Appetite 214 (2025) 108173

Contents lists available at ScienceDirect

Appetite

journal homepage: www.elsevier.com/locate/appet

Unveiling the association between chronotype and emotional eating in Spanish adolescents: The EHDLA study

Lina América Sánchez-Charcopa [a], Estela Jiménez-López [b,c], Arthur Eumann Mesas [b], Héctor Gutiérrez-Espinoza [d], Jorge Olivares-Arancibia [e], Rodrigo Yáñez-Sepúlveda [f], Daniel Duclos-Bastías [g], Pedro J. Tárraga-López [h,i], Juan Ramón Barrada [j], José Francisco López-Gil [a,k,*]

[a] School of Medicine, Universidad Espíritu Santo, Samborondón, Ecuador
[b] Health and Social Research Center, Universidad de Castilla-La Mancha, Cuenca, Spain
[c] Centro de Investigación Biomédica en Red de Salud Mental (CIBERSAM), Instituto de Salud Carlos III, Madrid, Spain
[d] Faculty of Education, Universidad Autónoma de Chile, Chile
[e] AFySE Group, Research in Physical Activity and School Health, School of Physical Education, Faculty of Education, Universidad de las Américas, Santiago, Chile
[f] Faculty Education and Social Sciences, Universidad Andres Bello, Viña del Mar, Chile
[g] iGEO Group, School of Physical Education, Pontificia Universidad Católica de Valparaíso, Valparaíso, Chile
[h] Faculty of Nursing, Universidad de Castilla-La Mancha, Albacete, Spain
[i] Gerencia de Atención Integrada de Albacete, Servicio de Salud de Castilla-La Mancha, Albacete, Spain
[j] Department of Psychology and Sociology, University of Zaragoza, Zaragoza, Spain
[k] Vicerrectoría de Investigación y Postgrado, Universidad de Los Lagos, Osorno, Chile

ARTICLE INFO

Keywords:
Chronotype
Emotional eating
Emotional regulation
Circadian rhythm
Adolescents

ABSTRACT

Emotional eating has been associated with a range of negative health outcomes. Research regarding chronotype and emotional eating among adolescents is limited. Thus, this study aimed to verify the association between chronotype and emotional eating in a sample of Spanish adolescents aged 12–17 years. This research used cross-sectional data obtained from the Eating Healthy and Daily Life Activities (EHDLA) study, including 820 students (55.5 % girls) from the three secondary schools in the *Valle de Ricote* (Region of Murcia, Spain). Chronotype was evaluated using the Morningness/Eveningness Scale in Children (MESC). Emotional eating was assessed using the Emotional Eating Scale Adapted for Use in Children and Adolescents (EES-C). Adolescents with a morning chronotype exhibited lower scores in overall emotional eating and specific domains—such as anxiety, depression, and restlessness—compared to those with an intermediate chronotype. Additionally, those with morning chronotypes showed a lower score in the restlessness domain compared to those with evening chronotypes. These findings suggest that adolescents with morning chronotypes may have enhanced emotional regulation and healthier eating behaviors. This study highlights the importance of considering chronotypes when developing personalized interventions for mental health and nutrition among adolescents.

1. Introduction

Emotional eating is a coping mechanism in which individuals consume food in response to negative emotional states (Dakanalis et al., 2023; Shriver et al., 2020). Individuals who engage in this behavior do so to deal with emotional states rather than in response to physical hunger, which typically leads to the selection of unhealthy foods (Dakanalis et al., 2023; Limbers & Summers, 2021; Reichenberger et al., 2020). Research has shown that emotional eating is associated with a range of negative outcomes in adults, including higher body mass index, increased perceived stress, and depressive symptoms (Carpio-Arias et al., 2022; Lazarevich et al., 2016; van Strien et al., 2016), as well as other psychopathological manifestations such as psychoticism, obsessive compulsive tendencies, and hostility (Poínhos et al., 2018). Several theories have been proposed to explain emotional eating, with psychosomatic theory being particularly noteworthy. This theory suggests that a lack of interoception leads individuals to adopt coping mechanisms for managing emotions (Limbers & Summers, 2021). This, along with

* Corresponding author. School of Medicine, Universidad Espíritu Santo, Samborondón, Ecuador.
E-mail address: josefranciscolopezgil@gmail.com (J.F. López-Gil).

https://doi.org/10.1016/j.appet.2025.108173
Received 10 October 2024; Received in revised form 21 May 2025; Accepted 4 June 2025
Available online 6 June 2025

emotional dysregulation, has been recognized as a risk factor in several studies (Ahlich & Rancourt, 2022; van Strien, 2000; Willem et al., 2021). Additionally, research has indicated that emotional eating is relatively uncommon during childhood (van Strien & Oosterveld, 2008). However, as individuals transition from childhood to adolescence, a series of biological (van Strien et al., 2010) and psychological changes (Nguyen-Rodriguez et al., 2009) could contribute to the observed increase in emotional eating (van Strien, 2018). In particular, among adolescents one study found a correlation between emotional eating and brain activity (Wu et al., 2018), revealing that individuals who engage in higher emotional eating show greater activation in the brain regions responsible for the sensation of reward from food, as well as heightened cognitive regulation of the emotional reaction triggered by food cues. Moreover, the study emphasized a stronger association between age and emotional eating among female participants (Wu et al., 2018).

