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To cite this article: Ismail Önder & Şenol Beşoluk (2013) Adaptation of the morningness eveningness scale for children into Turkish, *Biological Rhythm Research*, 44:2, 313-323, DOI: [10.1080/09291016.2012.681848](https://doi.org/10.1080/09291016.2012.681848)

To link to this article: <https://doi.org/10.1080/09291016.2012.681848>



Accepted author version posted online: 11 Apr 2012.
Published online: 28 May 2012.



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Adaptation of the morningness eveningness scale for children into Turkish

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(Received 21 January 2012; final version received 15 March 2012)

Circadian rhythm refers to individuals' preference associated with morning or evening activities. Circadian rhythm generally is measured by self reported instruments. One of these instruments is Morningness Eveningness Scale for Children (MESC). The aims of the study were to adapt MESC into Turkish, to determine psychometric properties of Turkish MESC and to assess chronotype preference in children aged from 9 to 12. A group of 515 children (4th to 6th graders) participated in the study. The explanatory factor analysis on the 10 items of the Turkish MESC revealed three orthogonal factors. Moreover, results of second order confirmatory factor analysis indicated that three factor structure of MESC explains morningness eveningness preference. The internal consistency and external validity of the Turkish MESC was sufficient and similar to previous studies. In overall, MESC is a valid and reliable instrument and can be used to assess circadian preferences in Turkish samples.

Keywords: chronotype; diurnal preference; morningness eveningness; reliability and validity

Introduction

Activities that recur with a periodicity of about 24 h are called circadian rhythms. Circadian rhythm is a personal characteristic that shows some physiological and psychological correlations and is thought to influence diverse aspects of an individuals' life. Circadian rhythm preference was found to correlate with academic performance, personality, emotional/behavioral problems, social problems, attention, cognition, sleep length/quality, etc. (Carskadon et al. 1993; Randler and Frech 2006, 2009; Gau et al. 2007; Randler 2009; Beşoluk 2011; Beşoluk and Önder 2011; Beşoluk et al. 2011; Preckel et al. 2011; Escribano et al. 2012). Circadian rhythm or morningness eveningness refers to individuals' preference associated with morning or evening activities. Morning type individuals prefer arising early, prefer morning activities and are more alert in the morning. On the other hand, evening type individuals prefer to get up/sleep later and prefer afternoon or evening activities. Researchers reported that individuals' morningness eveningness preferences changes with age and gender

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(Preckel et al. 2011). Significant evidence suggests that there are changes in time of day preferences over the course of human development (Wickersham 2006). Pupils shift their time of day preferences from morningness to eveningness during the age of puberty (Randler and Frech 2006). On the other hand, morningness increases with age in older adults (Díaz-Morales and Sorroche 2008). In regards to gender, recent meta-analysis suggests a weak but significant effect of gender on morningness (Randler 2007). Girls/women are more morning oriented than boys/men if similar age groups were compared (Tonetti et al. 2008). Controversially, some studies reported no gender effect on morningness eveningness preferences (Chelminski et al. 2000; Escribano et al. 2012).

Morningness eveningness is generally determined by self reported instruments since they are quicker and simpler compared to physiological measures (Díaz-Morales and Sorroche 2008). The best known instrument to determine morningness and eveningness is the Morningness Eveningness Questionnaire (MEQ) developed by Horne and Östberg (1976). Later, other instruments were developed, i.e. Basic Language Morningness Scale (BALM; Brown 1993), Munich ChronoType Questionnaire (MCTQ; Roenneberg et al. 2003), Composite Scale of Morningness (CSM; Smith et al. 1989), Early/Late-Preference Scale (Smith et al. 2002), Diurnal Type Scale (DTS; Torsvall and Åkerstedt 1980), Circadian Type Inventory (Di Milia et al. 2005), Pupil Morningness Eveningness Questionnaire (PMEQ; Randler and Frech 2006) and, Morningness Eveningness Scale for Children (MESc; Carskadon et al. 1993). PMEQ and MESc are the two instruments that are widely used to determine youngsters' chronotype. MESc was translated into several languages (Spanish: Díaz-Morales and Sorroche 2008; Italian: Natale and Buruni 2000; French: Caci et al. 2005) and validated (Díaz-Morales et al. 2007) but, not adapted into Turkish. Results of the chronotype researches indicated that morningness scores vary across cultures since, culture, social habits, life style, and geographic location affect chronotype preference. The aim of the study is to adapt MESc into Turkish and, to assess chronotype preference in children aged from 9 to 12 (in Turkey no data exist in this age range regarding chronotype preference). Moreover, psychometric properties of the Turkish MESc were determined.

