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*M*orningness–eveningness dimension in humans have been indicated to influence social behavior and individual health. The aim of the present study was to investigate the association of the morningness–eveningness dimension with behavioral and health aspects in a sample of undergraduate students. We assessed demographic data; the Pittsburgh Sleep Quality Index was used to evaluate sleep quality; the Morningness/ Eveningness Questionnaire to determine morningness–eveningness, and the Self-Reporting Questionnaire to assess minor psychiatric disorders. A total of 372 students (66.7% females), on average 21.6 years old, participated in this study. Among them, 92.2% did not smoke, 58.9% engaged in physical activities, and 19.7% were night-shift workers. In regard to morningness–eveningness, 55.9% of the participants were intermediate between evening (39.5%) and morning (4.6%) types. Poor sleep quality (OR = 1.89), minor psychiatric disorders (OR = 1.92), and tobacco consumption (OR = 3.65) predominated among evening types. Evening types were predominantly males (OR = 1.72). This study suggests that evening types are more vulnerable to sleep and psychiatric disturbances, and tend to smoke more than morning types.

Keywords: Chronotype; Morningness/eveningness; Minor psychiatric disorders; Daytime sleepiness; Sleep quality.

*L*e continuum de matinalité-vespéralité chez les humains exerce une influence sur le comportement social et sur la santé de l'individu. Le but de la présente étude était d'examiner l'association du continuum matinal–vespéral avec les aspects comportementaux et de la santé auprès d'un échantillon d'étudiants de premier cycle universitaire. Nous avons évalué les données démographiques et nous avons utilisé le *Pittsburg Sleep Quality Index* pour évaluer la qualité du sommeil, le *Morningness/Eveningness Questionnaire* pour situer les participants sur le continuum matinal–vespéral et le *Self-Reporting Questionnaire* pour évaluer les troubles psychiatriques mineurs. Au total, 372 étudiants (66.7% féminin), âgés en moyenne de 21.6 ans, ont participé à cette étude. Parmi ceux-ci, 92.2% ne fumaient pas, 58.9% pratiquaient des activités physiques et 19.7% étaient des travailleurs de nuit. En regard du continuum matinal–vespéral, 55.9% des participants se situaient à un niveau intermédiaire, alors que 39.5% étaient de type vespéral et 4.6% de type matinal. Une pauvre qualité de sommeil (rapport des cotes = 1.89), des troubles psychiatriques mineurs (RC = 1.92) et une consommation de tabac (RC = 3.65) prédominaient chez les participants de type vespéral. Les participants de type vespéral étaient majoritairement de sexe masculin (RC = 1.72). Cette étude suggère que les individus de type vespéral sont plus vulnérables aux perturbations du sommeil et psychiatriques et qu'ils tendent à fumer davantage que les individus de type matinal.

*L*a dimensión matutinidad/vespertinidad en las personas influye sobre la conducta social y la salud del individuo. El propósito de la presente investigación fue estudiar la asociación entre la dimensión matutinidad/vespertinidad con los aspectos conductuales y de salud en alumnos universitarios. Se evaluaron datos demográficos; se utilizó el Índice de Calidad de Sueño de Pittsburg (Pittsburg Sleep Quality Index) para evaluar la calidad del sueño; el Cuestionario de Estilos Diurno/Nocturno (Morningness/Eveningness Questionnaire) para determinar los estilos diurno/nocturno; y el Cuestionario de Autoevaluación (Self-Reporting Questionnaire) para evaluar trastornos psiquiátricos menores. La muestra total consistió en 372 alumnos (66.7% mujeres), y la edad promedio fue de 21.6. El 92.2% de los encuestados eran no fumadores, 58.9% hacía actividad física, y el 19.7% trabajaban en turnos de noche. Respecto del estilo diurno/nocturno, el 55.9% de los participantes puntuaron en un nivel intermedio entre el estilo nocturno (39.5%) y el estilo diurno (4.6%). En el estilo nocturno predominó la calidad de sueño pobre (OR = 1.89), los trastornos psiquiátricos menores (OR = 1.92), y el consumo de tabaco (OR = 3.65). El sexo masculino puntuó más alto en el estilo nocturno (OR = 1.72). Este estudio indica que las personas con un estilo nocturno son más vulnerables a trastornos de sueño y psiquiátricos, y suelen fumar más que las personas de estilo diurno.

