other hand, while one participant [S1] explained that he was bothered by getting up at night to go to work, participants [S2, 3, 6] reported how it affected them, and several reported being more active when the days were longer [S5, 6, 7].

3.4. Influence on success rate according to teaching timetable

The success rate has been studied in those degree courses in which odd-numbered academic years are scheduled in the morning and even-numbered years in the afternoon. The data were obtained from the Information Service of the University of Burgos.

Dividing the courses into two blocks (first and second year, third and fourth year), the success rate is higher in the courses conducted in the afternoon. The biggest difference in the pass rate between the first and second year is in the Chemistry degree, with a difference of 13.9%. The most notable difference between the third and fourth year was found in the Mechanical Engineering degree, with an 18.1% higher pass rate for afternoon timetable (Table 15).

4. Discussion

The objective of this study was twofold: firstly, to identify the circadian types of the diverse collectives at the University of Burgos; and secondly, to examine the impact of the institution's timetabling on the health of both workers and students, according to their chronotypes.

The MEQ score range of this study was 17-81, like those obtained by other authors: 18-74 (Ana Adan & Almirall, 1990), 17-78 (Ana Adan & Natale, 2002), 23-81 (Paine et al., 2006). In the case of the Chinese version of the MEQ conducted with 188 volunteers aged 19-51, the range of scores is narrower, ranging from 31-76 (Li et al., 2011). The mean value for the whole sample (50.5) was slightly higher than the mean value of 48.9 obtained by 42 students aged 19-29 (Gao et al., 2019) but lower than the value of 60.29 obtained by Li et al. (2011) in their study.

The results of this study stand out for the high accumulation of frequencies of intermediate scores (66.5%), as in other studies: 61% (Ana Adan & Almirall, 1990), 59.95% (Ana Adan & Natale, 2002), 62.7% (Tonetti & Natale, 2019). In the case of the morning and evening typologies, 17.8% and 15.7% respectively, the percentages do not correspond very well with those of other studies. In the study by Adan and Natale (Ana Adan & Natale, 2002) with a sample of 2,706 Spanish and Italian participants aged between 18 and 30, most of them students, the percentages of morning and evening typology were 12.29% and 27.76% respectively. This is not the case in the study of the Chinese population by

Table 15. Sucess rate of students from different degrees during the 4 academic years.

	First year	Second year	Third year	Fourth year
Chemistry	59.4%	73.32%	82.68%	97.78%
Computer Engineering	71.34%	73.61%	74.32%	90.34%
Mechanical Engineering	70.67%	71.42%	75.78%	93.87%
Industrial Electronics and Automation Engineering	65.92%	71.08%	84.3%	97.71%

Note: In orange: Morning timetable. In green: Afternoon timetable.

Li et al. (2011), where 55.32% of the sample was moderately morning type compared to 30.85% who obtained the intermediate circadian typology. Similar result was obtained in the New Zealand population study, where 49.8% of the sample were morning types while only 5.6% were evening types (Paine et al., 2006). This was because the individuals in this group ranged in age from 30 to 49. However, in the present study, in light of the scores on the questionnaires and the content of the interviews, it can be hypothesized that participants may be articulating more extreme self-evaluations of their circadian types than moderate or intermediate: 'If it is a working day and I have gone to bed later, then I do the same, but more tired and in the evening I am not at ease. If it is a day that is not a working day, then I do not have the head for much more' [Subject1 - AS-1]; '[…] but when eight or nine o'clock at night comes, it is as if I have missed everything […]. Well, it's as if I'm strangely well, I'm still tired, but my head can think more clearly' [Subject2 - TR-1]; 'If I get up later than usual, I feel more rested and, therefore, I get more out of the activities I do during the day' [Subject6 - TR-2].

