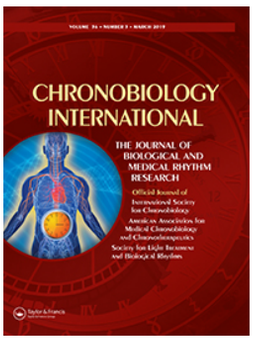

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Adaptation of the Morningness–Eveningness Stability Scale improved (MESSi) into Turkish

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ABSTRACT

Morningness–eveningness is an individual difference that is related with various traits such as behavioral problems, personality, and health. The aim of the current study is to adopt the Morningness–Eveningness Stability Scale improved (MESSi) which is a novel assessment tool that consists of subscales of morning affect (MA), eveningness (EV), and distinctness (DI) into Turkish. Concurrent validity of the MESSi along with Big five inventory (BIG-5), Subjective alertness level, Pittsburg Sleep Quality Index (PSQI), Positive and Negative Affect Schedule (PANAS) were analyzed. The scale was administered to 1,076 high school and university students aged 14–47 years (M = 19.49, SD = 3.53). The explanatory factor analysis (EFA) and confirmatory factor analysis (CFA) revealed the three-factor structure of MESSi. According to the concurrent validity result of the MESSi with BIG-5, conscientiousness was found to correlate positively with MA and negatively with EV. Also, extraversion showed a negative correlation with DI and positive correlation with MA. Furthermore, the subjective alertness rating results showed that MA was positively related to alertness in the morning hours and negatively in the evening hours. Also, sleep quality-related results showed that EV and DI are positively related to total PSQI scores and negatively related to MA. In addition, concerning positive affect (PA) and negative affect (NA), MA was positively related with PA and negatively with NA, while DI was negatively related with PA and positively with NA. In overall, MESSi is a valid and reliable instrument and can be used in Turkish students.

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Circadian preference; morningness–eveningness; adaptation; personality; sleep quality; subjective alertness level

1. Introduction

Morningness–eveningness (M-E) preference is an inter-individual difference that is also known as diurnal or circadian preference. Circadian rhythm is controlled by endogenous circadian clock that has genetic basses and effected by exogenous factors (Adan et al. 2012). Due to this individual difference, energy levels of individuals during the day changes so; people prefer to do activities in different time of the day. Morning-Type (MT) individuals prefer to be active in early hours of the day, while evening-type (ET) individuals prefer to be active latter hours of the day. Besides these types, individuals that have M-E preference in between MT and ET are called neither types (NT) (Hofstra and de Weerd 2008). M-E is influenced by biological factors (e.g. body temperature, cortisol, melatonin), technological and social factors (e.g. electronic media, lightening, TV screens, daily life activities), and environmental factors (e.g. climate, latitude, longitude) (Adan et al. 2012; Demirhan et al. 2016; Masal et al. 2015; Önder et al. 2014, Randler 2008). Further, M-E preference is associated with personality, health, feeding habits, and psychological well-being (Beşoluk 2018; Cavallera and Giudici 2008; Díaz-Morales et al. 2013; Lázár et al. 2012; Natale et al. 2008). MT individuals are more conscientious (Lipnevich et al. 2017; Tonetti et al. 2009; Tsaousis 2010) and more prone to have healthy behavior (Díaz-Morales et al. 2013). On the other hand, ET preference may lead behavioral problems (e.g. depression, loneliness), personality disorders (substance abuse, eating disorders, internet addiction, diurnal sleepiness), and also low school performance (Beşoluk et al. 2011; Merikanto et al.

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2013; Önder et al. 2014). Therefore, determining and having information regarding M-E preference of individuals is important.

Subjective and objective methods are used to measure individuals' circadian rhythm. Objective methods are based on biological variables such as measurement of salivary and blood hormone levels or body temperature. Also, actigraphy is an objective method that measures sleep and wakefulness cycles. Sleep diaries, self-report questionnaires, and scales are subjective methods. Although subjective methods are not valid as objective methods, they are cheap and easy to apply to large group of individuals. Therefore, subjective methods are used by many researchers to obtain qualitative and quantitative data regarding individuals' circadian rhythm.

