Validation of the Italian Version of the Morningness-Eveningness Questionnaire for Adolescents by A. Lancry and Th. Arbault

ABEF 1 Guido M. Cavallera
ABDE 2 Giuseppe Boari

Background: This study aimed to validate the Italian version of the Morningness-Eveningness questionnaire for adolescents by Lancry and Arbault.

Material/Methods: The Morningness-Eveningness Questionnaire by Lancry and Arbault was translated from French into Italian by using forward-backward translation. Students aged 11–15 years old were enrolled from two schools in Milan (Italia). Validation of the questionnaire was performed in subsequent phases. A pre-test was given to 66 students aged 11–15 years (males 57.4%, females 42.6%) from a convenience sample. Syntactic aspects of the pre-test were improved, and the questionnaire in a revised version was re-administered to 292 students of same age (males 43.8%, females 54.1%) from a convenience sample.

Results: Factor analysis was performed on pre-test data, using the principal component method accounting for Morningness-Eveningness. Problematic items possibly uncorrelated with the extracted factor were identified, and reliability produced a Cronbach’s Alpha close to 0.7. In the test phase factor analysis was performed using the principal component method. Based on reliability analyses, we excluded a number of items because of their low performance, giving rise to a Cronbach’s Alpha of 0.819. Pearson product-moment external correlations between Morningness-Eveningness disposition and temperament, behavioral, and cognitive aspects were evaluated.

Conclusions: A factor analysis, Cronbach’s alpha and concurrent validity coefficients with disposition, behavior, and cognition, were performed, suggesting potential reliability and validity. The questionnaire is a useful and relevant tool for measuring Morningness-Eveningness disposition in adolescents, which has seldom been investigated with adequate psychometric instruments.

MeSH Keywords: Adolescent • Circadian Rhythm • Questionnaires

Full-text PDF: http://www.medscimonit.com/abstract/index/idArt/894091
Background

Individuals have biological rhythms which shift over a 24-hour period. These rhythms have been studied from the chrono-biological [1] and chrono-psychological perspectives. Psychometric measures have been produced to evaluate such rhythms with specific reference to timing and aspects of wakefulness and sleepiness over the 24 hours. Under this perspective, it has been noticed that people can be described as belonging to two types: Morning and Evening types. Morning types awake early, are refreshed on waking up, and go to bed early in the evening; whereas evening types get up with difficulty, are tired when they wake up, and stay up late at night [2]. In 1976 Horne and Östberg presented the MEQ (Morningness-Eveningness Questionnaire) to measure Morningness-Eveningness disposition, and various different instruments have been created over the years. The reduced scale of the MEQ (rMEQ) was created by Adan and Almirall [3], the Marburger Questionnaire by Moog [4], the Composite Scale by Smith, Reilly, and Midkiff [5], the Preference Scale by Smith, Folkard, Schmieder, Parra, Spelten, Almiral et al. [6], the Morningness-Eveningness Questionnaire by Lancry and Arbault [7], and the Munich Chronotype Questionnaire by Roenneberg, Wirz-Justice, and Merrow [8].

Physiological and biological parameters characterize Morningness-Eveningness disposition. Morningness is associated with sleep phases, and the decay rate of slow-wave activity seems to be faster in Morning types compared with Evening types [9]. Morning types have a circadian temperature phase 2 hours earlier than Evening types [10], acrophases of cortisol occur earlier in the Morningness group with respect to the Eveningness group [11], and Morning types reveal a more rapid decline in melatonin levels after the peak than Evening types [12]. Morningness-Eveningness disposition has a hereditability of around 50% [13], and different polymorphisms in clock genes have a relationship with Morningness-Eveningness disposition, with specific reference to hCLOCK, PER1, and PER2 [14]. A shift from Morningness to Eveningness has been observed during adolescence [15], while after adolescence Morningness tends to increase with age [16], and people from the age of 50 onwards types tend toward Morningness [2]. Larger percentages of Eveningness have been reported among males, and Morningness is frequently observed among females [17], though not always [18]. A larger number of Evening types have been observed among boys than in girls in adolescence [16,19]. Morning and Evening types have been the subject of interest in relation to a wide range of behavioral variables. The relationship between Morningness-Eveningness disposition and personality traits has been observed; positive correlations between Agreeableness and Morningness [20], and between Conscientiousness and Morningness [18], and a negative correlation between Open-mindedness and Morningness [21] have been pointed out. Evening types are more extraverted than Morning types [22], show higher scores on Openness [23], and tend to be more neurotic than Morning types [24], though there are exceptions [23]. Evening types score higher on psychotism than Morning types [25]; higher scores have been reported in Evening types than in Morning types using Zuckerman’s Sensation Seeking Scale [26]. People with neither a Morning nor an Evening disposition tend to be closer to Evening types in Isolation Intolerance [27]. Morningness is positively related to Stability in undergraduates [28], and Neuroticism is related to Eveningness only in females and in adolescents aged 10–17 years [20]. It has been suggested that the relationship between Morningness-Eveningness and Neuroticism is modulated by sex [29]. Morningness-Eveningness disposition has been researched with reference to psychopathology. Circadian timing is delayed in patients with depressive disorders [30], and levels of depression in Evening types tend to be moderated by age [32] and hormones. Higher scores on suicidal thoughts have been identified in Evening types [33], and Eveningness is positively correlated with bulimic behavior [34]; a higher percentage of risky and aggressive driving is significantly correlated with Eveningness [35]. Drug consumption has a negative effect on circadian expression, and the effect of drug addiction on circadian expression can persist for weeks or months after drug use has ceased [18]. Evening types report higher consumption of some psychoactive substances (caffeine, alcohol, nicotine), even in adolescence [18], and undergraduate students of Morningness disposition tend to consume more caffeine in the evening than Morning types [2].