The disruption of the sleep–wake cycle is one of the most prevalent complaints in clinical practice. Sleep deprivation due to clinical and psychiatric conditions, as well as lifestyle, is endemic in modern life (Schimitt et al., 2010). Another important characteristic concerns interindividual differences in sleep allocation due to a time-dependent behavior, the morningness–eveningness dimension (Horne & Ostberg, 1976). Based on the categorization of morningness–eveningness, individuals can be regarded as a morning, evening, or intermediate type.

Morning individuals are those who spontaneously wake up early in the morning with a very good level of awareness—being able to go to bed early in the evening. These individuals are characterized by an advanced phase (due in large part to their endogenous rhythms) in comparison to the rest of the population. Evening individuals are those who tend to wake up late in the day and go to bed late at night, and who have difficulties adapting to an early sleep schedule. Their performance and subjective sensation of awareness are more accentuated in the evening or at night. The highest values of their endogenous rhythms are late in relation to the rest of the population (phase delay). The morningness or eveningness dimension changes throughout life (Giannotti, Cortesi, Sebastiani, & Ottaviano, 2002). Children and elderly people tend to be morning types, while teenagers and young adults tend to be evening types (Giannotti et al., 2002; Roenneberg et al., 2007a). These changes are also gender-dependent, as shown by the distribution of chronotypes (calculated as midpoint of sleep onset and waking up on free and work days) in human populations (Roenneberg et al., 2007a). Several studies have associated chronotype with psychological wellbeing, e.g., late types report

psychological and psychosomatic disturbances more often than do early types (Giannotti et al., 2002). Evening types are also more likely to show depressive symptoms (Giannotti et al., 2002; Hidalgo et al., 2009).

Although circadian rhythm has been associated with mood disorders, the mechanism behind it is unclear and therefore no causal relationship can be established. However, both light exposure and clock genes' variability in humans seem to play a role (for review see Bunney & Bunney, 2000). A number of genes found to be regulating the clock mechanism in mammals (for review see Ko & Takahashi, 2006) such as *CLOCK* (Sjoholm et al., 2010), *NPAS* (Soria et al., 2010) and *CRY* (Lavebratt et al., 2009) have been associated with human mood disorders.

It is not yet clear which genes regulate chronotype in humans (for review see Allebrandt and Roenneberg, 2008), but it is thought to be genetically regulated, as indicated by "knockout" model organism studies (for review see Ko & Takahashi, 2006). It is too early to assume that the same genes would affect both chronotype and mood disorders, or to establish a causal relationship between these phenotypes. There is nevertheless a clear relationship between natural light exposure and quality of life, e.g., decreased natural light exposure is related to decreased weekly sleep duration, inadequate sleep, stress, irregular schedules for meals, sleep disorders (Roenneberg & Merrow, 2003), autonomic dysfunction, daytime sleepiness, and decrease in professional or academic performance (Shin, Kim, Lee, Ahn, & Joo, 2003).

Here, we evaluated the morningness–eveningness dimension in a homogeneous population of undergraduate students from South Brazil. We report the associations of morningness–

eveningness with age, sex, social and behavioral aspects such as sleep quality, daytime sleepiness, and minor psychiatric disorders.

MATERIALS AND METHODS

This was a cross-sectional study of full-time undergraduate students in their sixth semester at the Universidade de Passo Fundo (UPF), Rio Grande do Sul, Brazil. The local Ethics Committee approved the study design, and participants signed an informed consent form.

The following demographic data were assessed: undergraduate course, age, sex, marital status, family and individual income, extra class work, and weekly work hours. Also, the use of psychoactive drugs and physical activity were assessed by a yes or no question.