Sleep dairies, actigraphy, and self-report questionnaires are used for determining an individual's M-E preference. But sleep dairies require follow-up studies and actigraphy is a very expensive method, so their usage is limited into large sample size studies. Because of these limitations, M-E preference is generally assessed by self-report questionnaires and there are four instruments which are adopted into Turkish: Morningness–Eveningness Questionnaire (MEQ), Composite Scale of Morningness (CSM), Morningness–Eveningness Scale for Children (MESC) and Children's Chronotype Questionnaire (CCTQ). MEQ and CSM are used for adults; MESC and CCTQ are used for children. MEQ is the most widely used instrument in the world which was developed by Horne and Östberg (1976) and adopted in Turkish by Punduk et al. (2005) and Agargun, Cilli, Boysan and Selvi (2007). It consists of 19 items which are related with wake-up times, bed times, and preferred times for cognitive or physical activity. The other instrument is CSM that is developed by Smith et al. (1989) and adopted in Turkish by Önder et al. (2013). CSM is composed of 13 items that refer to preferred rising and bed times, preferred times of physical and mental performance, subjective alertness after rising, and subjective evaluation of morningness and eveningness (EV). MESC was produced by Carskadon et al. (1993) by modifying the items of similar questionnaires constructed for use in adults and adopted into Turkish by Önder and Beşoluk (2013). It has 10 items having 4 or 5 choices. The last one is CCTQ and it is a combination of the Munich Chronotype Questionnaire (MCTQ) and the MESC. It is both personal and parent-reported questionnaire that consists of 16 items on sleep/wake parameters for scheduled days and free days (Dursun et al. 2015).

The review study conducted by Tonetti et al. (2015) reported that Morningness–Eveningness Questionnaire for Children and Adolescents (MEQ-CA) was validated by highest number of external criteria such as actigraphy and oral body temperature compared to MESC and CSM. Also, Di Milia et al. (2013) conducted a review study on the reliability and validity of MEQ, CSM, MCTQ, reduced Morningness–Eveningness Questionnaire (rMEQ), and Preferences Scale (PS). They have indicated that MEQ, CSM, and PS have better reliability coefficients compared to the rMEQ. Meanwhile, MEQ, rMEQ, and CSM were found to correlate highly. There are several other instruments to define individuals' chronotype. But by the time new instruments were developed in the light of the new information, Ogińska (2011) suggested the amplitude as an additional measure of circadian rhythm and Ottoni et al. (2011) suggested two questions about energetic feeling to reflect the new item developments. For this purpose, Randler, Díaz-Morales and Rahafar (2016) developed a new instrument which is a novel measurement evolving out of the existing measurements and consist of the combination of the three questionnaires: CSM, Caen Chronotype Questionnaire (CCQ), and Circadian Energy Scale (CIRENS). The aim of the current study was to adopt the Morningness–Eveningness Stability Scale improved (MESSi) to Turkish.

1.1. Morningness–Eveningness Stability Scale improved (MESSi)

The MESSi was used as an improved measure of M-E trait composed of 15 items with having 5 choices (Randler et al. 2016). In MESSi, two items were selected from CIRENS (Ottoni et al. 2011), four items were selected from CSM (Smith et al. 1989), and nine items were selected from CCQ (Dosseville et al. 2013). The MESSi has three subscales which are Morning Affect (MA), EV, and Distinctness (DI)

according to factor and external validity analysis. MA was composed of items 3, 4, and 12 of CSM, item 4 of CCQ, and morning level of energy from CIRENS. EV was composed of revised item 13 of CSM (evening reformulated), revised items 2 and 11 of CCQ (evening reformulated), item 5 of CCQ, and evening level of energy of CIRENS. Also, DI was composed of items 6, 8, 10, 14, and 15 of CCQ. According to Rahafar et al. (2017), confirmatory factor analysis (CFA) of MESSi indicated mediocre to acceptable fit (RMSEA between 0.06 and 0.09) in the countries of Spain, Iran, and Germany. The Cronbach's alpha internal consistency coefficients for MA, EV, and DI were found as 0.87, 0.84, and 0.73, respectively (Randler et al. 2016). In addition, alpha coefficients of the Spanish version of MESSi subscales were found as: MA: 0.85, EV: 0.83, and DI: 0.72 (Díaz-Morales and Randler 2017). Besides, Slovenian version of MESSi subscales was found as: MA: 0.82, EV: 0.85, and DI: 0.69, and many of the sleep–wake variables were correlated with MA and EV (Tomažič and Randler 2018). Rodrigues et al. (2018) indicated the suitability of the MESSi for multicultural research on relevant and multiple aspects of chronotype. In addition, many of the sleep–wake variables were correlated with MA and EV. Moreover, Faßl et al. (2018) found that subscales of MESSi showed good convergent validity with rMEQ and also MA was negatively correlated with the midpoint of sleep as measured by actigraphy.

2. Method

2.1. Participants

The scale was administered to 1,076 high school and university students aged 14–47 years (M = 19.49, SD = 3.53) and 796 of which were female (73.9%) and 280 were male (26.0%). Meanwhile, 46 (30 female, 16 male) students received scale for linguistic equivalence and 63 (53 female, 10 male) student received twice for test–retest reliability. Descriptive statistics regarding subscales of MESSi were presented in Table 1 according to EFA and CFA sample.