Adolescents with Eveningness disposition show lower scores on vitality, physical well-being, relations with parents, relations with teachers, and school work [36], and early midpoint of sleep as well as conscientiousness and intelligence seems to be associated with better grades in primary school [37]. The importance of implementing prevention programs aimed at improving sleep habits has been pointed out [38]. Effects of timing are relevant on academic performance: Adolescents of Evening disposition show poorer academic achievement [2], they tend to have more difficulty getting up in the Morning and more alertness in the Evening than Morning types during school terms [39]. Exercise, meditation, taking showers, and conflict over breakfast with reference to Morningness-Eveningness disposition in adolescents have been studied [39]. Evening types have reduced sleep quality when compared with Morning and neither types on weekdays, while Evening types tend to reach the same levels on weekends, suggesting the occurrence of a sleep deficit during weekdays due to social commitments [40]. Morningness-Eveningness disposition with reference to sleep patterns can have important consequences on social environment, since sleepiness is an important public problem associated with accidents in the workplace and decreased productivity [41].
In humans, sleep and wakefulness are influenced by homeostatic process and internal circadian clock, and desynchronization of the two processes can be associated with sleep disruption during shift work and jet lag [18], and can have cardiovascular and metabolic consequences [42]. The contribution of external and social factors to Morningness-Eveningness disposition is relevant, and desynchronization of the two processes can be associated with circadian rhythm sleep disorders and delayed sleep phase disorder [18]. Night shifts are more difficult for Morning types than for Evening types [18]; Morning shift workers are more alert during morning hours of work, while Evening types are more alert during evening hours of work [43]. Workers with rigid sleep attitudes are more prone to health problems [44], and flexibility is positively correlated to shift work tolerance [45]. Sleep is a physiological state that needs integrity to allow the organism to recuperate, and noise is made of external stimuli processed by sensory functions despite a non-conscious perception. Studies support evidence that night-time noise is associated with cardiovascular diseases and stroke particularly in the elderly, and suggest that nocturnal noise exposure is more relevant for the genesis of cardiovascular disease than daytime noise exposure [46].

Few studies have been published about Morningness-Eveningness with reference to jet lag, [18] and more research is required in this direction. Latitude and longitude also tend to play a role in circadian rhythms: there are more Morning types toward the East and North and in rural municipalities than in urban municipalities [18]. Studies point out that subjects living at relatively high latitude, such as Canada, Spain, and Italy and born in the fall tend to be Morning types in comparison to those born in other seasons; at low latitude (Kochi, Japan) an effect of season of birth on Morningness confined to young female children has been observed [47]. No correlations are noted between changes in atmospheric pressure and duration of sleep; however, a slight increase in motility during sleep has been detected when the barometric pressure is higher than usual [48]. Small changes in atmospheric pressure due to weather may be important in obstructive sleep apnea [49]. Finally, a decrease in the strength of the Zeitgeber can be noticed in Evening types, who obtained lower levels of light exposure during daytime and higher during nighttime and with a more irregular lifestyle than Morning types [18].