Morningness/eveningness dimensions were assessed with the Morningness/Eveningness Questionnaire (MEQ; Horne & Ostberg, 1976). It was used to estimate phase tendencies in circadian rhythm from self-description. The scores range from 16 to 86 and the cutoffs used in this study were: (1) 16 to 33 for evening; (2) 34 to 44 for moderate evening; (3) 45 to 65 for intermediate; (4) 66 to 76 for moderate morning, and (5) 77 to 86 for morning. To evaluate sleep quality in the past 30 days, we used the Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1989), with the global scores > 5.0, sensitivity of 89.6%, and specificity of 86.5% (kappa $= .75$, $p \leq .001$) to distinguish between good and poor sleep quality. The Epworth Sleepiness Scale (ESS; Johns, 1991) was used to evaluate daytime sleepiness. A score higher than 10 points was considered severe daytime sleepiness (maximum $= 24$ points). Minor psychiatric disorders were assessed with the Self-Reporting Questionnaire 20 (SRQ-20, adapted by Mari and Williams, 1986). Minor psychiatric disorders were defined by an SRQ-20 score ≥ 5 for men and ≥ 7 for women. Using these cutoffs, the sensitivity of the method to detect minor psychiatric disorders is 83.5% and the specificity is 80% (Mari & Williams, 1986). The Alcohol Use Identification Test (AUDIT; Saunders, Aasland, Babor, de la Fuente, & Grant, 1993) was applied to classify alcohol consumption. The test was developed by the World Health Organization to determine if a person's alcohol consumption might be harmful. Scores were: (1) for low-risk, 0 to 7 points; (2) at risk, 8 to 15 points; (3) at high risk or abuse, 15 to 19 points, and (4) likely dependent, 20 or more points (maximum $= 40$ points).

Statistical analyses

MEQ scores were dichotomized into evening type and non-evening type, and analyzed as a categorical variable. Bivariate analysis (χ^2 test Mantel-Haensel with Yates correction) was used to assess differences in the proportions of the variables studied. Logistic regression analyses were carried out in the course of assessing the effects of confounding variables and of reporting an association between the morningness–eveningness and sex, sleep habits, positive score in SRQ, daytime sleepiness and sleep quality.

The variables that showed a significant association with MEQ were included in a multivariate logistic regression following the stepwise backward procedure. Values were considered significant when the type-I error (α) was less than .05. All procedures were carried out using the Statistical Package for the Social Sciences (SPSS/PC15.0).

RESULTS

A total of 372 university students were included in the study. The behavioral and demographic characteristics are shown in Table 1.

The MEQ showed a normal distribution (*skewness* .015 and *kurtosis* $-.28$). The classification showed 55.9% as intermediate type, 39.5% as evening type, and 4.6% as morning type. Evening types were more frequent than morning types, and there was no association between age and morningness–eveningness dimension ($p = .769$). The mean preferred waking-up time was 7.25 a.m. $\pm$ 1.33 (mean $\pm$ SD) and the going-to-sleep time was

TABLE 1
Demographic characteristics of the sample

Variable	Percentage/mean $\pm$ SD/range
Sex	66.7% (female)
Age	21.6 $\pm$ 3.08 (18–29)
Body mass index	21.93 $\pm$ 3.81 (16.11–43.21)
Satisfaction level with the course	7.34 $\pm$ 1.99 (1–10)
School performance	7.46 $\pm$ 1.61 (1–10)
Tobacco	7.8%
Risk for alcohol abuse	58.9%
Physical activity	58.6%
Minor psychiatric disorder	25%
Poor sleep quality	24.6%
Daytime sleepiness	50.8%
Hours of sleep needed (h)	8.43 $\pm$ 1.28 (5–13)
Preferred sleep time (p.m)	.66 $\pm$ 1.22 (8 p.m.–3 a.m.)
Wake up time (a.m)	7.25 $\pm$ 1.33 (4 a.m.–2 p.m.)
Sleep Duration (h)	6.87 $\pm$ 1.34 (4–12)