Several studies point out that age is a key factor in determining circadian typology, stating that, as age increases, there is a tendency for individuals to become more morning-oriented (Paine et al., 2006; Fárková et al., 2020). This tendency is also evident in the present study, with 27 participants aged 18-24 years exhibiting a morning circadian typology, in contrast to 59 participants aged 55-64 years who exhibited the same circadian typology. After calculating Pearson's coefficient for age ($r = 0.37$) a slight relationship with circadian typology is observed. In other studies, age was highly significant in the three circadian typologies: morning, intermediate, and evening (Caci et al., 2009). Furthermore, the majority of participants referenced this circumstance during the interviews: 'No, when I was younger, I socialised more in the evenings […] and, the next day I could continue with my routine, even if I had gone to bed later than usual, which I cannot do now' [Subject7 - AS-3]; 'When I was younger I could stay up later during the week without hardly noticing it the next day […]' [Subject8 - ST-3].

With regard to gender, there is no consensus opinion. Some studies indicate that females show more morningness in their circadian typology than males (Ana Adan & Natale, 2002; Randler, 2007; Beşoluk et al., 2011) while others indicate just the opposite (Ana Adan & Almirall, 1990). After calculating Pearson's coefficient ($r = -0.03$) and performing an analysis of covariance (ANCOVA) (F-ratio = 0.55; p-value = 0.6470) it was found that there is no significant relationship between MEQ score and gender ($r = -0.03$) as in other researches (Paine et al., 2006; Caci et al., 2009; Natale et al., 2009; Fárková et al., 2020). As for the mean values of the MEQ score, almost equal for both genders, 49.33 male and 49.95 female, they are very close to those of the study of 3,446 citizens of the Czech Republic who obtained a mean score on the same questionnaire of 51.49 for the male gender and 51.06 for the female gender (Fárková et al., 2020).

The frequency distribution of MEQ scores correlated normally for the whole sample according to the Kolmogorov-Smirnov test (Ana Adan & Natale, 2002; Li et al., 2011). This is not the case in all studies as age was not normally distributed in the study by Caci et al. (2009).

The results reveal that more than half of the students in the study (68.2%) have an intermediate circadian typology, while 9.8% have a morning circadian typology and 22% have an evening circadian typology. These percentages differ from those obtained in a study of students at a Turkish Faculty of Education (Beşoluk et al., 2011) where the morning students' percentage (19.1%) is higher than that of evening students (14.8%). Considering only the age range between 18 and 24 years and the student collective, the percentage of evening typologies (definite and moderate) obtained at the University of Burgos (24.4%) is slightly higher than that obtained in students of the same ages at the Faculty of Education in Turkey (14.9%). On the other hand, the opposite is true for morning typologies, 6% at the University of Burgos compared to 19.1% at the University of Turkey (Beşoluk et al., 2011).

In the interviews, participants reported health effects due to discrepancies between social and internal clocks, i.e. what are known as chronodisruptions, leading to illness. The data obtained from the questionnaires and interviews in combination enabled the establishment of the perceptions of the three target groups regarding their health and well-being in relation to chronotype synchronisation and desynchronisation. The data from the questionnaires and qualitative interviews indicated that, regardless of circadian type, the University of Burgos timetables did not appear to pose an initial conflict. However, while the majority of questionnaire respondents (66.5%) indicated intermediate scores, those with all three circadian types reported anecdotes of altered well-being and health when participating in evening

social activities and early morning academic/work commitments. This suggests that social activities (dinners and cultural events) in our context are not compatible with the University's academic and work schedule. Furthermore, undertaking work tasks or participating in social activities that necessitate the sacrifice of hours of sleep in favour of academic and work objectives, as reported by participants from the TR and ST representative collectives, is associated with more pronounced effects on health.

These narratives of students, Teaching and Research, and Administrative and Service Staff are linked to one of the most contentious debates of the present era, and one that is likely to become more prevalent: the four-day working week. The end of the industrial age and the transition to the technological age demonstrate that it is possible to produce more in less time. It can be observed that, on average, one-fifth of an individual's time is spent at work (19.25%) and the remaining time is considered as leisure time. Nevertheless, the objective is to reduce this working time without compromising individual or collective wealth. The experiences of several European countries demonstrate that this is not only feasible but also advisable.