People born in autumn and winter tend to be more Morningness-oriented, while those born in spring and summer tend to be more Eveningness-oriented [50]; this is also observed in adolescents [18].

Researchers have also explored Morningness-Eveningness disposition with reference to cognitive parameters. It has been suggested that the nature of a task and the strategies used to carry it out might be critical factors in diurnal performance trends [51]. According to what is known as the “arousal model”, circadian performance variations reflect underlying circadian rhythms in arousal levels [18]. According to the model known as the “synchrony effect”, it has been suggested that people who are more alert in the morning tend to perform better in the morning than in the afternoon, while people who are more alert in the evening tend to perform better in the afternoon or evening than in the morning [52]. Cognitive styles can be associated with Morningness-Eveningness; from this perspective, Eveningness has been correlated with creative thinking [53], Morningness disposition with left-thinking style, and Eveningness disposition with right-thinking style [54].

Morningness-Eveningness has been explored with reference to sports [25,55], and is correlated with creative thinking in young people playing recreational sports [56]. Morning-oriented adolescents are more physically active, and give more positive attributes to the effects of physical activity; these findings can have an impact on programs devoted to increasing physical activity in adolescence [57]. Findings of a walking task exercise reveal that Evening types are at a disadvantage when performing a physical task in the morning [58]. With the purpose of determining whether exercise on a stationary cycle ergometer during night shifts can delay temperature rhythm, it has been observed that there is a correlation between temperature rhythm phase shift and Morningness-Eveningness – greater Eveningness results in larger phase shifts [59].

Exhaustive reviews concerning Morningness-Eveningness have been published recently by Adam et al. [18], by Cavallera, Boari, Ortolano, and Giudici [60], and by Cavallera and Giudici [2].

Over the years, specific questionnaires have been produced aimed at gaining a better understanding of Morning and Evening types. The MEQ by Horne and Östberg [61] is the best-known questionnaire in this direction, but research is scarce with specific reference to Morningness-Eveningness disposition in youth; the Morningness-Eveningness questionnaire by Lancy and Arbault [7], the Morningness-Eveningness scale for children (MESC) by Carskadon, Viera, and Acebo [62], and the Children’s Chronotype Questionnaire (CCTQ) by Werner, Lebourgeois, Geiger, Jenni [63] are objects of interest. This study aimed to validate the Italian version of the Morningness-Eveningness questionnaire for adolescents by Lancy and Arbault.

Material and Methods

The Morningness-Eveningness Questionnaire by Lancy and Arbault was translated from French into Italian. A forward-backward translation was performed by two translators, and the process of translation was supervised by one bilingual translator. The original French version was translated into Italian by one translator, and the Italian version was then back-translated into
French by a second translator. The original and the back-translated versions were compared and, where necessary, modifications were made to correct language errors and to ensure conceptual equivalence between the two texts rather than literal translation. Following statistical reliability analyses in the pretest phase, syntactic aspects of the questionnaire items were improved, and a final version of the questionnaire was produced and discussed in a group with the supervisor and teachers of the schools. The questionnaire in the pre-test and test phases were administered to students aged 11–15 years old from two major schools in Milan (Italy): Collegio San Carlo and Collegio Parini. The questionnaires were checked for omissions and duplications at the time of completion. Students were given 30 minutes to self-administer the questionnaire in a separate setting; their parents were informed of the research and gave their informed consent. The test was validated in subsequent phases.

A convenience sample of 66 students aged 11 to 15 years was enrolled in the pre-test phase: mean age 13.36, 57.4% males and 42.6% females. A second convenience sample of 292 students was enrolled in the test phase: mean age 12.90, 43.8% males, 54.1% females. As suggested by Lancry and Arbault (1991), items D1, D2, D6, D10, and D16 were encoded according to the scheme presented in Table 1. Moreover, items D3, D4, D9, D13, D15, and D17 were reversed by the usual rule Rev(X) = X_{max} + X_{min} – X, making it possible to correctly perform the procedure of Scale Reliability Analysis when needed. In the final version of the translated and validated scale D10 is item 8, D16 is item 14.

### Results

A factor analysis was first performed on pre-test data (Table 2) using the principal component method accounting for Morningness-Eveningness. Since we were looking for a single common characteristic, accounting for the Morningness-Eveningness level of the types, only one component was extracted (method: principal components, 1 factor extracted).