Humans have a circadian rhythm determined by endogenous and exogenous factors (Zou et al., 2022). This rhythmicity gives rise to the concept of chronotype, which refers to an individual's inclination towards specific times for sleeping and engaging in activities (Montaruli et al., 2021). Three main chronotypes have been established: morningness (morning type), eveningness (evening type), and intermediate chronotype (Montaruli et al., 2021; Zou et al., 2022). During adolescence, significant changes occur not only in the circadian rhythm, but also in the sleep homeostatic process, resulting in an extension of the sleep period, which aligns with the evening tendencies that are characteristic of this developmental stage (Tarokh et al., 2019). Adolescents with evening chronotypes have been related to a higher substance use (Hasler et al., 2017), emotional and behavioral difficulties (Gau et al., 2007), and lower adherence to the Mediterranean diet (López-Gil et al., 2023). Additionally, it has been found that adolescents with an evening chronotype are more prone to engage in sedentary activities and exhibit lower levels of physical activity (Sempere-Rubio et al., 2022). This association could be partly attributed to exogenous factors that create a gap between social time and the internal circadian rhythm, a phenomenon known as "social jet lag" (Zou et al., 2022). Moreover, prior research highlighted the importance of chronotypes in shaping eating patterns among adolescents (Roβbach et al., 2018), revealing that individuals with evening chronotypes are more likely to skip breakfast and have higher energy intake during the evening, which aligns with their internal circadian rhythm rather than with external schedules influenced by social factors (Roβbach et al., 2018).

Although the number of published articles is limited, research has begun to explore the associations between chronotype and emotional eating. For instance, a study among adult participants, emphasized the importance of categorizing individuals according to their chronotype to establish associations with psychological factors, including emotional eating (Konttinen et al., 2014). In addition, a study including Turkish university students reported that individuals with an evening chronotype were more likely to have emotional eating patterns and higher scores on the Depression, Anxiety, and Stress Scale-21 (DASS-21), whereas individuals with a morning chronotype reported greater life satisfaction (Esin & Ayyıldız, 2024). Another study conducted among Russian female university students highlighted that chronobiology could be a key factor in predicting eating habits, revealing that an evening chronotype was associated with emotional eating, while a morning chronotype was linked to uncontrolled eating and cognitive eating restraint (Budkevich et al., 2021). These studies underscore the need to extend research on these associations to other age groups, such as children and adolescents.

Social factors, such as academic and social pressures (Chamberlin et al., 2018), unfavorable family environments, limited access to resources (e.g. psychological support services), and sociodemographic circumstances (e.g. food insecurity) (Joseph et al., 2023), may impact adolescent health and contribute to emotional eating. In this context, it seems possible that food could function as a means of coping with affective states (Limbers et al., 2021). To effectively address this issue, it is important to take a comprehensive approach that considers the interaction between these influences and other potential factors, such as chronotype. This perspective is crucial for developing personalized mental health and dietary recommendations (Joseph et al., 2023). To our knowledge, no other study has sought to determine the relationship between chronotype and emotional eating among adolescents. Consequently, this study aimed to verify this association in a sample of Spanish adolescents aged 12–17 years.

2. Materials and methods

2.1. Study design and population

The Eating Healthy and Daily Life Activities (EHDLA) study collected cross-sectional data from participants aged 12–17 years from the three secondary schools of the *Valle de Ricote* (Region of Murcia, Spain) during the 2021–2022 academic year. A detailed description of the methodology is available in another publication (López-Gil, 2022). Data were collected during physical education classes. The participants were required to meet several criteria: (1) be aged between 12 and 17 years, (2) provide informed consent from both themselves and their legal representatives, and (3) be registered and/or reside in the *Valle de Ricote*. Exclusions were applied to students with medical conditions requiring special attention or restrictions on physical activity, those not participating in physical education classes, and those undergoing treatment for chronic conditions. Of the initial sample which comprised 1138 students, some were excluded due to incomplete data on key variables: 456 lacked at least one item in the emotional eating questionnaire (33.1 %), 22 had missing chronotype information (1.6 %), 63 had no recorded body mass index (4.6 %), 32 did not provide sleep duration data (2.3 %), and 7 lacked physical activity data (0.5 %). This resulted in a final sample of 820 students, of whom 55.5 % were girls.

This study was approved by the Ethics Committee of the Albacete University Hospital Complex and the Albacete Integrated Care Management (ID 2021–85), and the Bioethics Committee of the University of Murcia (ID 2218/2018). This study also adhered to the principles outlined in the Helsinki Declaration, ensuring the protection of participants' human rights.

2.2. Study variables

2.2.1. Emotional eating (dependent variable)

The Emotional Eating Scale Adapted for Use in Children and Adolescents (EES-C), designed for individuals aged 8–17 years, was used to evaluate emotional eating (Tanofsky-Kraff et al., 2007). It includes a 25-item questionnaire designed to assess the propensity to eat in response to negative emotions. Each item is rated on a 5-point Likert scale, with 0 indicating "no desire to eat" and 4 indicating "very strong desire to eat". The Spanish version has been adapted and validated specifically for adolescents (Perpiñá et al., 2011). The factorial structure consists of five factors that measure the desire to eat in response to the following emotional states: EE-Anger (emotional eating in response to anger), EE-Anxiety (emotional eating in response to anxiety), EE-Depression (emotional eating in response to depression), EE-Restlessness (emotional eating in response to restlessness), and EE-Helplessness (emotional eating in response to helplessness) (Perpiñá et al., 2011). For scoring purposes, responses were coded from 0 to 4 points and then summed to obtain both a overall emotional eating score and subscale scores for each emotional domain. In the sample used for this study, the scale demonstrated excellent internal consistency, with a Cronbach's alpha (α) of 0.93 (95 % CI [0.92 to 0.94]).