Recent studies have indicated that early school start times may have a detrimental effect on students' sleep and daytime functioning. Yeo et al. (2023) observed that students who attended subjects taught in the early morning exhibited diminished performance compared to those taught later in the day. Furthermore, the study found that the attendance rate was approximately ten percentage points lower for students who commenced classes at an earlier hour compared to those who commenced classes later in the day. These findings are consistent with those of the present study, which revealed that the majority of students who completed the MEQ questionnaire exhibited an intermediate or evening chronotype, with enhanced performance when academic activities were conducted in the evening. For instance, in the Mechanical Engineering degree programme, there was a notable difference of approximately 18% between the third and fourth years, with afternoon teaching demonstrating a superior outcome. However, other researchers have reported that students with a morning chronotype tend to outperform those with an afternoon chronotype (Toscano-Hermoso et al., 2020).

Delaying the start time of academic and work activities could be a strategy to enhance the quality of life for students and workers. Some public health recommendations emphasize the importance of aligning schedules with circadian rhythms, especially in young adults, who tend to exhibit evening chronotypes (Cheng & Carroll, 2020; Roenneberg et al., 2004). Alfonsi et al., 2020 and Bruno et al., 2023 have shown that later start times support better sleep, improved cognitive performance, and overall well-being. These studies could also be applied to university students since, as mentioned above, the majority of 18–24-year students have intermediate or evening chronotypes. Adjusting study and work schedules to accommodate biological rhythms could have important public health benefits.

The main strengths and limitations correspond to those of any mixed methods study. The scarcity of studies focused on the university environment makes it difficult to establish comparisons. Obtaining a representative sample in the quantitative phase, together with the qualitative approach to go deeper into the phenomenon, made it possible to provide a detailed description of circadian typologies at the University of Burgos and of the participant's perception of the effects of chronotype (des)synchronisation on health. The mixed-method design highlighted the discrepancies that may arise from social desirability and tensions in sharing personal views and experiences of the three groups on the continuing mismatch between work and social and internal clocks. Nevertheless, this study could provide an explanatory framework to contribute to a greater sensitivity to the convenience of organising university timetables in a way that respects the social needs of students, Teaching and Research, and Administrative and Service Staff.

5. Conclusions

The majority circadian typology in the different members of the university community is intermediate, exceeding 60% in each of the groups: 68.2% ST, 64.5% AS, and 64.6% TR. This indicates that age is a determining factor in the circadian typology, as only 6.6% of participants aged 18-24 have a morning circadian typology, compared to 40.1% of participants aged 55-64 who present the same typology. This corresponds to the results obtained by collectives, as a higher percentage of students present an evening circadian typology, and the AS and TR are more represented in the morning circadian typology. It

should be noted that 68.7% of the students are between 18 and 24 years old, but in the AS and TR the highest percentage of participants are between 45 and 54 years old (41.7% and 44.8%, respectively). In terms of gender, in both cases, male and female, the tendencies were more morning than evening. In terms of educational centres, the Faculty of Humanities and Communication is the only one that has a higher percentage of participants with a morning circadian typology than an evening one, the rest have a higher percentage of participants with an evening circadian typology. In the context of this study, an increasing discrepancy between the daily rhythm of biological and social clocks is observed in the three collectives. Apart from circadian rhythms, the TR and ST groups report greater discomfort in relation to flexible working hours, which leads more often than desired to a lengthening of the working day and more perceived detrimental effects on health.

Acknowledgements

The authors wish to thank the entire University of Burgos community for their collaboration and participation in this study.

Institutional review board statement

This article has received ethical institutional approval (Ref. UBU 44/2021), June 15-2021 from the Bioethical Committee of University of Burgos.

Informed consent statement

This study adhered to ethical standards outlined by the American Psychological Association (APA) and the National Association of Psychology regarding human subjects. Participants were fully informed about the study's purpose, procedures, and voluntary nature. They were assured of anonymity, and no identifying information or medical treatment was involved. Participants were aware of their right to withdraw from the study at any time. By initiating the survey, participants were considered to have read and accepted the informed consent.