Method

Participants

In this study, 515 pupils aged between 9 and 12 years participated ($\bar{X} = 10.4$, $SD = 1.3$). The students of the study were attending 4th, 5th, and 6th grades. 52.4% were girls. The researchers conducted the study after obtaining the parents' consent and participation was voluntary and anonymous.

Instruments

Morningness Eveningness Scale for Children (MESc)

This scale was produced by Carskadon et al. (1993) for children by modifying the items of similar questionnaires constructed for use in adults that are valid and reliable. The scale has 10 items having four or five choices. Each item is given a score from 1 to 4 when the response patterns are limited to four and from 1 to 5 for all the items implying five response patterns. The theoretical total score ranges from 10 (eveningness) to 43 (morningness). The scale has been adapted to different cultural contexts (Natale and

Bruni 2000; Kim et al. 2002; Caci et al. 2005; Díaz-Morales and Sorroche 2008). The internal consistency coefficient of the scale was found as 0.69 in this study.

Composite Scale of Morningness (CSM)

The CSM was developed by Smith et al. (1989) and consists of 13 items regarding the time individuals get up and go to bed, preferred times for physical and mental activity, and subjective alertness. Theoretical total score ranges from 13 (eveningness) to 55 (morningness). The reliability and validity of the CSM has been corroborated by many studies (Pornpitakpan 1998; Smith et al. 2002; Caci et al. 2005; Randler and Díaz-Morales 2007; Voinescu et al. 2010). Cronbach's alpha of the CSM in the present study was 0.72.

Procedures

Translation and back translation procedure was used to ensure translation quality of the scale. Back translation involves translating the scale from the source language to the target language by bilingual individuals. This translated version is then back translated to the source language by other bilingual individuals. Then, the original and the back-translated versions of the test are compared and the extent of similarity of both versions supports the language equivalence of both versions (Hambleton 2005). In this study, two bilinguals translated the instrument to Turkish and then another two bilinguals back translated it to English. The researcher and translators discussed on whether the items of the two versions are similar until they reach a consensus. Moreover, in-depth interviews were implemented with a small group of students ($N=6$) about the understanding of the scale items. Students gave their impression on the clarity of the each item. They were also encouraged to make suggestions whenever necessary. The items of the Turkish MESC are presented in Appendix. For the construct validity analysis, explanatory and confirmatory factor analysis was performed. Explanatory factor analysis was performed on data obtained from main sample ($N=515$), however confirmatory factor analysis was performed on data obtained from another sample of 345 children in the same age range. Test-retest reliability analysis was performed on a sub-sample of 100 children who received the scale twice over one month interval. In order to examine the external validity of the scale, the MESC was administered with CSM to a sub-sample of 70 students (there were three weeks between the administrations of the two scales).

Results

Descriptive statistics

Descriptive statistics regarding MESC total scores were presented in Table 1. The range for MESC scores was from 10 to 42. The distribution of MESC total scores in whole, girls and boys sample were negatively skewed indicating that the participants were more morning oriented in all samples. The skewness and kurtosis values did not deviate from ± 1 , verifying the presence of normality. There were no gender differences in MESC total scores [$t_{(513)}=0.84$, ns], although the tendency of the means indicates that girls scored higher in MESC ($\bar{X}_{\text{girls}} = 28.6$; $\bar{X}_{\text{boys}} = 28.2$). In order to study gender differences in more detail, the scale items were analyzed with t -tests. No gender difference was observed in all 10 items.

Exploratory Factor Analysis (EFA)

Explanatory factor analysis using principal component analysis with varimax rotation was carried out to determine the dimensional structure of MESC. EFA analysis was conducted using the following criteria: (a) eigenvalue > 1.0 ; (b) variables should load > 0.40 on a factor. A Bartlett's test of Sphericity with $p < 0.05$ and a Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy of 0.7 were used in performing EFA. The KMO value was found to be 0.71. Bartlett's sphericity test [$\chi^2(45) = 930.39, p = 0.000$] indicated that correlation between items were sufficiently high for the analysis.