2.2.2. Chronotype (independent variable)

The Morningness/Eveningness Scale in Children (MESC) (Carskadon et al., 1993), which has been validated and translated into Spanish (Díaz-Morales et al., 2007), was used for assessing adolescents'

inclination toward morning or evening activities by scoring their preferred times for events and performance levels at specific times of the day. Its reliability was confirmed by a Cronbach's α of 0.82, reflecting a high level of internal consistency. It consists of 10 items, each presenting different scenarios with 4–5 response options (e.g., "Is it easy for you to get up in the morning?" with answer options: (a) "No way!"; (b) "Sort of"; (c) "Pretty easy"; (d) "It's a cinch"). Adolescents selected the option with which they most identified, with scores ranging from 1 to 4 for seven questions or 1 to 5 points for three questions. The final score ranges from 10, indicating an evening preference, to 42 points, denoting a morning preference, with higher scores suggesting a stronger inclination toward morningness. To classify individuals into evening, intermediate, and morning types, cutoff points of 20 and 28 were used: scores of 20 or fewer points indicate an evening type, scores between 21 and 28 points indicate an intermediate type, and scores of 29 or more points indicate a morning type (Díaz-Morales et al., 2007). These thresholds, based on the 20th and 80th percentiles, are less restrictive than those originally proposed by Carskadon et al. (1993) (corresponding to the 10th and 90th percentiles), and have been adopted in previous studies to improve sample distribution and comparability across chronotype groups.

2.3. Covariates

Adolescents were asked to provide sex and age information. To assess socioeconomic status, the Family Affluence Scale (FAS-III) (Currie et al., 2008) was used, which calculates a score based on answers to six questions about family possessions. The score ranges from 0 to 13 points, with higher values reflecting higher socioeconomic status. Weight and height measurements were obtained following standard procedures. Body mass index was calculated by dividing their weight in kilograms by the square of their height in meters. Subsequently, age- and sex-specific body mass index z-scores were computed based on the World Health Organization (WHO) growth reference data for individuals aged 5–19 years (de Onis, 2007). Physical activity and sedentary behavior were evaluated using the Spanish version of the Youth Activity Profile (YAP-S) (Segura-Díaz et al., 2021), a 7-day recall questionnaire with 15 items that employs a 5-point Likert scale and covers three areas: out-of-school activities, school activities, and sedentary habits. Scores for physical activity and sedentary behavior were calculated by summing the items within each area. Additionally, a self-administered Food Frequency Questionnaire (FFQ) was used to measure energy intake. The FFQ, which consists of 45 items, has been validated for use in the Spanish population (Rodríguez et al., 2008). Adherence to the Mediterranean diet was assessed with the Mediterranean Diet Quality Index for Children and Teenagers (KIDMED) (Serra-Majem et al., 2004).

The association between chronotype and emotional eating may be influenced by various factors. It is important to consider several variables that could mediate or moderate the effects of chronotype when evaluating this relationship. The covariates examined in this study (i.e., age, sex, socioeconomic status, physical activity, sedentary behavior, sleep duration, body mass index, adherence to the Mediterranean diet, and energy intake) are well-recognized factors that could impact the dietary habits of adolescents (Julian et al., 2022; Kunset et al., 2023; López-Gil et al., 2023; Lu et al., 2016).

2.4. Statistical analysis

Statistical analyses were performed using R statistical software (version 4.4.0), along with RStudio (2024.04.1 + 748). Statistical significance was set at a p-value < 0.05. Density and quantile-quantile plots, together with the Shapiro-Wilk test, were employed to evaluate the normal distribution of the data. For categorical variables, data are reported as counts (n) and percentages (%), while continuous variables are presented as medians and interquartile ranges (IQRs) because of their non-normal distribution. As there was no significant interaction effect between sex and chronotype on the EES-C score (p-value > 0.05 for all), the analysis included both girls and boys together. Given the exploratory nature of the study and the inherent complexity of chronotype as a construct (Roenneberg et al., 2019), it was analyzed both as distinct categories (i.e., "evening type", "intermediate type" or "morning type") and as a continuous variable (i.e. MESC score). Generalized linear regression models (GLMs) were implemented to test the associations between chronotype and emotional eating among adolescents, employing robust techniques to manage heteroscedasticity and outliers (Maechler et al., 2024). Specifically, GLMs with a Gaussian distribution were implemented using the "*SMDM*" approach, which involves applying an S-estimate, followed by an M-estimate, a design-adaptive scale estimate, and another M-step. A supplemental analysis using chronotype as a continuous variable was conducted to confirm the robustness of the associations identified in the primary findings. These additional analyses allowed for a comparison of methods and provided further insights into the potential impact of model assumptions on the results. Furthermore, primary analyses were conducted using listwise deletion, including only participants with complete data across all model variables. To assess the robustness of our findings and reduce potential bias due to missingness, we additionally conducted sensitivity analyses using multiple imputation. To assess the plausibility of the missing at random (MAR) assumption, Little's MCAR test was conducted using the '*mcar_test*' function from the '*naniar*' package. Additionally, we compared participants with and without missing data on key demographic and behavioral variables. Little's MCAR test indicated that data were not missing completely at random ($\chi^2 = 479$, $df = 186$, $p < 0.001$). Consistent with a MAR mechanism, visual inspection of descriptive statistics showed no substantial differences between participants with and without missing data (Table S1), supporting the plausibility of the MAR assumption. Imputation was carried out via multivariate imputation by chained equations (MICE) (van Buuren & Groothuis-Oudshoorn, 2011). We used the '*mice*' package to generate 40 imputed datasets, following the recommendation that the number of imputations should exceed 100 times the maximum percentage of missingness in any variable (White et al., 2011). This procedure allowed us to verify the robustness of the findings and to reduce the potential risk of selection bias resulting from the exclusion of cases with incomplete data. Additionally, the estimated marginal means (M) of the EES-C score, along with their 95 % confidence intervals (CI), were computed for different chronotypes from the GLMs conducted. Given the exploratory nature of this observational study, we did not apply formal corrections for multiple comparisons, as these may be overly conservative and increase the risk of type II errors (Rothman, 1990). All the models were adjusted for multiple covariates, including age, sex, socioeconomic status, physical activity, sedentary behavior, sleep duration, body mass index (z-score), adherence to the Mediterranean diet, and energy intake. To assess potential multicollinearity among covariates (particularly between age, sex, and BMI z-score) variance inflation factors (VIFs) were calculated.