2.1.1. Big five inventory (BIG-5)

The short form of the BIG-5 was developed by Gosling et al. (2003) and adopted into Turkish by Günel (2010). It contains 10 items with 2 items for each dimension (extraversion, agreeableness, conscientiousness, neuroticism, and openness to experience). The Cronbach's alpha internal consistency coefficients of the dimension were reported as 0.89 (extraversion), 0.80 (agreeableness), 0.76 (conscientiousness), 0.71 (neuroticism), and 0.69 (openness to experience).

2.1.2. Subjective alertness level

Natale and Cicogna (1996) asserted that subjective alertness is probably the best predictor of all the circadian rhythms of psychological process. Thus, to show the external validity of the MESSi, participants were asked to indicate how alert they felt on a day when they had no important responsibilities. Participants rated their alertness starting from 6:00 am to 2:00 am in two-hour intervals on a 9-point Likert-type scale. In the scale, lower scores indicate a lower level of alertness (Bohle, Tilley, & Brown, 2001; Diaz-Morales & Sanchez-Lopez, 2005).

2.1.3. Pittsburg sleep quality index (PSQI)

The PSQI was developed by Buysse, Reynolds, Monk, Berman and Kupfer (1989) and adapted into Turkish by Agargun, Kara and Anlar (1996). The PSQI contains seven components: Subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. It contains 19 self-rated items, which are included in the present study and also 5 additional questions rated by the bed partner or roommate. The current study did not use the five questions that were rated by the participants' bed partner or roommate. The Cronbach's alpha coefficient of the PSQI was found to be 0.80.

2.1.4. Positive and negative affect schedule (PANAS)

The PANAS was developed by Watson et al. (1988) and adapted into Turkish by Gençöz (2000). PANAS contains 20 items and measures 2 mood scales which are negative affect (NA) and positive affect (PA). Each scale was composed of 10 items and 5-point scale was used ranging from very slightly or not at all (1) to extremely (5). The Cronbach's alpha coefficient of the NA was found to be 0.87 and PA was found to be 0.88.

Table 1. Descriptive statistics for the MESSi subscales according to EFA and CFA samples.

	Sample of explanatory factor analysis (EFA)						Sample of confirmatory factor analysis (CFA)					
	Female (N = 412)			Male (N = 183)			Female (N = 384)			Male (N = 97)		
	MA	EV	DI	MA	EV	DI	MA	EV	DI	MA	EV	DI
M ± SD	14.66 ± 4.29	17.28 ± 4.64	17.70 ± 3.14	14.79 ± 4.45	18.07 ± 4.54	15.91 ± 3.31	15.98 ± 2.95	14.82 ± 3.02	15.90 ± 3.09	16.81 ± 2.84	15.61 ± 2.72	15.61 ± 3.21
Skewness	−0.32	−0.38	−0.12	−0.03	−0.54	−0.36	−0.18	0.05	−0.13	0.04	0.07	0.28
Kurtosis	−0.48	−0.43	0.25	−0.90	−0.26	0.22	−0.37	−0.40	−0.16	−0.21	0.45	−0.42

2.2. Procedures

All students' participation was voluntary and anonymous and they responded to the data collecting tools in paper and pencil format. Study was conducted between April 2017 and May 2018. Validity and reliability data were collected between March 2018 and May 2018. In the first step of the study, MESSi was translated into Turkish and then back translated into English by four bilingual English speakers who were also expert on the topic of chronotype. Hambleton (2005)'s suggestions were taken into account while translating scale items into Turkish. To ensure that the items have the right meaning in Turkish form, face-to-face interviews were conducted with 20 participants. Then, researchers discussed on whether the items have the same meaning until they reach a consensus. After that, 46 university students received both Turkish and English version of the MESSi over three-week interval for linguistic equivalence. Meanwhile, another sample of students (N = 63) received the Turkish form of the MESSi twice over a month interval for test–retest reliability. Then, EFA and CFA were carried out in order to test factorial validity of MESSi. For these analyses, participants were randomly divided into two groups. In the first group (n = 595) EFA was performed and in the second group (n = 481) CFA was performed. In addition, 561 participating students also received the scales: BIG-5, Subjective alertness level, PSQI, and PANAS in order to examine the concurrent validity of the MESSi. The PASW Statistics 18.0, LISREL 8.71, and AMOS 20 programs were used for statistical analysis.

3. Results

3.1. Results of linguistic equivalence

The correlation between the Turkish- and English-form items and subscales of the MESSi is investigated and correlation coefficients obtained are presented in Table 2.

According to Table 2, the Turkish form of the MESSi was accepted to be linguistically equivalent to the English scale, because the correlation

Table 2. The correlation coefficients between Turkish and English form items and subscales of the MESSi.