Author contributions

Conceptualization, C.A-T and M.F.H.; methodology, M.F.H; software, A.G-R and S.G-R.; validation, E.G-G., A.G-R and S.G-R.; formal analysis, E.G-G., A.G-R and S.G-R.; investigation, E.G-G.; resources, E.G-G.; writing—original draft preparation, E. G-G and M.F.H.; writing—review and editing, C.A-T.; visualization, E.G-G., A.G-R and S.G-R.; supervision, C.A-T.; project administration, C.A-T.; funding acquisition, C.A-T. All authors have read and agreed to the published version of the manuscript.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This research is a result of the following projects: TED2021-131563B-I00 funded by MCIN/AEI/10.13039/501100011033 and by the 'European Union NextGenerationEU/PRTR'; PID2022-139477OB-I00, funded by MCIN/AEI/10.13039/501100011033 and by 'ERDF A way of making Europe', by the 'European Union'; INVESTUN/22/BU/001, Junta de Castilla y León, Consejería de Industria, Comercio y Empleo and BU042G24, from Consejería de Educación. One of the authors, Elena Garrachón Gómez thanks to University of Burgos for her predoctoral contract (2023-2027). No funding sources had any influence on study design, collection, analysis, or interpretation of data; manuscript preparation; or the decision to submit for publication.

About the authors

María Fernandez Hawrilak is full professor of Educational Sciences at Burgos University. Her main research interest are - Attention to diversity, and affective-sexual, emotional and artistic education.

Elena Garrachon-Gómez has a degree in environmental sciences and is working on her doctoral thesis in urban physics.

Ana García Rodríguez is assistant professor in the Mathematics department and a specialist in solar resource modelling.

Sol Garcia Rodríguez is assistant professor in the Mathematics department and a specialist in solar resource modelling.

Cristina Alonso Tristán is full professor of Thermal Engineering and Heat Transfer at Burgos University. Her main research interest are renewable energy, urban physics and thermodynamics properties of industrial fluids.

Data availability statement

The corresponding authors hold the data sets generated and analyzed during this study and are willing to share them upon request.

References

Adan, A., & Almirall, H. (1990). Adaptation and standardization of a Spanish version of the morningness-eveningness questionnaire: Individual differences. *Personality and Individual Differences*, *11*(11), 1123–1130. https://doi.org/10.1016/0191-8869(90)90023-K

Adan, A., & Natale, V. (2002). Gender differences in morningness-eveningness preference. *Chronobiology International*, *19*(4), 709–720. https://doi.org/10.1081/CBI-120005390

Adan, A., Archer, S. N., Hidalgo, M. P., Di Milia, L., Natale, V., & Randler, C. (2012). Circadian typology: A comprehensive review. *Chronobiology International*, *29*(9), 1153–1175. https://doi.org/10.3109/07420528.2012.719971

Adan, A., Caci, H., & Prat, G. (2005). Reliability of the Spanish version of the composite scale of morningness. *European Psychiatry: The Journal of the Association of European Psychiatrists*, *20*(7), 503–509. https://doi.org/10.1016/j.eurpsy.2005.01.003

Ahmad, M., Md Din, N. S. B., Tharumalay, R. D., Che Din, N., Ibrahim, N., Amit, N., Farah, N. M., Osman, R. A., Abdul Hamid, M. F., Ibrahim, I. A., Jamsari, E. A., Palil, M. R., & Ahmad, S. (2020). The Effects of circadian rhythm disruption on mental health and physiological responses among shift workers and general population. *International Journal of Environmental Research and Public Health*, *17*(19), 7156. https://doi.org/10.3390/ijerph17197156

Alfonsi, V., Scarpelli, S., D'Atri, A., Stella, G., & De Gennaro, L. (2020). Later school start time: The impact of sleep on academic performance and health in the adolescent population. *International Journal of Environmental Research and Public Health*, *17*(7), 2574. https://doi.org/10.3390/ijerph17072574