3. Results

3.1. Descriptive data of participants by chronotype

Table 1 presents the descriptive data of the participants according to their chronotypes. The highest median for overall emotional eating (EE-Overall) was observed in adolescents with an evening chronotype (median = 26.0; IQR = 27.0); while the lowest median EE-Overall score (median = 22.0; IQR = 26.0) was identified in adolescents with a morning chronotype.

Data expressed as median (interquartile range) for continuous variables and numbers (percentages) for categorical variables. EE, emotional eating; FAS-III, Family Affluence Scale-III; KIDMED, Mediterranean Diet Quality Index in children and adolescents; YAP-S, Spanish Youth Active Profile. [a] Based on the World Health

Table 1
Descriptive characteristics of the study participants, overall and stratified by chronotype status.

Variable	Eveningness	Intermediate	Morningness	Total
Participants	97 (11.8)	401 (48.9)	322 (39.3)	820 (100.0)
Age (years)	14.0 (2.0)	14.0 (2.0)	14.0 (2.0)	14.0 (1.6)
Sex				
Boys	28 (28.9)	172 (42.9)	165 (51.2)	365 (44.5)
Girls	69 (71.1)	229 (57.1)	157 (48.8)	455 (55.5)
FAS-III (score)	9.0 (3.0)	8.0 (3.0)	8.0 (2.8)	8.0 (3.0)
YAP-S physical activity (score)	2.3 (1.0)	2.6 (0.9)	2.7 (0.9)	2.6 (0.8)
YAP-S sedentary behaviors (score)	2.8 (1.0)	2.6 (0.8)	2.4 (0.8)	2.6 (0.8)
Overall sleep duration (minutes)	467.1 (90.0)	497.1 (72.9)	505.7 (64.3)	497.1 (68.6)
Body mass index (z-score) [a]	0.1 (2.1)	0.0 (1.9)	0.0 (2.1)	0.0 (2.0)
KIDMED (score)	5.0 (4.0)	6.0 (3.0)	7.0 (3.0)	7.0 (3.0)
Energy intake (kcal)	2867.9 (1742.3)	2593.0 (1433.5)	2477.9 (1505.8)	2581.9 (1487.4)
EE – Anger (score)	4.0 (9.0)	4.0 (8.0)	3.0 (7.0)	4.0 (7.0)
EE – Anxiety (score)	9.0 (9.0)	8.0 (8.0)	8.0 (8.0)	8.0 (9.0)
EE - Depression (score)	3.0 (6.0)	3.0 (5.0)	2.5 (4.0)	3.0 (5.0)
EE - Restlessness (score)	6.0 (6.0)	5.0 (6.0)	5.0 (6.0)	5.0 (6.0)
EE - Helplessness (score)	2.0 (3.0)	2.0 (4.0)	2.0 (4.0)	2.0 (4.0)
EE - Overall (score)	26.0 (27.0)	25.0 (26.0)	22.0 (26.0)	24.0 (26.0)

Organization (WHO) growth reference data for individuals aged 5–19 years (de Onis, 2007).

3.2. Results from the generalized linear regression models (GLMs)

Table 2 provides findings from the GLMs exploring the association between chronotype status and overall emotional eating, as well as its different domains (i.e., anger, anxiety, depression, restlessness, and helplessness). A significant association was found for the morning chronotype in the EE-Restlessness score (unstandardized beta coefficient [*B*] = −1.01, 95 % CI -2.02 to −0.02, *p*-value = 0.046) compared to their peers with an eveningness chronotype. The other predictors did not have significant effects on the analyzed emotional scores, as evidenced by their *p*-values above 0.05. For a more comprehensive analysis of the associations of chronotype and covariates with emotional eating, please refer to Tables S2–S7 in the Supplementary Material. All VIF values were below the commonly accepted threshold of 5, indicating no evidence of severe multicollinearity.

Table 2
Association of chronotype status with overall emotional eating and its different domains among Spanish adolescents.