Morning affect (MA)		Eveningness (EV)		Distinctness (DI)	
Item no	Pearson correlation coefficients	Item no	Pearson correlation coefficients	Item no	Pearson correlation coefficients
X1	0.877**	X5	0.714**	X8	0.609**
X2	0.632**	X7	0.782**	X9	0.527**
X3	0.691**	X13	0.422**	X10	0.822**
X4	0. 648**	X14	0.759**	X11	0.682**
X6	0.622**	X15	0.480**	X12	0.715**
MA total	*0.890***	*EV total*	*0.846***	*DI total*	*0.652***

** $p < 0.01$.

coefficients of items and total score were moderate or close to high.

3.2. Results of factorial validity

The factorial validity of the MESSi was investigated by both conducting EFA and CFA.

3.2.1. EFA results

Explanatory factor analysis using maximum likelihood with Varimax rotation was conducted to determine the factorial structure of MESSi. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy test provided a value of 0.84. Also the Bartlett's Test of Sphericity provided a statistically significant result (χ^2 = 3132.538, $p < 0.01$). According to Fidel (2000) and Green and Salkind (2005)'s criteria, the data were treated as suitable for EFA since both KMO and Bartlett's Test presented that correlation between items are sufficiently high for the analysis. Three factors were extracted based on the eigenvalue greater than one criterion for MESSi. Factor loadings of each item and variance explained by the factors are presented in Table 3. The factor loadings of items ranged from 0.44 to 0.85 and three factors accounted for 54.36% of the total variance. Factor loadings higher than 0.71 can be considered excellent measures of the factor, 0.63 very good, 0.55 good, 0.45 fair, and 0.32 poor (Comrey and Lee 1992).

The EFA findings showed that the three-factor structure of the Turkish form is similar to the English form (MA: item X1, X2, X3, X4, and X5; EV: item X6, X7, X8, X9, and X10 and DI: item X11, X12, X13, X14, and X15). In addition,

Table 3. Rotated component matrix for Turkish form of MESSi.

	Subfactors		
Items	Morning affect (MA)	eveningness (EV)	Distinctness (DI)
X6	**0.847**	0.135	0.003
X2	**0.829**	−0.190	0.089
X1	**0.764**	−0.224	0.154
X4	**0.659**	−0.286	0.249
X3	**0.622**	0.240	−0.019
X15	0.230	**0.827**	0.039
X14	0.265	**0.810**	−0.028
X13	0.247	**0.747**	−0.123
X5	0.049	**0.711**	−0.004
X7	0.276	**0.607**	−0.004
X10	0.012	0.028	**0.774**
X8	−0.015	0.084	**0.704**
X9	−0.007	−0.40	**0.563**
X11	0.124	0.030	**0.519**
X12	0.190	0.120	**0.443**
Eigen values	4.79	1.97	1.38
% of variance explained	31.94	13.18	9.24

Note: The bold ones refer the factor loadings in each sub-scales.

Table 4. Pearson correlations coefficients between MA, EV, and DI.

	MA	EV	DI
MA	1		
EV	−0.526**	1	
DI	−0.220**	0.089*	1

*$p < 0.05$; **$p < 0.01$.

Pearson correlation coefficients between MA, EV, and DI are presented in Table 4.

According to Table 4, the relation between MA and EV was negative and also higher than the relation between MA and DI. Also, the relation between EV and DI was positive but lower than the relation between MA-EV and MA-DI.

3.3. Confirmatory factor analysis (CFA)

CFA was carried out to determine whether data fit the model that was obtained in EFA. The model fit of three-factor structure (each consisting of five items) of the Turkish form has been tested. Schermelleh-Engel et al. (2003)'s recommendations were considered while evaluating model data fit. The standardized factor loadings of the items in each factor (MA, EV, and DI) were 0.73, 0.73, 0.44, 0.71, 0.71, 0.69, 0.56, 0.71, 0.68, 0.58, 0.58, 0.69, 0.86, 0.85, and 0.79, respectively (Figure 1). The *t*-values (Figure 2) were controlled and it is observed that all items are statistically significant at a level of 0.05.