#### Table 1. Timetable range coding for items D1, D2, D6, D10, D16.

| Item | Time range       |
|------|------------------|
| D1   | ≤20:45 ≤21:55 ≤22:45 >22:45 |
| D2   | ≤7:27 ≤9:33 ≤13:04 >13:04 |
| D6   | ≤22:28 ≤23:25 ≤00:13 >00:13 |
| D10  | ≤9:54 ≤12:45 ≤14:56 >14:56 |
| D16  | ≤8:52 ≤9:31 ≤10:21 >10:21 |
| Code | 4 3 2 1            |

#### Table 2. Pre-test AF factor loadings.

| Item | Loadings |
|------|----------|
| D1   | .715     |
| D2   | .331     |
| D3   | -0.008   |
| D4   | .644     |
| D5   | .701     |
| D6   | .534     |
| D7   | -101     |
| D8   | .112     |
| D9   | .482     |
| D10  | .320     |
| D11  | .536     |
| D12  | .779     |
| D13  | .214     |
| D14  | .494     |
| D15  | .069     |
| D16  | .215     |
| D17  | .643     |

Bold figures highlight problematic items, possibly uncorrelated with the extracted factor. This may be due to an improper formulation of the corresponding questions. Thus, syntactic aspects of the questionnaire items were improved in order to make them more intelligible. Furthermore, the assessment of reliability of the component previously extracted was performed (Table 3). Cronbach’s Alpha is quite close to 0.7 (Cronbach’s Alpha=0.658), whereas item statistics confirm that items D3 and D7 seem to be less reliable. Nevertheless, the non-significance of the Non-Additivity test suggests that a summated scale, over all items, may be correctly employed. The result of the Tukey test of Non-Additivity was non-significant (p-value=.546 NS).
With reference to the Test-phase data, factor analysis was performed by using the principal component method and extracting a single component (Table 4).

Item D5 and, particularly, items D7 and D8 show low performances; moreover, subsequent reliability analyses suggest the exclusion of items D7 and D8. Table 5 reports the final results.

The Cronbach’s Alpha (items D7 and D8 excluded) was 0.819 and the Tukey test of Non-Additivity was non-significant (p-value=.117 NS). The non-significance of the Non-Additivity test suggests that a summated scale, over all remaining items, may be correctly employed.

The summated scale is defined by the following expression:

\[
\text{SCALE}= \sum (D1–D6, D9–D17)
\]

It is interesting to analyze the relationship between the values of the summated scale (Scale) and the factor scores (expressed in standard units) given by the Factor Analysis procedure (AF Score). Their linear relation is:

\[
\text{Scale}=28.084+7.154 \times \text{(AF Score)}
\]

where R-squared index (0.981) and F test significance suggest that the Scale values may be correctly adopted instead of the factor scores, and are computationally more complicated.

Correlations between Morningness-Eveningness disposition and age have also been calculated, giving rise to the following results: −0.124 (p-value=0.022, one-tailed test). As expected, with age, Morningness-Eveningness disposition increases towards Morningness. Finally, external validations were performed by evaluating the linear correlation between items and temperaments, as well as with variables accounting for behavioral aspects (items H18–H21: preferred wake and sleep times) and cognitive aspects (items D22–D27: fatigue and alertness in the morning, in the afternoon, in the evening). Correlation between items and temperaments was not significant, whereas correlations between Morningness-Eveningness disposition and behavioral aspects, items H22 and H27, significantly decrease towards Morningness-Eveningness disposition; item H21 significantly increased, as expected, and item H20 was not significant (Table 6).

With reference to correlations between Morningness-Eveningness disposition and behavioral aspects disposition, items D22, D26, and D27 significantly decrease towards Morningness.

| Item | Loadings |
|------|----------|
| D1   | .376     |
| D2   | .442     |
| D3   | .594     |
| D4   | .556     |
| D5   | .290     |
| D6   | .570     |
| D7   | .004     |
| D8   | .209     |
| D9   | .387     |
| D10  | .529     |
| D11  | .736     |
| D12  | .483     |
| D13  | .372     |
| D14  | .638     |
| D15  | .548     |
| D16  | .646     |
| D17  | .756     |

Table 4. Pre-test AF factor loadings.