TABLE 2
Comparison of demographic and behavioral characteristics between morningness–eveningness dimensions (evening and non-evening) by chi-square test (Mantel-Haensel with Yates correction)

| Variable | Morningness–eveningness | | p |
	Non-eveningness	eveningness	
Age (years)			
19	32 (14.2%)	21 (14.3%)	.769
20–24	166 (73.8%)	111 (75.5%)	
25–29	23 (10.2%)	11 (7.5%)	
>30	4 (1.8%)	4 (2.7%)	
Gender			
Male	64 (28.4%)	60 (41.8%)	.013
Female	161 (71.6%)	87 (59.2%)	
Leisure during the week			
Yes	184 (81.8%)	127 (86.4%)	.251
No	41 (18.2%)	20 (13.6%)	
Employed			
Yes	180 (80.4%)	117 (80.1%)	.959
No	44 (19.6%)	29 (19.9%)	
Physical activity			
Yes	133 (59.9%)	83 (57.2%)	.573
No	89 (40.1%)	62 (42.8%)	
Drink coffee			
Yes	172 (76.8%)	103 (70.5%)	.179
No	52 (23.2%)	43 (29.5%)	
*Drink chimarrão**			
Yes	176 (78.6%)	105 (71.9%)	.143
No	48 (21.4%)	41 (28.1%)	
History of smoking			
Yes	8 (3.7%)	20 (14.1%)	.001
No	209 (96.3%)	122 (85.9%)	
AUDIT score			
Low risk	106 (47.1%)	48 (32.7%)	.006
At risk	119 (52.9%)	99 (67.3%)	
Minor psychiatric disorders (SRQ20)			
Yes	45 (20.0%)	48 (32.7%)	.006
No	180 (80%)	99 (67.3%)	
Daytime sleepiness (ESS)			
Yes	121 (53.8%)	62 (42.2%)	.029
No	104 (46.2%)	85 (57.8%)	
Sleep quality (PSQI)			
Poor	39 (18.8%)	45 (32.4%)	.004
Good	169 (81.3%)	94 (67.6%)	

AUDIT, Alcohol Use Identification. *Chimarrão is a regional drink that contains caffeine.

.66 p.m. ± 1.22 (mean ± SD). The difference between hours of sleep reported as needed and total effective time sleeping was −1.56 h (Table 1).

Table 2 shows the associations between evening and non-evening types and sociodemographic variables, sleep quality, daytime sleepiness, and minor psychiatric disorders. A significant association ($p < .05$) was observed between evening type and gender, minor psychiatric disorders, daytime sleepiness, and sleep quality.

Caffeinated beverages, such as coffee and *chimarrão* (a regional drink that contains caffeine) were not associated with evening type. However, use of psychoactive drugs, tobacco consumption, and risk of abusive alcohol consumption were correlated with eveningness.

The results for logistic regression analysis are summarized in Table 3. Poor sleep quality (OR = 1.89), minor psychiatric disorders (OR = 1.92), and tobacco consumption (OR = 3.65) predominated among evening types. Evening type predominated among males (OR = 1.72).

DISCUSSION

The aim of this study was to evaluate the distribution of morningness–eveningness in undergraduate students and its association with health and behavioral aspects. The results strongly suggest that evening types predominate among males, and that evening type is associated with tobacco use, poor sleep quality and minor psychiatric disorders (after adjustment for potential confounding variables in a multivariate model).

Intermediate types predominated in the sample investigated. Evening types were more frequent than morning types, as already observed in other adolescent and student populations (Hidalgo & Caumo, 2002). However, there was no association between age and morningness–eveningness dimension in this study, may be because of the homogeneity of the age group. There were more males among evening types, as previously reported in the Brazilian population (Hidalgo & Caumo, 2002).