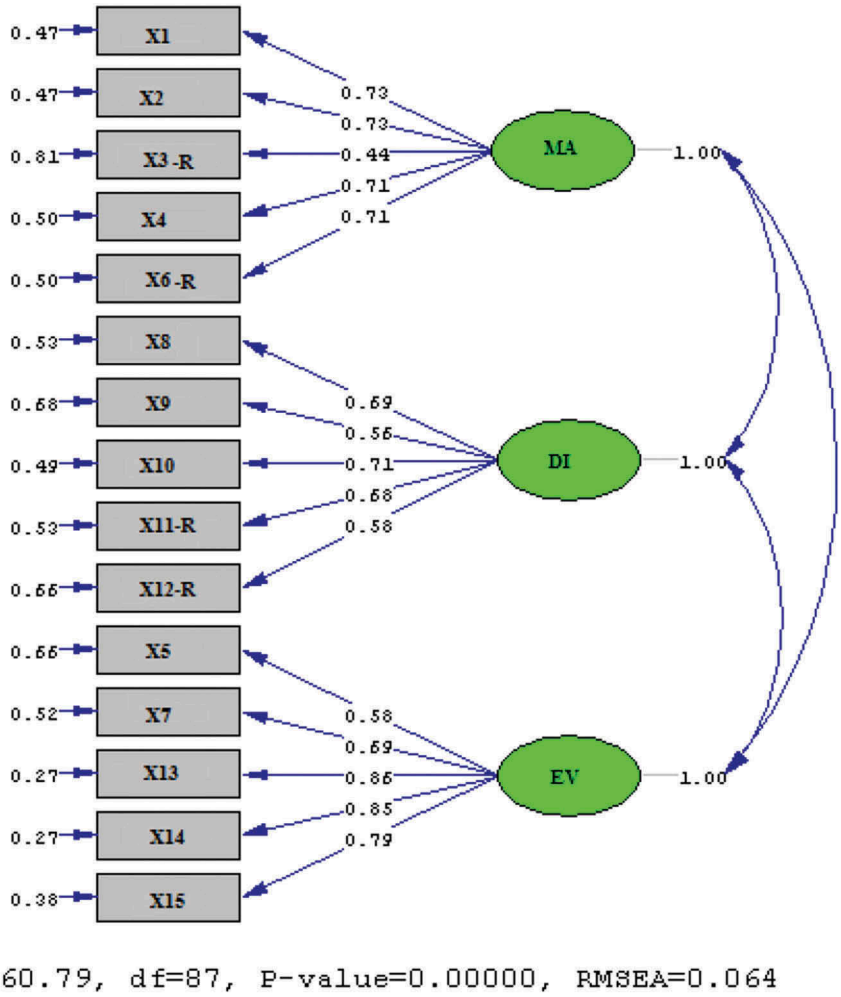

Figure 1. Standardized solutions of the CFA model.

The CFA analysis conducted presented the following goodness-of-fit indices: χ^2 = 260.79 (df = 87, $p < 0.01$), χ^2/df = 2.99, RMSEA = 0.064, CFI = 0.96, NFI = 0.94, NNFI = 0.95, GFI = 0.93, and AGFI = 0.91. These fit indices were in acceptable range; therefore, it can be stated that all values have very good fit or are close to good fit.

3.4. Results of concurrent validity

The BIG-5, Subjective alertness level, PSQI, and PANAS were applied to 561 students with two-week interval in order to investigate the concurrent validity of Turkish form (Table 5). Pearson's product moment correlation was used to examine the relationship between the scores acquired from each of the measurement tools.

The correlations between MESSi and BIG-5 provided statistically significant relationship between extraversion and MA (r = 0.094, $p < 0.05$) and extraversion and DI (r = −0.133, $p < 0.01$); conscientiousness and MA (r = 0.186, $p < 0.01$) and conscientiousness and EV (r = −0.107, $p < 0.05$). Correlations regarding subjective alertness showed that in general MA positively relates with alertness in the morning hours and negatively in the evening hours. On the other hand, EV was positively related to alertness in the evening hours and negatively in the morning hours. Also, DI correlated negatively with the alertness (except from 24:00 h to 2:00 h).

A statistically significant relationship was determined between the MA and PSQI (r = −0.147, $p < 0.01$), EV and PSQI (r = 0.904, $p < 0.05$), and DI and PSQI (r = 0. 109, $p < 0.01$).