The EFA on the 10 items of the Turkish MESC revealed three orthogonal factors. Factor loadings and variance explained by each factor for Turkish MESC items are presented in Table 2. The factor loadings in the study ranged from 0.49 to 0.85. Those factors explained 55.85% of the variance. The first factor (F1) includes the following items: 1, 6, and 8. These are generally related with sleep/wake time; therefore the factor was named as “sleep/wake planning”. The second factor (F2) is composed of items 3, 4, 5, and 10. These items are related with performance generally and the factor was named as “having high performance”. The third factor (F3) includes the following items: 2, 7, and 9. Since these items are related with being a morning type the factor was named as “morningness”.

Table 1. Descriptive statistics for the MESC total score.

	Girls	Boys	Total
<i>N</i>	270	245	515
Mean \pm SD	28.6 \pm 5.3	28.2 \pm 5.0	28.4 \pm 5.2
Median	29	28	29
Range	32	32	32
Skewness	-0.61	-0.43	-0.52
Kurtosis	0.66	0.30	0.48

Table 2. Rotated component matrix for MESC.

Item	Factors		
	I	II	III
6	0.85		
8	0.82		
1	0.65		
4		0.77	
10		0.72	
5		0.62	
3		0.49	
2			0.83
9			0.74
7			0.66
Eigen values	2.72	1.69	1.18
% of variance explained	27.15	16.88	11.82

Confirmatory Factor Analysis (CFA)

Confirmatory factor analysis was conducted to determine whether data fit the model that was based on results obtained in EFA. The second order three factor model was tested (Figure 1). Path diagram was generated, fixing one factor loading per variable to 1.00, and a number of goodness of fit indices were obtained using maximum likelihood estimation with LISREL 8.54. Schermelleh-Engel et al. (2003)'s recommendations were followed while evaluating model data fit.

The CFA analysis conducted presented the following goodness of fit indices: $\chi^2/df = 2.34$, RMSEA = 0.062, SRMR = 0.056, CFI = 0.95, NFI = 0.91, NNFI = 0.93, GFI = 0.96, and AGFI = 0.93. These fit indices were in acceptable range. However, it is better to examine recommended modifications before giving the final decision. There were two modification indices suggesting adding an error covariance between item 6 and 8 and between item 7 and 9. The items 6 and 8 are both related to retiring time and the items 7 and 9 are both related to morningness. Therefore, it is likely