With reference to correlations between Morningness-Eveningness disposition and behavioral aspects disposition, items D22, D26, and D27 significantly decrease towards Morningness.

| Item | Item – total correlation | alpha – if removed |
|------|--------------------------|--------------------|
| D1   | .512                     | .619               |
| D2   | .237                     | .647               |
| D3   | −.037                    | .686               |
| D4   | .474                     | .618               |
| D5   | .559                     | .610               |
| D6   | .364                     | .630               |
| D7   | −.122                    | .697               |
| D8   | .036                     | .678               |
| D9   | .356                     | .630               |
| D10  | .137                     | .660               |
| D11  | .419                     | .625               |
| D12  | .570                     | .605               |
| D13  | .060                     | .665               |
| D14  | .409                     | .629               |
| D15  | .109                     | .667               |
| D16  | .219                     | .649               |
| D17  | .492                     | .612               |

Table 3. Pre-test reliability analysis.
Morningness-Eveningness disposition, while items D24 and D25 significantly increase, as expected. Item D23 correlation was not significant (Table 7).

Finally, in order to estimate the optimal classification of teenagers in three homogeneous groups (Evening types, neither types, Morning types), a k-means cluster analysis procedure was performed on score data generated by the FA. The corresponding cut-points were then evaluated on the summated scale values by using the linear relation previously suggested (Table 8).

The summated scale scores range from a minimum of 15 to a maximum of 60, since the 15 administered items use a four-point scale (1–4). The translated and validated scale results in 15 items, after excluding items 7 and 8. The code system of scoring of items 3, 4, 7, 11, 13, 15 is: 4, 3, 2, 1; the code system of scoring of items 5, 9, 10, 12 is: 1, 2, 3, 4. Coding system for items 1, 2, 6, 8, 14 refers to timetable range indicated in Table 1.

**Discussion**

Sleep plays a fundamental role in adolescent development, and monitoring adolescents for sleep parameters is of great relevance for improving school performance, emotional well-being, and health. The American Academy of Pediatrics supports the efforts of schools to optimize sleep in adolescents.
in order to allow students to achieve optimal levels of physical and mental health.

During puberty, youngsters tend to become more Eveningness-oriented; a decrease in Morningness occurs around age 15 years, a return to Morningness has been identified at around age 20 years [64], and the amount of sleep time decreases among children from age 11 to 15 [65]. From childhood through adolescence, sleep architecture tends to be modified, with decreases in slow-wave sleep and increases in stage 2 sleep [66].

Data about specific psychometric instruments measuring Morningness-Eveningness disposition in young people are scarce: the Morningness-Eveningness questionnaire by Lancry and Arbault (1991), the MESC by Carskadon (1993) and the CCTQ by Werner, Lebourgeois, Geiger, Jenni (2009) are among the most significant psychometric measures which can be found in the literature.

This study aimed to validate the Italian translation of the Morningness-Eveningness questionnaire by Lancry and Arbault, performed in the subsequent pre-test and test phases. Factor analysis on pre-test data accounting for Morningness-Eveningness revealed a single extracted component, confirming construct validity; the latent construct of interest and problematic items uncorrelated with the single factor because of improper syntactic formulation were identified. Items were therefore improved in the subsequent test phase. The reliability of the pre-test revealed a Cronbach’s Alpha close to 0.7. In the subsequent test phase, a single component was extracted using factor analysis, a number of items were excluded because of their low statistical performance, and the Cronbach’s Alpha revealed a satisfactory value, excluding the presence of threats to internal validity. External validations were performed; correlations between Morningness-Eveningness disposition and sleeping habits and correlations between Morningness-Eveningness disposition and arousal state were significant in most cases, suggesting exclusion of threats to external validity. Validation of the questionnaire therefore reveals good psychometric properties.

A classification of teenagers aged 11–15 years into three types was proposed (Evening types, neither types, Morning types) using k-means cluster analysis, and cut-off points were evaluated: a range of 15–25 for Evening types, 26–34 for neither types, and 35–60 for Morning types.

One limitation of the study is that all the types come from the same city (Milan), and from schools which have a reputation of being among the best schools in Milan. Another limitation is that, as far as we know, the questionnaire by Lancry and Arbault has not yet been translated into other languages, and therefore international references under this perspective are scarce. Another limitation might also be that the method itself is based on self-reporting, so that its effectiveness and accuracy without reference to the observations carried out by parents or teachers could be subject to discussion. It should be observed that Lancry and Arbault themselves had administered the questionnaire without any reference to reports by parents in their original work, that our sample is made up of adolescents coming from particularly good junior and senior high schools in the city of Milan, that prior to administration of the questionnaire adolescents had been informed about the questionnaire itself, and that the questionnaire is made up of easily understandable questions. Moreover, at the end of the questionnaire, students were asked if the items were clearly understandable, and were asked to make suggestions for improving the items themselves.