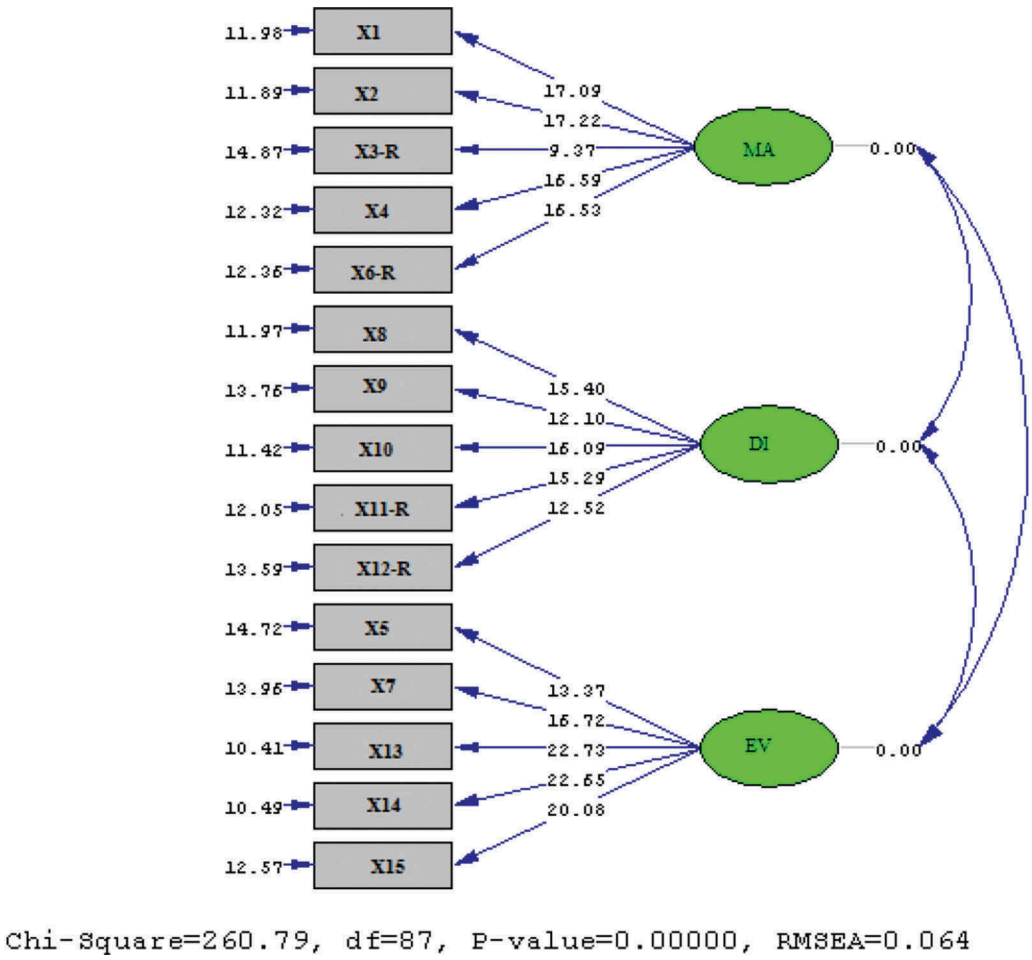

Figure 2. t-Values of the CFA model.

Furthermore, MA was positively related with PA (r = 0.216, p < 0.01) and negatively with NA (r = −0.263, p < 0.01), while DI was negatively related with PA (r = −0. 296, p < 0.01) and positively with NA (r = 0.283, p < 0.01). In addition, EV was positively related with NA (r = 0. 105, p < 0.05).

3.5. Results of age group and gender invariance

Multi Group Confirmatory Factor Analysis (MGCFA) was performed by AMOS to test age group (14–18 years, N = 300/19–30 years, N = 300) and gender invariance. MGCFA was conducted on data which were chosen randomly from each age group. Configural, metric, scalar, and residual invariance was investigated for three-factor model. Results were presented in Table 6.

Three-factor model was tested for both age and gender group and the analysis results showed that the configural invariance model is acceptable according to cut-off values presented by van de Schoot et al. (2012) which are CFI>0.90 and RMSEA <0.08. In addition, considering Chen's (2007) criteria (ΔCFI ≥ −0.01 combined with ΔRMSEA ≤.015) results presented that metric invariance was achieved in age groups, while metric and scalar invariance was achieved in gender groups.

3.6. Results of reliability

Consistency of the results over time was explored by test–retest reliability. Turkish form of MESSi was administered to 63 students twice and test–retest reliability was found as 0.72 (p < 0.05). The Cronbach's Alpha values for the subscales MA, EV, and DI were 0.84, 0.81, and 0.58, respectively.

Table 5. Pearson correlations between MESSİ subscales and BIG-5, PSQI, PANAS, and subjective level of alertness.