Arrona-Palacios, A., & Díaz-Morales, J. F. (2017). Morningness–eveningness and sleep habits at school: A comparative study between Mexico and Spain. *Biological Rhythm Research*, *48*(2), 175–188. https://doi.org/10.1080/09291016.2016.1245459

Au, J., & Reece, J. (2017). The relationship between chronotype and depressive symptoms: A meta-analysis. *Journal of Affective Disorders*, *218*(April), 93–104. https://doi.org/10.1016/j.jad.2017.04.021

Beşoluk, S., Onder, I., & Deveci, I. (2011). Morningness-eveningness preferences and academic achievement of university students. *Chronobiology International*, *28*(2), 118–125. https://doi.org/10.3109/07420528.2010.540729

Borisenkov, M. F., Popov, S. V., Smirnov, V. V., Dorogina, O. I., Pecherkina, A. A., & Symaniuk, E. E. (2022). Later school start time is associated with better academic performance, sleep-wake rhythm characteristics, and eating behavior. *Chronobiology International*, *39*(11), 1444–1453. https://doi.org/10.1080/07420528.2022.2117050

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Braun, V., & Clarke, V. (2019). Reflecting on reflexive thematic analysis. *Qualitative Research in Sport, Exercise and Health*, *11*(4), 589–597. https://doi.org/10.1080/2159676X.2019.1628806

Bruno, S., Benedetti, D., Bazzani, A., Ferri, F., Granieri, I., Cruz-Sanabria, F., Fiori, S., d'Ascanio, P., Frumento, P., & Faraguna, U. (2023). School attendance, chronotype, and day of-the-week effect in adolescent male basketball players. *Journal of Biological Rhythms*, *38*(2), 185–196. https://doi.org/10.1177/07487304221144340

Caci, H., Deschaux, O., Adan, A., & Natale, V. (2009). Comparing three morningness scales: Age and gender effects, structure and cut-off criteria. *Sleep Medicine*, *10*(2), 240–245. https://doi.org/10.1016/j.sleep.2008.01.007

Chellappa, S. L. (2020). Circadian misalignment: A biological basis for mood vulnerability in shift work. *The European Journal of Neuroscience*, *52*(8), 3846–3850. https://doi.org/10.1111/ejn.14871

Chellappa, S. L., Morris, C. J., & Scheer, F. A. (2020). Circadian misalignment increases mood Vulnerability in simulated shift work. *Scientific Reports*, *10*(1), 18614. https://doi.org/10.1038/s41598-020-75245-9

Cheng, E. R., & Carroll, A. E. (2020). Delaying school start times to improve population health. *JAMA Pediatrics*, *174*(7), 641–643. https://doi.org/10.1001/jamapediatrics.2020.0351

Creswell, J. W., & Clark, V. L. P. (2018). *Designing and Conducting Mixed Methods Research*. 3[a]. SAGE.

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, *16*(3), 297–334. https://doi.org/10.1007/BF02310555

Danielsson, K., Sakarya, A., & Jansson-Fröjmark, M. (2019). The reduced morningness–eveningness questionnaire: Psychometric properties and related factors in a young Swedish population. *Chronobiology International*, *36*(4), 530–540. https://doi.org/10.1080/07420528.2018.1564322

Di Milia, L., Adan, A., Natale, V., & Randler, C. (2013). Reviewing the psychometric properties of contemporary circadian typology measures. *Chronobiology International*, *30*(10), 1261–1271. https://doi.org/10.3109/07420528.2013.817415

Fabbian, F., Zucchi, B., De Giorgi, A., Tiseo, R., Boari, B., Salmi, R., Cappadona, R., Gianesini, G., Bassi, E., Signani, F., Raparelli, V., Basili, S., & Manfredini, R.,. (2016). Chronotype, gender and general health. *Chronobiology International*, *33*(7), 863–882. https://doi.org/10.1080/07420528.2016.1176927