The importance of adequately understanding sleeping behaviors in adolescence is a topic of frequent discussion, both from a scientific perspective and in terms of common opinion among the public. Efforts to optimize sleep in adolescents are supported by scientists worldwide for reasons of physical and mental health, and educational programs have been produced to inform families and pediatricians about correct sleep behaviors as a fundamental basis of positive development processes throughout life. From these perspectives, the use of a psychometric instrument can be of significant help. It is therefore suggested that in the future the validated Italian version of the Morningness-Eveningness questionnaire by Lancry and Arbault should be distributed and used in schools as a useful and advantageous psychometric tool for obtaining a better understanding of one of the most critical times in life – adolescence.

Conclusions

The translated questionnaire by Lancry and Arbault provides a relevant tool for measuring Morningness-Eveningness in adolescents, which has seldom been explored with adequate psychometric instruments, since proper psychometric instruments on this topic are scarce.

Future research should extend investigation and administration of the questionnaire over a wider geographic area and a wider range of different types of school. Moreover, researchers should involve foreign colleagues in translation of the questionnaire by Lancry and Arbault into other languages in order to compare their respective data. Improvements in the questionnaire could contribute to a better understanding of young people’s sleeping behaviors and their consequences worldwide, and to the development of preventive social and health policies for adolescents.
Acknowledgments

We thank Don Aldo Geranzani Rector of Collegio San Carlo (Milan, Italy), and the Headmaster of Liceo Parini (Milan, Italy) for their kind support in this research, dott.ssa Alessandra Ortolano (University of Chieti-Pescara) and dott.ssa Cinzia Costa (University of Chieti-Pescara) for their bibliographical research.

References:

1. Koukkari WL, Sothern RB: Introducing biological rhythms. New York: Springer; 2006
2. Cavallera GM, Giudici S: Morningness and eveningness personality: A survey in literature from 1995 up till 2006. Pers Individ Dif, 2008: 44: 3–20
3. Adan A, Almirall H: Horne & Östberg Morningness-Eveningness questionnaire: a reduced scale. Pers Individ Dif, 1991: 12: 241–53
4. Neubauer AC: Psychometric comparison of two circadian rhythm questionnaires and their relationship with personality. Pers Individ Dif, 1992: 13: 125–31
5. Smith CS, Reilly C, Midkiff K: Evaluation of three circadian rhythm questionnaires with suggestions for an improved measure of Morningness. J Appl Psychol, 1989: 74: 728–38
6. Smith CS, Folkard S, Schmieder RA et al: Investigation of morning-evening orientation in six countries using the preference scale. Pers Individ Dif, 2002: 32: 949–68
7. Lancy A, Arbaut T: Matinalité-Vespalité chez des enfants de 11–15 ans. Psychologie Française, 1991: 36: 277–85 [in French]
8. Roenneberg T, Wirz-Justice S, Merrow M: Life between clocks – daily temporal patterns of human chronotypes. J Biol Rhythms, 2013: 18: 80–90
9. Mongrain V, Carrier J, Dumont M: Chronotype and sex effects on sleep architecture and quantitative sleep EEG in healthy young adults, Sleep, 2005: 28: 819–27
10. Baehr EK, Reveille W, Eastman CI: Individual differences in the phase and amplitude of the human circadian temperature rhythm: With an emphasis on Morningness–eveningness. J Sleep Res, 2000; 9: 117–27
11. Bailey SL, Heitkemper MM: Circadian rhythmicity of cortisol and body temperature: Morningness–eveningness effects. Chronobiol Int, 2001: 18: 249–61
12. Gibertini M, Graham C, Cook MR: Self-report of circadian type reflects the phase of the melatonin rhythm. Biol Psychol, 1999: 50: 19–33
13. Koskennuo M, Hulbin C, Partinen M et al: Heritability of diurnal type: a nationwide study of 8753 adult twin pairs. J Sleep Res, 2007: 16: 156–62
14. Carpen JD, Archer SN, Skene DJ: A single-nucleotide polymorphism in the S- untranslated region of the H Per2 gene is associated with diurnal preference. J Sleep Res, 2005; 14: 2
15. Achari KV, Pati AK: Morningness–eveningness preference in Indian school children as function of gender, age and habitat. Biol Rhythm Res, 2007; 38: 1–8
16. Tonetti L, Fabbi M, Natale V: Sex difference in sleep-time preference and sleep need: a cross-sectional survey among Italian pre-adolescents, adolescents, and adults. Chronobiol Int, 2008; 25, 745–59
17. Adan A, Natale V: Gender differences in Morningness–eveningness preference. Chronobiol Int, 2002, 19: 709–29
18. Adan A, Archer SN, Hidalgo MP et al: Circadian typology: a comprehensive review. Chronobiol Int, 2012; 29: 1153–75
19. Borisenkov MF, Perminova EV, Kosov A: Chronotype, sleep length, and school achievement of 11- to 23-year-old students in northern European Russia. Chronobiol Int, 2010; 27: 1259–70
20. Randler Ch: Morningness–eveningness, sleep–wake variables and big five personality factors. Pers Individ Dif, 2008; 45: 191–96
21. Cavallera GM, Giampietro M: Morning and evening personality characteristics in a sample of Italians. Percept Mot Skills, 2007; 104: 277–86
22. Jackson LA, Gerard DA: Diurnal types, the “Big Five” personality factors, and other young personal characteristics. J Soc Behav Pers, 1996; 11: 273–83
23. Hogben AL, Ellis J, Archer SN, von Schantz M: Conscientiousness is a predictor of diurnal preference. Chronobiol Int, 2007; 24: 1249–54
24. Tonetti L, Fabbi M, Natale V: Relationship between circadian typology and Big Five personality domains. Chronobiol Int, 2009; 26: 337–47
25. Tankova I, Adan A, Buela-Casal G: Circadian typology and individual differences. A review. Pers Individ Dif, 1994, 16: 671–84
26. Tonetti L, Adan A, Caci H et al: Morningness–eveningness preference and sensation seeking. Eur Psychiatry, 2010; 25: 111–15
27. Randler C, Gomà–í–Freixanet M, Muro A et al: Different circadian typology measures modulate their relationship with personality? A test using the Alternative Five Factor Model. Chronobiol Int, 2014, 7: 1–8
28. DeYoung CG, Hasbrouck L, Mihalik M et al: Morning people are stable people: Circadian rhythm and the higher-order factors of the Big Five. Pers Individ Dif, 2007; 43: 267–76
29. Muro A, Gomà–í–Freixanet M, Adan A: Morningness–eveningness, sex, and the Alternative Five Factor Model of personality. Chronobiol Int, 2009; 6: 1235–48
30. Gligo LM, Magalhães PV, Andersen ML et al: Circadian preference in bipolar disorder. Sleep Breath, 2010; 4: 153–55
31. Toomey R, Panzoni MS, Kremen WS et al: A twin-study of genetic contributions to morningness–eveningness and depression. Chronobiol Int, 2014; 27: 1–7
32. Kim SJ, Lee YI, Kim H et al: Age as a moderator of the association between depressive symptoms and morningness–eveningness. J Psychosom Res, 2010; 68: 159–64
33. Gaspar-Barba E, Calati R, Cruz-Fuentes CS et al: Depressive symptomatology is influenced by chronotypes. J Affect Disord, 2009; 119: 100–6
34. Kasof J: Eveningness and biminimal behavior. Pers Individ Dif, 2001; 31: 361–69
35. Qu W, Ge Y, Xiong Y et al: Dangerous driving in a Chinese sample: associations with morningness–eveningness preference and personality. PLoS One, 2015; 10(1): e0116717
36. Delgado Prieto, P., Diaz-Morales JF, Escibano BC et al: Morningness–eveningness and health-related quality of life among adolescents. Span J Psychol, 2012; 15: 613–23
37. Arhidi T, Vollmer C, Dörrler T et al: The influence of chronotype and intelligence on academic achievement in primary school is mediated by conscientiousness, midpoint of sleep and motivation. Chronobiol Int, 2014; 13: 1–9
38. Tran J, Lettmarhant S, Lohsoonthorn V et al: Daytime sleepiness, circadian preference, caffeine consumption and use of other stimulants among Thai college students. J Public Health Epidemiol, 2014; 8: 202–10
39. Cofer LF, Grice JW, Sethre-Hofstad L et al: Development perspectives on Morningness–eveningness and social interactions. Hum Dev, 1999; 42: 169–98
40. Vitale JA, Roveda E, Montaruli R et al: Chronotype influences activity circadian rhythm and sleep differences in sleep quality between weekdays and weekend. Chronobiol Int, 2014; 3: 1–11
41. Hidalgo MP, De Souza CM, Zanette CB, Nunes PV: Association of daytime sleepiness and the Morningness–eveningness dimension in young adult subjects in Brazil. Psychol Rep, 2003; 93: 427–33
42. Sack RL, Auckley D, Auger RR et al: Circadian rhythm sleep disorders: part I, basic principles, shift work and jet lag disorders. An American Academy of Sleep Medicine review. Sleep, 2007; 11: 1460–83
43. Di Milla L, Muller H: Does impression management impact the relationship between morningness–eveningness and self-rated sleepiness? Pers Individ Dif, 2012; 52: 702–6
44. Kaltenra B, Vidacek S, Przmic Z et al: Is tolerance to shiftwork predictable from individual difference measures? Work Stress, 1995; 9: 140–47
45. Saksilv-Lehouillier I, Bjorvatn B, Hetland H et al: Individual, situational and lifestyle factors related to shift work tolerance among nurses who are new to and experienced in night work. J Adv Nurs, 2013; 69: 1136–46
46. Hume KJ, Brink M, Basner M: Effects of environmental noise on sleep. Noise Health, 2012; 14: 297–302
47. Harada T, Kobayashi R, Wada K et al: Effect of birth season on circadian typology appearing in Japanese young children aged 2 to 12 years disappears in older students aged 18 to 25 years. Chronobiol Int, 2011; 28: 638–42
48. Klettman N: Sleep and Wakefulness. 3rd ed. Chicago: University Press; 1987
49. Doherty MJ, Youn CE, Haltiner AM, Watson NF: Ambient Atmospheric-Pressure Changes Influence Sleep Disordered Breathing? J Clin Sleep Med, 2010; 15: 152–56