	Morning affect	Eveningness	Distinctness
BIG-5			
Extraversion	0.094*	−0.016	−0.133**
Agreeableness	−0.032	−0.023	0.021
Conscientiousness	0.186**	−0.107*	−0.046
Emotional stability	0.017	−0.047	0.007
Openness to experience	−0.001	−0.011	0.055
Subjective alertness times			
6:00–8:00	0.347**	−0.250**	−0.108**
8:00–10:00	0.468**	−0.320**	−0.222**
10:00–12:00	0.479**	−0.288**	−0.206**
12:00–14:00	0.369**	−0.209**	−0.216**
14:00–16:00	0.213**	−0.088**	−0.193**
16:00–18:00	0.113**	−0.024	−0.154*
18:00–20:00	0.060	0.068*	−0.138**
20:00–22:00	−0.039	0.201**	−0.094**
22:00–24:00	−0.132**	0.307**	−0.044
24:00–2:00	−0.224**	0.331**	0.016
PSQI			
Subjective sleep quality	−0.199**	0.118**	0.082
Sleep latency	−0.159**	−0.036	0.183**
Sleep duration	−0.021	0.086*	−0.006
Habitual sleep efficiency	−0.082	−0.006	−0.060
Sleep disturbances	−0.233**	0.054	0.206**
Use sleep medication	0.063	−0.127**	0.032
Daytime dysfunction	−0.206**	0.113**	0.127**
PSQI_total	−0.147**	0.094*	0.109**
PANAS			
PA	0.216**	−0.019	−0.296**
NA	−0.263**	0.105*	0.283**

Note: Pearson's correlation coefficients; $^{**}p < 0.01$, $^{*}p < 0.05$.

4. Discussion

The aim of the current study was to adopt the MESSi into Turkish. In accordance with this aim, linguistic equivalence, reliability, and validity studies were conducted. When reliability analysis results are examined, it is observed that the internal consistency coefficients and test–retest reliability analysis of the Turkish form provide acceptable results. The exploratory factor analysis of the Turkish form showed that three-factor structure of the scale is in accordance with the English form of MESSi. Moreover, very good or are close-to-good-fit indices obtained in CFA indicates a good model data fit. These results indicate that three-factor structure of the Turkish form is verified. Gender-based measurement invariance suggests that the three-factor model of Turkish form had the same factor pattern and structure across the two groups. A similar result was found by Rodrigues et al. (2018). Meanwhile configural and metric invariance was obtained from age-based measurement. The concurrent validity investigation provided correlations in coherence with the literature. For example, conscientiousness was found to correlate positively with MA and negatively with EV. These results are in accordance with the results of adaptation study conducted by Díaz-Morales and Randler (2017). Meanwhile, several other studies show that conscientiousness is positively related with morningness (DeYoung et al. 2007; Lipnevich et al. 2017; Tonetti et al. 2009). In the current study, positive correlation was found between extraversion and MA. Randler et al. (2017) found a similar result in their study. Also, extraversion showed negative correlation with DI. A similar result was reported in the Spanish adaptation study of the MESSi (Díaz-Morales and Randler 2017).

Furthermore, the subjective alertness rating results showed that MA was positively related to alertness in the morning hours and negatively in the evening hours. The opposite relationships were found in EV. This confirms previous findings on alertness and M-E preference (Bohle et al. 2001; Díaz-Morales and Randler 2017). Also, DI correlated negatively with the alertness rating in general.

Table 6. MGCFA results of age group and gender measurement invariance.

		Model fit				Model comparisons		
		χ^2	df	CFI	RMSEA [90%CI]	Models	ΔCFI	ΔRMSEA
Age group invariance	M1.Configural	577.085	180	0.904	0.061 [0.055, 0.066]	-	-	-
	M2.Metric	595.074	192	0.903	0.059 [0.054, 0.065]	M2-M1	−0.001	−0.002
	M3.Scalar	655.391	207	0.892	0.060 [0.055, 0.065]	M3-M2	−0.011	0.001
	M4.Residual	795.192	222	0.861	0.066 [0.061, 0.071]	M4-M3	−0.031	0.006
Gender invariance	M1.Configural	561.443	180	0.906	0.060 [0.054, 0.065]	-	-	-
	M2.Metric	588.621	192	0.903	0.059 [0.053, 0.064]	M2-M1	−0.003	−0.001
	M3.Scalar	614.259	207	0.900	0.057 [0.052, 0.063]	M3-M2	−0.003	−0.002
	M4.Residual	652.029	222	0.894	0.057 [0.052, 0.062]	M4-M3	−0.006	0.000

Note. χ^2: Chi-square, df: Degrees of freedom, CFI: Comparative fit index, RMSEA: Root mean square error of approximation, CI: Confidence interval, Δ: Difference.

Sleep quality-related results showed that EV and DI are positively related to total PSQI scores and negatively related to MA. In sub-dimensions of PSQI, it was found that subjective sleep quality, sleep latency, sleep disturbances, and daytime dysfunction correlated negatively with MA. Subjective sleep quality, sleep duration, and daytime dysfunction correlated positively with EV while using sleep medication showed negative correlation with EV. In addition, positive correlations were found between sleep latency, sleep disturbances, daytime dysfunction, and DI.

In addition, concerning PA and NA, a statistically significant relationship was found between MA, EV, and DI. Although MA was positively related with PA and negatively with NA, DI was negatively related with PA and positively with NA. Also, EV was positively related with NA.