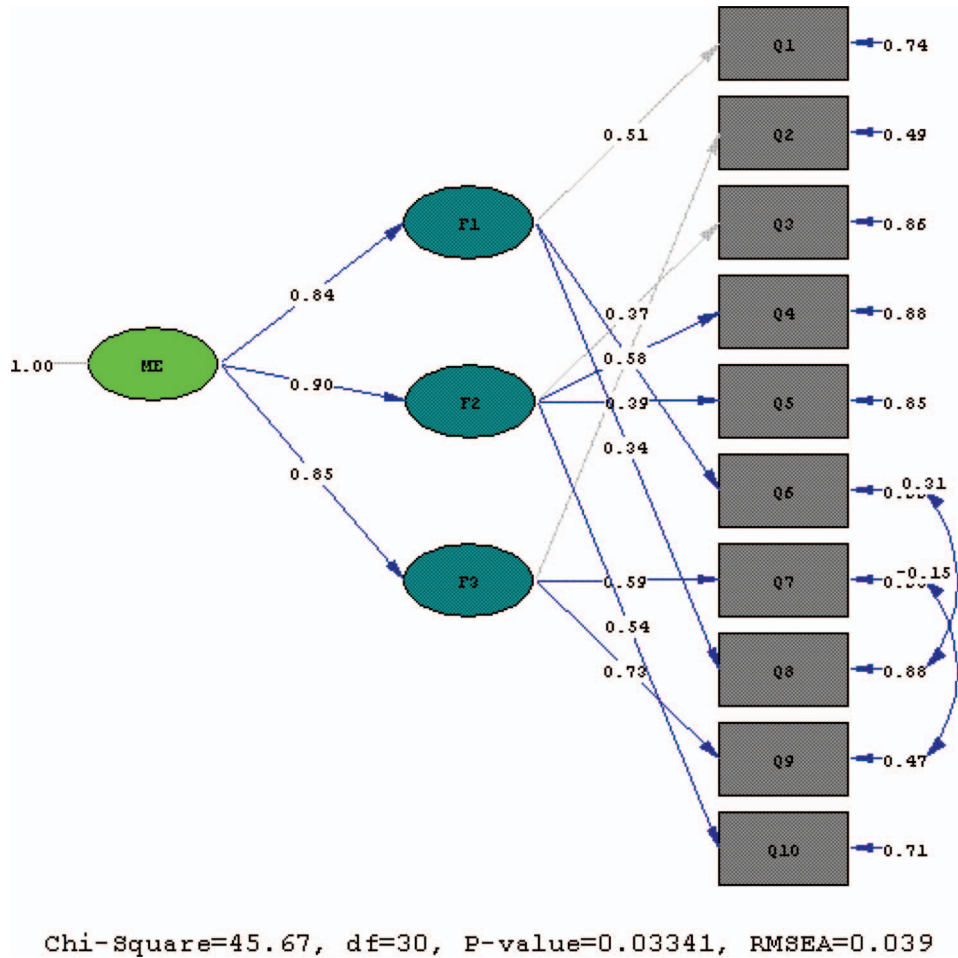


Figure 1. Second order three factor model.

these items have similar errors in their measurement. Allowing the errors in these items to covary, provided a better fit. Goodness of fit statistics that were estimated after making the suggested modifications were improved and are presented in Table 3.

The second order three factor model was a good fit of the data. All fitted indices obtained were in good range.

Reliability

Item means and item-total correlations with respect to gender are given in Table 4. All coefficients turned out to be satisfactory. The lowest item total correlations were obtained for item 1 and 3 in total sample and in girls' sample, while for item 1 and 4 in boys' sample.

The internal consistency of Cronbach's alpha = 0.69 was satisfactory for the Turkish version of MESC. Similar internal consistency was reported by Natale and Bruni (2000), Delgado et al. (in press), and Escribano et al. (2012). The item total correlations ranged from 0.41 to 0.60 in total sample, 0.41 to 0.64 in girls and 0.35 to

Table 3. Goodness of fit indexes for the three factor model of the MESC.

Fit indexes	Three factor model
χ^2/df	1.52
RMSEA	0.039
SRMR	0.037
CFI	0.98
NFI	0.95
NNFI	0.97
GFI	0.97
AGFI	0.95

Note: AGFI = adjusted goodness-of-fit-index; CFI = comparative fit index; GFI = goodness-of-fit index; NFI = normed fit index; NNFI = non-normed fit index; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual.

Table 4. Mean, standard deviation and item-total score correlation coefficients of MESC.

Item	Sample					
	Mean \pm SD			Item total score correlation		
	Total sample	Girls	Boys	Total sample	Girls	Boys
1	2.60 \pm 1.08	2.57 \pm 1.09	2.64 \pm 1.08	0.41	0.47	0.35
2	2.43 \pm 0.91	2.43 \pm 0.92	2.42 \pm 0.91	0.55	0.54	0.56
3	2.84 \pm 0.90	2.84 \pm 0.90	2.84 \pm 0.92	0.42	0.41	0.43
4	2.96 \pm 0.99	2.91 \pm 0.98	3.01 \pm 1.00	0.44	0.48	0.40
5	2.88 \pm 1.13	2.96 \pm 1.07	2.79 \pm 1.19	0.52	0.55	0.50
6	3.24 \pm 1.10	3.30 \pm 1.06	3.18 \pm 1.13	0.60	0.64	0.56
7	2.64 \pm 0.88	2.62 \pm 0.85	2.66 \pm 0.90	0.53	0.51	0.55
8	3.41 \pm 1.02	3.44 \pm 0.99	3.36 \pm 1.06	0.52	0.58	0.47
9	2.31 \pm 1.04	2.37 \pm 1.02	2.25 \pm 1.05	0.58	0.62	0.54
10	3.12 \pm 1.02	3.17 \pm 1.01	3.06 \pm 1.04	0.57	0.58	0.56

0.56 in boys. Furthermore, internal consistency coefficient did not improve by deleting any item (see Table 5).

The stability of the results of the scale was questioned by test–retest reliability. The correlation of MESC total scores with MESC retest scores were 0.78 ($p = 0.000$). It means quite satisfactory reproducibility of the results.