Predictor	EE – Anger (score)				
	B	SE	95% LLCI	95% ULCI	*p*-value
Eveningness	Reference				
Intermediate	0.32	0.56	−0.79	1.42	0.574
Morningness	−0.29	0.60	−1.47	0.89	0.628
Predictor	EE – Anxiety (score)				
	B	SE	95% LLCI	95% ULCI	*p*-value
Eveningness	Reference				
Intermediate	−0.37	0.70	−1.75	1.00	0.593
Morningness	−1.29	0.75	−2.75	0.18	0.086
Predictor	EE – Depression (score)				
	B	SE	95% LLCI	95% ULCI	*p*-value
Eveningness	Reference				
Intermediate	−0.08	0.37	−0.80	0.65	0.834
Morningness	−0.57	0.40	−1.35	0.21	0.150
Predictor	EE – Restlessness (score)				
	B	SE	95% LLCI	95% ULCI	*p*-value
Eveningness	Reference				
Intermediate	−0.38	0.47	−1.31	0.55	0.420
Morningness	−1.01	0.51	−2.00	−0.02	0.046
Predictor	EE – Helplessness (score)				
	B	SE	95% LLCI	95% ULCI	*p*-value
Eveningness	Reference				
Intermediate	0.10	0.28	−0.45	0.65	0.712
Morningness	−0.25	0.30	−0.83	0.34	0.407
Predictor	EE – Overall (score)				
	B	SE	95% LLCI	95% ULCI	*p*-value
Eveningness	Reference				
Intermediate	−0.80	2.03	−4.79	3.19	0.694
Morningness	−3.74	2.17	−7.99	0.52	0.086

B, unstandardized beta coefficient; EE, emotional eating; LLCI, lower limit confidence interval; SE, standard error; ULCI, upper limit confidence interval. Adjusted for age, sex, socioeconomic status, physical activity, sedentary behavior, sleep duration, body mass index (z-score), adherence to the Mediterranean diet, and energy intake.

Fig. 1 illustrates the estimated marginal means of EE-Overall and its various domains, categorized by chronotype status. Significant differences were found in some emotional eating outcomes among participants with different chronotypes. Adolescents with a morning chronotype showed a lower EE-Overall score (M = 23.2; 95 % CI 21.2 to 25.1) relative to those with an intermediate chronotype (M = 26.1; 95 % CI 24.4 to 27.8) (*p*-value = 0.028). Furthermore, individuals with a morning chronotype reported a lower EE-Anxiety score (M = 8.0; 95 % CI 7.3 to 8.6) than those with an intermediate chronotype (M = 8.9; 95 % CI 8.3 to 9.5) (*p*-value = 0.046). Similarly, the EE-Depression score was lower in the morning chronotype group (M = 3.1; 95 % CI 2.7 to 3.4) than in the intermediate chronotype group (M = 3.6; 95 % CI 3.2 to 3.9) (*p*-value = 0.042). Additionally, adolescents with a morning chronotype had a lower EE-Restlessness score (M = 5.1; 95 % CI 4.7 to 5.6) compared to those with an intermediate chronotype (M = 5.7; 95 % CI 5.3 to 6.1) (*p*-value = 0.044) and those with an evening chronotype (M = 6.1; 95 % CI 5.3 to 7.0) (*p*-value = 0.046). Fig. S1 presents the corresponding results obtained from the multiple imputation analysis. The results remained relatively stable regardless of whether listwise deletion or multiple imputation was used, reinforcing the robustness of the associations observed. Moreover, the results for the association between chronotype (using the questionnaire score as a continuous variable) and emotional eating are presented in Fig. S2.

4. Discussion

Although previous studies have examined the association between chronotype and emotional eating in adults (Budkevich et al., 2021; Garaulet et al., 2023; Konttinen et al., 2014), to our knowledge, no study has assessed this association in an adolescent population. Overall, our results suggested that the morning chronotype was associated to lower levels of emotional eating among Spanish adolescents. Specifically,