Fárková, E., Novák, J. M., Manková, D., & Kopřivová, J. (2020). Comparison of Munich chronotype questionnaire (MCTQ) and morningness-eveningness questionnaire (MEQ) Czech version. *Chronobiology International*, *37*(11), 1591–1598. https://doi.org/10.1080/07420528.2020.1787426

Folkard, S., Monk, T. H., & Lobban, M. C. (1979). Towards a predictive test of adjustment to shift work. *Ergonomics*, *22*(1), 79–91. https://doi.org/10.1080/00140137908924591

Foster, R. G. (2020). Sleep, circadian rhythms and health. *Interface Focus*, *10*(3), 20190098. https://doi.org/10.1098/rsfs.2019.0098

Gao, L., Li, P., Hu, C., To, T., Patxot, M., Falvey, B., Wong, P. M., Scheer, F. A. J. L., Lin, C., Lo, M.-T., & Hu, K.,. (2019). Nocturnal heart rate variability moderates the association between sleep-wake regularity and mood in young adults. *Sleep*, *42*(5), 1–10. https://doi.org/10.1093/sleep/zsz034

Guba, E. G., & Lincoln, Y. S. (1989). *Fourth generation evaluation*. Sage.

Hernández, R., Fernández, C., & Baptista, P. (2014). *Metodología de La Investigación*. 6a. McGRAW-HILL.

Horne, J. A., & Ostberg, O. (1976). A self assessment questionnaire to determine morningness eveningness in human circadian rhythms. *International Journal of Chronobiology*, *4*(2), 97–110.

Juda, M., Vetter, C., & Roenneberg, T. (2013). Chronotype modulates sleep duration, sleep quality, and social jet lag in shift-workers. *Journal of Biological Rhythms*, *28*(2), 141–151. https://doi.org/10.1177/0748730412475042

Kervezee, L., Kosmadopoulos, A., & Boivin, D. B. (2020). Metabolic and cardiovascular consequences of shift work: The role of circadian disruption and sleep disturbances. *The European Journal of Neuroscience*, *51*(1), 396–412. https://doi.org/10.1111/ejn.14216

Khan, S., Haider Malik, B., Gupta, D., & Rutkofsky, I. (2020). The role of circadian misalignment due to insomnia, lack of sleep, and shift work in increasing the risk of cardiac diseases: A systematic review. *Cureus*, *12*(1), e6616. https://doi.org/10.7759/cureus.6616

Li, S. X., Qi, Q., Li, X., Wang, Li, J., Liu, Y., Liu, L., Zhang, B., Zhang., & L., Lu. (2011). Preliminary test for the Chinese version of the morningness-eveningness questionnaire. *Sleep and Biological Rhythms*, *9*(1), 19–23. https://doi.org/10.1111/j.1479-8425.2010.00480.x

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry* (pp. 289–331). SAGE Publications, Inc. ISBN-0-8039-2431-3

Marqueta, M., Rodriguez, L., Enjuto, D., Juárez, J. J., & Martin-Ramiro, J. J. (2017). Relación Entre La Jornada Laboral y Las Horas de Sueño Con El Sobrepeso y La Obesidad En La Población Adulta Española Según Los Datos de La Encuesta Nacional de Salud 2012. *Revista Española de Salud Pública*, *91*(1), 1–10.

Natale, V., Adan, A., & Fabbri, M. (2009). Season of birth, gender, and social-cultural effects on sleep timing preferences in humans. *Sleep*, *32*(3), 423–426. https://doi.org/10.1093/sleep/32.3.423

Paine, S. J., Gander, P. H., & Travier, N. (2006). The epidemiology of morningness/eveningness: Influence of age, gender, ethnicity, and socioeconomic factors in adults (30-49 years). *Journal of Biological Rhythms*, *21*(1), 68–76. https://doi.org/10.1177/0748730405283154