External validity

The Turkish MESC total scores were moderately correlated (Pearson $r = 0.64$, $p < 0.000$) with the Turkish CSM total scores. Turkish CSM is a valid and reliable instrument.

Cut off scores of the MESC

The cut off scores of percentiles 10 and 90 may be used to differentiate morning, intermediate, and evening types as suggested by Díaz-Morales and Sorroche (2008). The cut off scores of the MESC in this study were 21 and 35 in total sample, 21 and 35 in girls and 21 and 34 in boys, respectively.

Discussion

The principle aim of this study was to adapt MESC and provide psychometric properties of MESC in a Turkish children sample. As would be expected of the 9–12 years age range, slightly negative skewness in distribution and the average MESC scores suggested a positive tendency towards morningness. The mean values obtained in the MESC between 9 and 12 years of age (see Table 1) were comparable by those obtained by Carskadon et al. (1993) in 6th graders (boys mean MESC score: 28.5, $SD = 5.6$; girls mean MESC score: 28.7, $SD = 5.3$). Similarly, Kim et al (2002) found mean MESC score for age 9 through 12 as 28.85 ($SD: 4.71$), 28 ($SD: 6.45$), 28.67 ($SD: 5.80$), and 27.42 ($SD: 4.32$), respectively. Gau and Soong (2003) obtained a mean MESC value of 29.4 in 10–14 age range. In slightly older populations, Caci et al (2005) and Natale and Bruni (2000) found slightly lower mean MESC scores (27.76 and 28.23, respectively) compared to this study.

Table 5. Reliability of the entire MESC.

Item	Cronbach's alpha if item deleted		
	Total sample	Girls	Boys
1	0.69	0.72	0.66
2	0.66	0.70	0.60
3	0.68	0.72	0.63
4	0.68	0.72	0.64
5	0.67	0.70	0.63
6	0.65	0.69	0.61
7	0.66	0.71	0.61
8	0.67	0.70	0.63
9	0.65	0.69	0.61
10	0.66	0.70	0.60
Entire scale	0.69	0.73	0.65

Meanwhile, Díaz-Morales and Sorroche (2008) and Escribano et al. (2012) reported a mean MESC score at age 12 as 25.36 and 26.60, respectively.

Cut off scores in whole sample was found as 21 and 35 in this study. Díaz-Morales and Sorroche (2008) and Díaz-Morales et al. (2007) reported MESC cut off scores as 18–30. Escribano et al. (2012) used MESC vales of 22/28 (corresponding to 33th and 66th percentiles) as cut off scores. In some of the studies, 20/80 percentiles were used as cut off scores; MESC score of 21/29 in Delgado et al. (in press) and 20/28 in Díaz-Morales and Sorroche (2008). Meanwhile, Gau et al. (2007) transformed MESC scores to *t*-scores and presented cut off scores based on the *t*-scores (*t* score > 60 for morning type, $40 < t$ score < 60 intermediate type, *t* score < 40 for evening type).

The slight difference in results reported by different researchers with respect to average MESC scores and cut off scores are expected since these studies are conducted in various countries and age intervals. Several factors may account for this difference, such as culture, social habits, latitude, climate, outdoor light, and electronic screen media (Benedito-Silva et al. 1998; Borisenkov 2011; Vollmer et al. 2012). The low item total correlations obtained in some items of the MESC can be considered in this context. For example, in item three in which the physical performance was asked, the correlation was low compared to the other items. Doing physical exercise or sports early in the morning is not common in Turkey. It is then not surprising to observe low correlation in that item. Meanwhile, the low correlation in item one can be explained by clock hours. As Oginska (2011) indicated, clock time habits are strongly based on local social, climatic, and cultural conditions.

In this study, no gender difference was found in MESC scores although the tendency of the means indicates that girls scored higher in MESC. There are some studies which reported no gender differences in morningness eveningness preferences (Kim et al. 2002; Escribano et al. 2012). However, some other studies have reported gender difference in morningness eveningness (Adan and Natale 2002; Randler 2007; Delgado et al. in press). The results of studies of circadian preference as a function of gender difference are controversial.