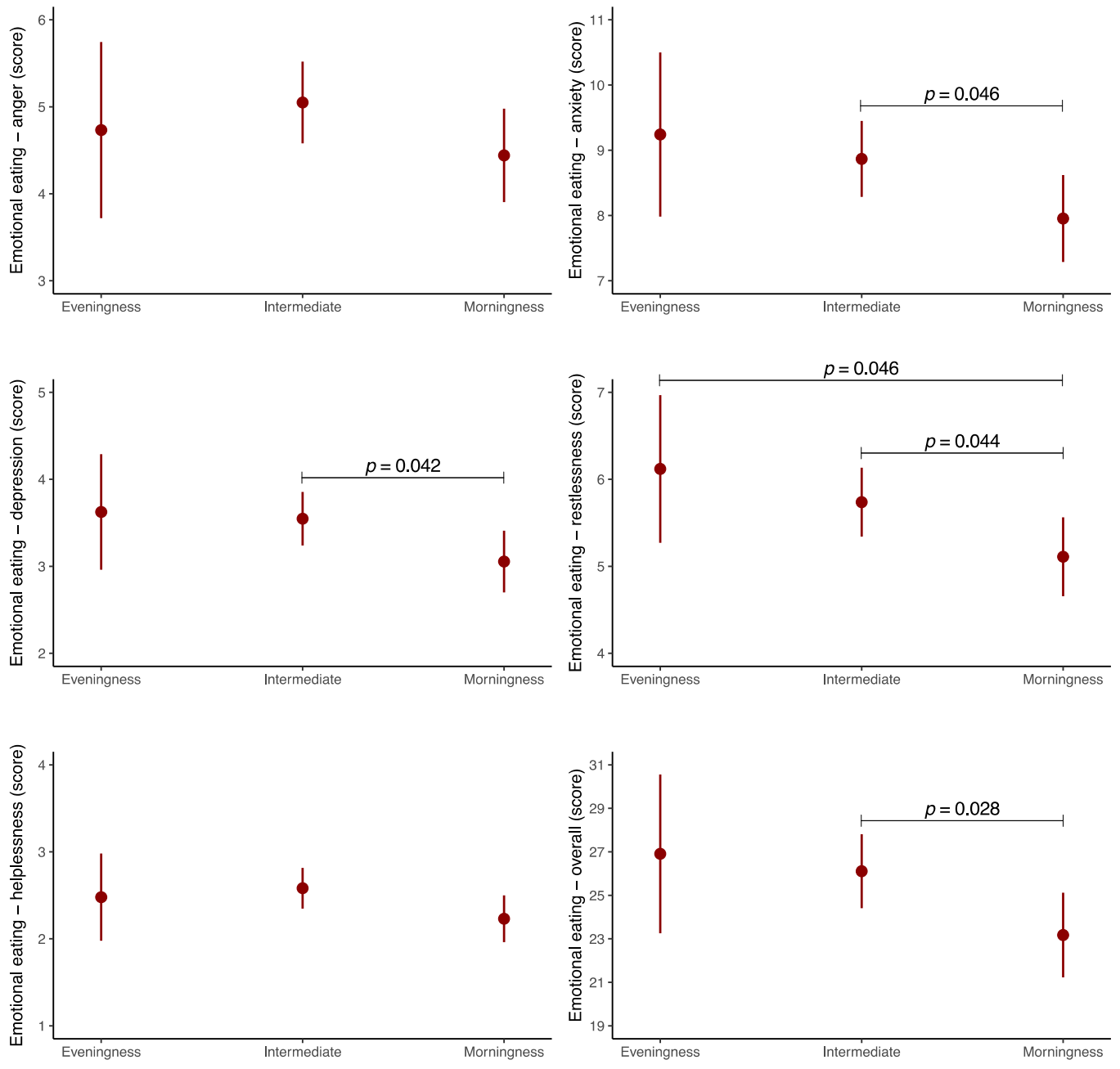

Fig. 1. Estimated marginal means of overall emotional eating and its different domains based on chronotype status among Spanish adolescents. Adjusted for age, sex, socioeconomic status, physical activity, sedentary behavior, sleep duration, body mass index (z-score), adherence to the Mediterranean diet, and energy intake.

participants with morning preferences reported the lowest median for EE-Overall score and exhibited significantly lower scores in EE-Overall, EE-Anxiety, and EE-Depression, compared with their peers with an intermediate chronotype. Additionally, the morningness chronotype group had the lowest EE-Restlessness score, compared to both evening and intermediate chronotype groups. These results suggest that students with a morning chronotype tend to experience less emotional eating related to anxiety, depression, and restlessness compared to their counterparts, underscoring the complex relationship between individual chronobiology and emotional eating. These findings are consistent with previous research showing that adults with morning chronotypes are associated with lower levels of emotional eating across different environmental, cultural, and genetic contexts (Garaulet et al., 2023). Additionally, other studies have revealed that adults with morning chronotypes are less likely to engage in emotional eating patterns than those with evening chronotypes (Budkevich et al., 2021; Esin & Ayyıldız, 2024; Vera et al., 2018). However, in this study, we did not find significant differences in the emotional eating outcomes between morning and evening chronotypes, aside from the EE-Restlessness score. This lack of statistical significance may be attributed to the small sample size of the evening chronotype group, which included only 97 participants (11.8 % of the total sample). Consequently, the emotional eating behaviors among individuals with this chronotype may not have been adequately represented, which could have affected the statistical power

of the findings.

Although the mechanisms by which chronotype might be associated with emotional eating have not been elucidated, a possible reason for this association could be related to difficulties in emotional and cognitive regulation. Factors such as disinhibition (Garaulet et al., 2023), cognitive fusion (Guerrini Usubini et al., 2022), and negative metacognitive beliefs (Limbers et al., 2021) may act as mediators in this relationship. Research has shown that circadian preferences are related to affective and emotional tendencies (Ottoni et al., 2012). Specifically, an inclination towards a morning chronotype has been associated to an increased use of cognitive reappraisal as an emotional regulation strategy (Antúnez, 2020) and predicts greater self-regulation of eating habits (Al-Hazmi & Noorwali, 2023; López-Gil et al., 2020). Conversely, individuals with an evening chronotype tend to show reduced emotional regulation, affective instability, and a tendency to externalize emotions, evidenced by their coping strategies, caution, and volitional skills (Ottoni et al., 2012). Further studies have noted that individuals with an evening chronotype have higher levels of disinhibition and frequent food cravings than those with a morning chronotype, suggesting a positive association between the two situations (Garaulet et al., 2023). In adolescents, the tendency to avoid unpleasant internal emotional states might lead to experiential avoidance, related to cognitive fusion, both of which have been identified as predictive factors of emotional eating (Guerrini Usubini et al., 2022), in addition to negative metacognitive beliefs (Limbers et al., 2021), such as lack of control over thoughts. Based on these findings, it seems relevant to consider chronotype when addressing issues related to emotional eating and cognitive regulation.