In sum, Turkish form of MESSi is a valid and reliable instrument (see in Appendix) and can be used to assess MA, EV, and DI. MESSi provides an advantage to the contemporary measures by considering diurnal amplitude/DI in addition to MA and EV. However, psychometric evidences of MESSi were determined with only subjective measures using paper and pencil measurement tools, which is a limitation of the study. Therefore, further studies should be conducted using objective measures (actigraphy, temperature measures, and hormone tests) in order to establish further validity. In addition not using previously validated chronotype scales in Turkish is a limitation of the study. Another limitation of the study is subjective alertness was measured by a single item and BIG-5 personality was determined with a 10-item scale.

Disclosure statement

The authors report no conflicts of interest.

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Appendix: Turkish form of MESSi

X1. Normal koşullar altında sabahları uyanmak sizin için ne kadar kolaydır?
[1] Kesinlikle kolay değildir
[2] Pek kolay değildir
[3] Ne kolay ne de zordur
[4] Kolaydır
[5] Son derece kolaydır

X2. Sabah uyandığınızda ilk yarım saat içinde kendinizi ne kadar uyanık hissedersiniz?
[1] Hiç uyanık hissetmem
[2] Çok az uyanık hissederim
[3] Orta düzeyde uyanık hissederim
[4] Uyanık hissederim
[5] Çok uyanık hissederim

***X3**. Gece uykusunun ardından sabah kalktığınızda algılama hızınızın normal hale gelmesi ne kadar zaman alır?
[1] 0–10 dakika arası
[2] 11–20 dakika arası
[3] 21–40 dakika arası
[4] 41–60 dakika arası
[5] 60 dakikadan fazla

X4. Sabahları enerji seviyeniz genellikle nasıldır?
[1] Çok düşük
[2] Düşük
[3] Orta
[4] Yüksek
[5] Çok yüksek

X5. Akşamları enerji seviyeniz genellikle nasıldır?
[1] Çok düşük
[2] Düşük
[3] Orta
[4]Yüksek
[5] Çok yüksek

***X6**. Uyandıktan sonra uzun bir süre kendimi uykulu hissederim.
[1] Hiç uygun değil
[2] Az uygun
[3] Orta düzeyde uygun
[4] Oldukça uygun
[5] Tamamen uygun

X7. Eğer kendi kendime herhangi bir şey çalışacak olursam, bunu daha çok akşamları yapmayı tercih ederim.
[1] Hiç uygun değil
[2] Az uygun
[3] Orta düzeyde uygun
[4] Oldukça uygun
[5] Tamamen uygun

X8. Duygu ve zihin durumum (modum) gün boyunca aynı kalır.
[1] Hiç uygun değil
[2] Az uygun
[3] Orta düzeyde uygun
[4] Oldukça uygun
[5] Tamamen uygun

X9. Gün içinde herhangi bir anda bir şey üzerinde zihinsel olarak yoğunlaşabilirim (odaklanabilirim).
[1] Hiç uygun değil
[2] Az uygun
[3] Orta düzeyde uygun
[4] Oldukça uygun
[5] Tamamen uygun

X10. Günün her anında bir şeyler yapmak için istekliliğim aynıdır.
[1] Hiç uygun değil
[2] Az uygun
[3] Orta düzeyde uygun
[4] Oldukça uygun
[5] Tamamen uygun

***X11**. Gün içerisinde hiçbir şey yapamayacağımı hissettiğim anlar olur.
[1] Hiç uygun değil
[2] Az uygun
[3] Orta düzeyde uygun
[4] Oldukça uygun
[5] Tamamen uygun

***X12**. Gün içerisinde bazı anlarda zihinsel faaliyet yürütmek (düşünmek) benim için daha zordur.
[1] Hiç uygun değil
[2] Az uygun
[3] Orta düzeyde uygun
[4] Oldukça uygun
[5] Tamamen uygun

X13. Sabah saatleri ile kıyaslandığında akşam saatlerinde daha aktif bir kişiyim.

[1] Hiç uygun değil
[2] Az uygun
[3] Orta düzeyde uygun
[4] Oldukça uygun
[5] Tamamen uygun

X**14**. En iyi akşamları düşünebildiğimi hissederim.
[1] Hiç uygun değil
[2] Az uygun
[3] Orta düzeyde uygun
[4] Oldukça uygun
[5] Tamamen uygun

X15. Ruh halim genellikle akşamları mükemmel olur.
[1] Hiç uygun değil
[2] Az uygun
[3] Orta düzeyde uygun
[4] Oldukça uygun
[5] Tamamen uygun

* *işaretli olan maddeler ters maddedir.*