Panjeh, S., Pompeia, S., Archer, S. N., Pedrazzoli, M., von Schantz, M., & Cogo-Moreira, H. (2021). What Are we measuring with the morningness–eveningness questionnaire? Exploratory factor analysis across four samples from two countries. *Chronobiology International*, *38*(2), 234–247. https://doi.org/10.1080/07420528.2020.1815758

Randler, C. (2007). Gender differences in morningness-eveningness assessed by self-report questionnaires: A meta-analysis. *Personality and Individual Differences*, *43*(7), 1667–1675. https://doi.org/10.1016/j.paid.2007.05.004

Reiter, A. M., Sargent, C., & Roach, G. D. (2021). Concordance of chronotype categorisations based on dim light melatonin onset, the morningness-eveningness questionnaire, and the Munich chronotype questionnaire. *Clocks & Sleep*, *3*(2), 342–350. https://doi.org/10.3390/clockssleep3020021

Rodríguez, G.-M., María, T., José Miguel, R.-G.-M., José Miguel, R.-C., Vera-Catalán, T., Simonelli-Muñoz, A. J., & Gallego-Gómez, J. I. (2020). Work shift and circadian rhythm as risk factors for poor sleep quality in public workers from Murcia (Spain). *International Journal of Environmental Research and Public Health*, *17*(16), 1–8. https://doi.org/10.3390/ijerph17165881

Roenneberg, T., Kuehnle, T., Pramstaller, P. P., Ricken, J., Havel, M., Guth, A., & Merrow, M. (2004). A marker for the end of adolescence. *Current Biology: CB*, *14*(24), R1038–9. https://doi.org/10.1016/j.cub.2004.11.039

Roenneberg, T., Winnebeck, E. C., & Klerman, E. B. (2019). Daylight saving time and artificial time zones - A battle between biological and social times. *Frontiers in Physiology*, *10*(JUL), 944. https://doi.org/10.3389/fphys.2019.00944

Roenneberg, T., Wirz-Justice, A., & Merrow, M. (2003). Life between clocks: Daily temporal patterns of human chronotypes. *Journal of Biological Rhythms*, *18*(1), 80–90. https://doi.org/10.1177/0748730402239679

Smith, C. S., Reilly, C., & Midkiff, K. (1989). Evaluation of three circadian rhythm questionnaires with suggestions for an improved measure of morningness. *The Journal of Applied Psychology*, *74*(5), 728–738. https://doi.org/10.1037/0021-9010.74.5.728

Teddlie, C., & Tashakkori, A. (2006). A general typology of research designs featuring mixed methods. *Research in the Schools*, *13*(1), 12–28. http://www.msera.org/Rits_131/Teddlie_Tashakkori_131.pdf

Tonetti, L., & Natale, V. (2019). Discrimination between extreme chronotypes using the full and reduced version of the morningness-eveningness questionnaire. *Chronobiology International*, *36*(2), 181–187. https://doi.org/10.1080/07420528.2018.1525392

Torsvall, L., & Akerstedt, T. (1980). A Diurnal type scale. Construction consistency and validation in shift work. *Scandinavian Journal of Work, Environment & Health*, *6*(4), 283–290. https://doi.org/10.5271/sjweh.2608

Toscano-Hermoso, M. D., Arbinaga, F., Fernández-Ozcorta, E. J., Gómez-Salgado, J., & Ruiz-Frutos, C. (2020). Influence of sleeping patterns in health and academic performance among university students. *International Journal of Environmental Research and Public Health*, *17*(8), 2760. https://doi.org/10.3390/ijerph17082760

Wittmann, M., Dinich, J., Merrow, M., & Roenneberg, T. (2006). Social Jetlag: Misalignment of biological and social time. *Chronobiology International*, *23*(1-2), 497–509. https://doi.org/10.1080/07420520500545979

Yeo, S. C., Lai, C. K. Y., Tan, J., Lim, S., Chandramoghan, Y., Tan, T. K., & Gooley, J. J. (2023). Early morning university classes are associated with impaired sleep and academic performance. *Nature Human Behaviour*, *7*(4), 502–514. https://doi.org/10.1038/s41562-023-01531-x