Additionally, a previous research has suggested that individuals with morning chronotypes may have lower levels of mental health problems than those with intermediate chronotypes (Mao et al., 2024). In contrast, individuals with an evening chronotype (particularly men) may be more likely to develop mental disorders (Antúnez et al., 2014), with depression being one of the most strongly associated conditions (Merikanto et al., 2013; Van den Berg et al., 2018; Zou et al., 2022). This may also explain our findings, as emotional eating functions as a coping mechanism to manage stressful or complex situations, and literature suggests that higher psychological distress, including depression and anxiety, predicts increased levels of emotional eating (Hsu & Forestell, 2021; Muha et al., 2024). Moreover, it is essential to acknowledge that adolescents' dietary patterns are significantly influenced by environmental factors (Joseph et al., 2023). Notably, parental mental health influences the emergence of emotion-based eating patterns in this population, which is mediated by non-responsive feeding methods (Sampige et al., 2023). Furthermore, individuals with an evening chronotype are more likely to experience poor sleep quality and negative mood states (Gelbmann et al., 2012; Giannotti et al., 2002; Lang et al., 2022), as well as anxiety due to sleep difficulties (Giannotti et al., 2002), whereas morning preferences may act as a protective factor against sleep-related issues (Gelbmann et al., 2012) compared to intermediate chronotypes, who may also experience insomnia (Mao et al., 2024). These issues may directly affect emotional regulation and contribute to emotional eating (Lundahl & Nelson, 2015; Saleh-Ghadimi et al., 2019), as they are linked to stress in bidirectional relationships that affect both metabolism and the central nervous system (Merrill, 2022).

Furthermore, some explanations for the relationship between morningness and healthy eating patterns have been proposed (Guenther & Stolarski, 2021), with time perspectives as a mediator. This suggests that individuals with a morning preference may exhibit a more positive outlook on the future, potentially leading to increased conscientiousness, which could subsequently influence their eating behaviors. Nonetheless, this explanation only partially accounts for the effects of chronotype on eating habits, and further studies are needed to elucidate this association (Guenther & Stolarski, 2021). Regarding the implications of our findings, research emphasizes chronotype as a biological construct (Roenneberg et al., 2019), consistent with the original concept proposed by Ehret (1974), suggesting that it is part of a complex system that fosters a stable state rather than a fixed trait, it is crucial to emphasize that chronotype regulation (Zou et al., 2022) results from the interaction between the homeostatic sleep process (Tarokh et al., 2019), which is affected by the buildup and removal of neurotransmitters, and the circadian process, which is influenced by environmental cues (zeitgebers) (Golombek & Rosenstein, 2010) and genetics. As such, variations in zeitgebers strengths, particularly the light-dark cycle being the primary one (Roenneberg et al., 2019) may contribute to shifts in chronotype (Golombek & Rosenstein, 2010). Based on these findings, it has been suggested to assess classroom lighting conditions, and the amount of time students spend outdoors (Lang et al., 2022). Nevertheless, further research is needed to provide more precise recommendations.

The current study has some limitations that should be acknowledged. Since cross-sectional data were reported, causal relationships between chronotype and emotional eating cannot be established. In addition, it is crucial to emphasize the need of longitudinal studies to further investigate and clarify the direction of the relationship between chronobiological characteristics and emotional eating, particularly for the intermediate chronotype, which remains underexplored compared to the more frequently studied morningness and eveningness types (Montaruli et al., 2017). Moreover, given the growing interest in positive emotional eating (i.e., eating in response to positive emotions) (Manchón et al., 2021; Nolan et al., 2025), future studies should consider integrating this concept to more thoroughly explore the emotional influences on eating behaviors. Additionally, data obtained from the MESC and the EES-C were self-reported and may be subject to desirability and recall biases. Specifically, despite its validation, the MESC does not provide an objective measure of chronotype. Therefore, incorporating objective methods, such as dim-light melatonin onset (Garaulet et al., 2023) or wrist-worn actigraphy (Schneider et al., 2022) would strengthen the assessment of chronotype. Although the EHDLA study originally employed a representative sampling strategy for its primary objective (López-Gil, 2022), the present analysis is based on a secondary dataset with missing data. Therefore, the representativeness of the sample for the current analyses cannot be guaranteed. Additionally, as the study was conducted in a specific region, the findings may not be generalizable to other populations in Spain or other countries. These factors should be taken into account when interpreting the results. Moreover, it is important to note that the cutoff points used to classify chronotypes (20 and 28) are not universally established and are inherently arbitrary, as there is no standardized consensus in the literature. While we chose to use the cutoffs from the Spanish validation study to maintain consistency with previous research, redefining the cutoffs based on percentiles from our own sample might have provided a more tailored classification. Future studies could explore the impact of sample-specific cutoffs to enhance the generalizability of findings. Lastly, given the exploratory nature of this study, no adjustments were made for multiple comparisons. As such, findings should be interpreted with caution and considered hypothesis-generating. Despite these limitations, the study also has strengths, including the fact that the EES-C was also validated and that the data presented were adjusted for relevant covariates (i.e., sociodemographic, lifestyle, and anthropometric factors). This increased the accuracy of the results, which were analyzed using robust statistical methods. Furthermore, we conducted a multiple imputation analysis to assess the robustness our results.