The number of morning types in this sample was extremely low, possibly due to a sample consisting only of young university students (21.6 ± 3.08 years old). An abrupt change in the timing of sleep is known to be a marker of the adolescence. As observed in others studies, chronotype is age-dependent, and reaches its maximum individual lateness at around the age of 20 (Roenneberg, Kumar, & Merrow, 2007b).

It is known that sleep deprivation can be caused by a misalignment of the endogenous time with the social time. It is also called social jetlag, and is associated with psychiatric disorders (Hidalgo et al., 2002; Hirata et al., 2007). The prevalence of minor psychiatric disorders in our study is similar to previous results from studies with the Brazilian population (Hidalgo et al., 2002). The association between eveningness and the occurrence of minor psychiatric disorders in our work remained significant after logistic regression analysis ($p < .05$). However, the association between

TABLE 3
Results of stepwise forward logistic regression analysis of potential factors associated with evening type in
university students

Variables	Eveningness: n (%)	OR Adjusted	CI 95%	p
Gender				
Male (n = 124)	60 (41.10)	1.72	1.06–2.81	.029
Female (n = 247)	86 (58.90)			
Sleep quality				
Poor (n = 84)	45 (32.61)	1.90	1.07–3.35	.027
Good (n = 262)	93 (67.39)			
Minor psychiatric disorders				
Yes (n = 93)	48 (32.88)	1.92	1.11–3.4	.021
No (n = 278)	98 (67.12)			
Tobacco use				
Yes (n = 28)	20 (14.28)	3.66	1.44–9.26	.006
No (n = 330)	121 (85.82)			

OR, odds ratio; CI, confidence interval. The table shows, after adjustment for potential confounding variables,
that evening type predominates among males (OR = 1.72). Poor sleep quality (OR = 1.90), minor psychiatric
disorders (OR = 1.92),a and tobacco use (OR = 3.66) were higher between evening types.

daytime sleepiness and morningness–eveningness
dimension was not confirmed by logistic regression
with evening type as the dependent variable. We
suggest here that this result was strongly influ-
enced by the use of psychoactive drugs. A higher
prevalence of tobacco and caffeine consumption
has been associated with eveningness (Megdal &
Schernhammer, 2007; Wittmann, Paulus, &
Roenneberg, 2010). This association was also
observed in this study, mainly related to tobacco
consumption.

The average sleep quality measured by PSQI
showed that most students have a good sleep
quality; however, when categorized by the depen-
dent variable morningness–eveningness score, this
showed a significant association with poor sleep
quality, as found by Megdal and Schernhammer
(2007). The significant association of eveningness
with bad sleep quality, minor psychiatric disorders,
and abusive use of tobacco corroborates the
findings of previous studies, which indicate a
tendency toward physical and mental morbidity
related to eveningness.

Students also reported a subjective feeling of
sleep need (8.43 ± 1.28 h) which was larger than
their effective hours of sleep (6.87 ± 1.34 h). This
sleep debt was caused by late sleep (after midnight)
and academic morning schedule forcing them to
wake up early (7.25 ± 1.33 h). This accumulation of
sleep depth over the week, as well as a higher pre-
valence of smoking and alcohol consumption, was
observed in another study (Wittmann et al., 2010).

Here we could not calculate social jetlag, but we
imply that evening types may have a lower
morning academic performance due to their
awareness deficit in early morning. Hidalgo et al.

(2004) found an association between evening type
and low school performance. Loayza et al. (2001)
also report that school schedules and academic
demands (exogenous factors) and morningness–
eveningness (endogenous factors) can influence the
wakefulness of university students, leading to a
negative effect on school performance. Our results
are strong predictors of this association, suggesting
that future studies should address this hypothesis.

In conclusion, the associations of eveningness
with poor sleep quality, minor psychiatric dis-
orders and tobacco consumption indicate that
longitudinal studies are necessary to detect causal
relationships among these variables. Our study
reinforces the necessity of preventive and educa-
tional programs for students to increase their
awareness of school performance.

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