50. Natale V, Adan A: Season of birth modulates morningness-eveningness preference in humans. Neurosci Lett, 1999; 274: 139–41

51. Monk TH, Leng VC: Interactions between inter-individual and inter-task differences in the diurnal variation of human performance. Chronobiol Int, 1986; 3: 171–77

52. May CP, Hasher L: Synchrony effects in inhibitory control over thought and action. J Exp Psychol, 1998; 24: 453–63

53. Giampietro M, Cavallera GM: Morning and evening types and creative thinking. Pers Individ Dif, 2007; 42: 453–63

54. Fabbri M, Antonietti A, Giorgetti M et al: Circadian typology and style of thinking differences. Learn Individ Dif, 2007; 17: 175–80

55. Cavallera GM, Passerini A, Pepe A: Personality traits and the role of gender swimmers at the leisure level. Soc Behav Pers, 2013; 4: 693–704

56. Cavallera GM, Boari G, Labbrozzi D, Del Bello E: Morningness-Eveningness Personality and Creative Thinking among young people who play recreational sport. Soc Behav Pers, 2011; 39: 503–18

57. Schaal S, Peter M, Randler C: Morningness-eveningness and physical activity in adolescents. Int J Sport Exercise Psychol, 2010; 8(2): 147

58. Vitale JA, Calogiuri G, Weydahl A: Influence of chronotype on responses to a standardized, self-paced walking task in the morning vs. afternoon: a pilot study. Percept Mot Skills, 2013; 116: 1020–28

59. Eastman CI, Hoese EK, Youngstedt SD, Liu L: Phase-shifting human circadian rhythms with exercise during the night shift. Physiol Behav, 1995; 6: 1287–91

60. Cavallera GM, Boari G, Giudici S, Ortolano A: Cognitive parameters and morning and evening types: two decades of research (1990–2009). Percept Mot Skills, 2011; 112: 649–65

61. Horne JA, Östberg O: A self-assessment questionnaire to determine Morningness-Eveningness in human circadian rhythms. Int J Chronobiol, 1976; 4: 97–110

62. Carskadon MA, Viera C, Acebo C: Association between puberty and delayed phase preference. Sleep, 1993; 16: 258–62

63. Werner H, Lebourgeois MK, Geiger A, Jenni OG: Assessment of chronotype in four to eleven-year-old children: reliability and validity of the Children’s Chronotype Questionnaire (CCTQ). Chronobiol Int, 2009; 26: 992–1014

64. Carskadon MA: Sleep in adolescents: the perfect storm. Pediatr Clin North Am, 2011; 58: 637–47

65. Pesonen AK, Martikainen S, Heinonen K et al: Continuity and change in poor sleep from childhood to early adolescence. Sleep, 2014; 37: 289–97

66. McLaughlin Crabtree V, Williams NA: Normal sleep in children and adolescents. Child Adolesc Psychiatr Clin N Am, 2009; 18: 799–811