The internal consistency coefficients and test–retest reliability constants were acceptable and were comparable with those found in other studies (Natale and Bruni 2000; Delgado et al. in press; Escribano et al. 2012). For the MESC structure, two factor solutions have been described in the literature (Natale and Bruni 2000; Caci et al. 2005; Díaz-Morales and Sorroche 2008). However, in this study three factors were extracted. Moreover, results of second order CFA indicated that three factor structure of MESC explains morningness eveningness preference. The correlation between Turkish MESC and CSM was sufficiently high ($r = 0.64$) reinforcing the validity of MESC. In overall, MESC is a valid and reliable instrument and can be used to assess circadian preferences in Turkish samples.

Limitations

Absence of data regarding correlations of MESC with biological markers and sleep variables in free days are limitations of the study.

Acknowledgments

The authors thank Professor Mary A. Carskadon for having provided the MESC and authorized its use. The authors also thank the students who participated in the study.

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Appendix

Çocuklara Yönelik Günlük Ritim Belirleme Ölçeği

(Carskadon et al., 1993; Morningness/Eveningness Scale for Children)

- 1*. Okulun tatil edildiğini ve istediğin zaman kalkabileceğini hayal et. Bu durumda aşağıdaki zaman aralıklarının hangisinde yataktan kalkarsın?
- Sabah 5:00 ile 6:30 arası
 - Sabah 6:30 ile 7:45 arası
 - Sabah 7:45 ile 9:45 arası
 - Sabah 9:45 ile 11:00 arası
 - Sabah 11:00 ile öğlen arası
2. Okula giderken senin için sabahları yataktan kalkmak kolay mıdır?
- Hayır, çok zor
 - Hayır, zor
 - Evet, kolay
 - Evet, çok kolay
- 3*. Beden eğitimi dersiniz sabah saat 7:00’ye konulsaydı, bu derste nasıl bir performans (başarı) sergilerdiniz?
- Çok iyi
 - İyi
 - Kötü
 - Çok kötü

- 4*. Kötü haber: iki saat süren bir sınav olmak zorundasın.
İyi haber: bu sınavı, en başarılı olabileceğini düşündüğün saate olabilirsiniz.
Sınavı hangi zaman aralığında olmak istersin?
(a) Sabah 8:00 – 10:00
(b) Sabah 11:00 – Öğlen 1:00
(c) Öğleden sonra 3:00 – 5:00
(d) Akşam 7:00 – 9:00
- 5*. Sevdiğin şeyleri yapmak için ne zaman en fazla enerjiye sahip olursun?
(a) Sabahları çünkü akşamları yorgun oluyorum
(b) Akşamdan daha çok sabahları
(c) Sabahtan daha çok akşamları
(d) Akşamları çünkü sabahları yorgun oluyorum
- 6*. Tahmin et ne oldu? Annen ve baban kendi yatma saatini belirlemene izin verdiler.
Aşağıdaki zaman aralıklarından hangisini seçersin?
(a) Akşam 8:00 ile 9:00 arası
(b) Akşam 9:00 ile 10:15 arası
(c) Akşam 10:15 ile gece 12:30 arası
(d) Gece 12:30 ile 1:45 arası
(e) Gece 1:45 ile 3:00 arası
7. Sabah kalktığında ilk yarım saat içinde kendini ne kadar uyanmış hissedersin?
(a) Hiç
(b) Biraz sersem
(c) Normal
(d) Oldukça uyanmış
- 8*. Yatma zamanının geldiğini vücudun sana ne zaman söylemeye başlar (sen bu uyarıyı dikkate almasan dahi)?
(a) Akşam 8:00 ile 9:00 arası
(b) Akşam 9:00 ile 10:15 arası
(c) Akşam 10:15 ile gece 12:30 arası
(d) Gece 12:30 ile 1:45 arası
(e) Gece 1:45 ile 3:00 arası
9. Her sabah saat 6:00'da kalkmak zorunda olsaydın. Bu durumu için ne söyledin?
(a) Berbat
(b) Pekiyi değil
(c) Olabilir (eğer mecbursam)
(d) Güzel, sorun değil
- 10*. Sabahları kalktığında tam olarak uyanık hissetmen ne kadar zaman alır?
(a) 0 ile 10 dakika arası
(b) 11 ile 20 dakika arası
(c) 21 ile 40 dakika arası
(d) 40 dakikadan daha fazla

Toplam puan hesaplanırken;

a = 1, b = 2, c = 3, d = 4, e = 5 puan verilmelidir.

*işaretli olan maddeler toplam puan hesaplanırken ters çevrilmelidir.