5. Conclusion

This study highlights a significant association between chronotypes and emotional eating patterns among Spanish adolescents. Specifically, individuals with a morning chronotype presented lower scores for EE-Overall, EE-Anxiety, EE-Depression and EE-Restlessness than their intermediate chronotype counterparts. Furthermore, students with a morning preference showed a lower score for EE-Restlessness, compared

to those with an evening chronotype. These findings suggest that adolescents with a morning chronotype may be less prone to emotional eating, a tendency potentially linked to improved emotional regulation, which could influence their coping strategies and promote healthier eating behaviors. However, further research is needed to explore the mechanisms underlying this relationship. Given these findings, it could be essential to consider chronotype when developing tailored interventions aimed at improving both dietary habits and mental health among adolescents, as aligning interventions with their natural daily rhythms may significantly enhance their effectiveness.

CRediT authorship contribution statement

Lina América Sánchez-Charcopa: Writing – original draft, Conceptualization. **Estela Jiménez-López:** Writing – review & editing, Supervision. **Arthur Eumann Mesas:** Writing – review & editing, Supervision. **Héctor Gutiérrez-Espinoza:** Writing – review & editing. **Jorge Olivares-Arancibia:** Writing – original draft. **Rodrigo Yáñez-Sepúlveda:** Writing – review & editing. **Daniel Duclos-Bastías:** Writing – review & editing. **Pedro J. Tárraga-López:** Writing – review & editing. **Juan Ramón Barrada:** Writing – review & editing. **José Francisco López-Gil:** Writing – review & editing, Visualization, Validation, Supervision, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Ethical statement

This study was granted approval by the Ethics Committee of the Albacete University Hospital Complex and the Albacete Integrated Care Management (ID 2021–85; approval date: November 23, 2021), and the Bioethics Committee of the University of Murcia (ID 2218/2018; approval date: February 18, 2019).

Data availability

Data will be made available on request. However, since the participants are minors, privacy and confidentiality must be respected.

Funding

This research received no external funding.

Declaration of competing interest

None.

Acknowledgments

The authors would like to express their gratitude to the *Ayuntamiento de Archena*, the participants, parents/legal guardians, physical education teachers, schools, and staff who provided information for this study.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.appet.2025.108173.

Data availability

Data will be made available on request.

References

Ahlich, E., & Rancourt, D. (2022). Boredom proneness, interoception, and emotional eating. *Appetite, 178*, Article 106167. https://doi.org/10.1016/j.appet.2022.106167

Al-Hazmi, M. H., & Noorwali, E. A. (2023). Morning individuals in Saudi Arabia have higher self-regulation of eating behavior compared to evening types. *Chronobiology International, 40*(3), 223–233. https://doi.org/10.1080/07420528.2022.2158846.

Antúnez, J. M., Navarro, J. F., & Adan, A. (2014). Morningness–eveningness and personality characteristics of young healthy adults. *Personality and Individual Differences, 68*, 136–142. https://doi.org/10.1016/j.paid.2014.04.015

Budkevich, R. O., Putilov, A. A., Tinkova, E. L., & Budkevich, E. V. (2021). Chronobiological traits predict the restrained, uncontrolled, and emotional eating behaviors of female university students. *Chronobiology International, 38*(7), 1032–1041. https://doi.org/10.1080/07420528.2021.1903483

Carpio-Arias, T. V., Solís Manzano, A. M., Sandoval, V., Vinueza-Veloz, A. F., Rodríguez Betancourt, A., Betancourt Ortíz, S. L., & Vinueza-Veloz, M. F. (2022). Relationship between perceived stress and emotional eating. A cross sectional study. *Clinical Nutrition Espen, 49*, 314–318. https://doi.org/10.1016/j.clnesp.2022.03.030

Carskadon, M. A., Vieira, C., & Acebo, C. (1993). Association between puberty and delayed phase preference. *Sleep, 16*(3), 258–262. https://doi.org/10.1093/sleep/16.3.258

Carskadon, M. A., Vieira, C., & Acebo, C. (1993). Association between puberty and delayed phase preference. *Sleep, 16*(3), 258–262. https://doi.org/10.1093/sleep/16.3.258

Chamberlin, A., Nguyen-Rodriguez, S., Gray, V. B., Reiboldt, W., Peterson, C., & Spruijt-Metz, D. (2018). Academic-related factors and emotional eating in adolescents. *Journal of School Health, 88*(7), 493–499. https://doi.org/10.1111/josh.12638

Currie, C., Molcho, M., Boyce, W., Holstein, B., Torsheim, T., & Richter, M. (2008). Researching health inequalities in adolescents: The development of the Health Behaviour in School-Aged Children (HBSC) family affluence scale. *Social Science & Medicine, 66*(6), 1429–1436. https://doi.org/10.1016/j.socscimed.2007.11.024

Dakanalis, A., Mentzelou, M., Papadopoulou, S. K., Papandreou, D., Spanoudaki, M., Vasios, G. K., Pavlidou, E., Mantzorou, M., & Giaginis, C. (2023). The association of emotional eating with overweight/obesity, depression, anxiety/stress, and dietary patterns: A review of the current clinical evidence. *Nutrients, 15*(5), 1173. https://doi.org/10.3390/nu15051173

de Onis, M. (2007). Development of a WHO growth reference for school-aged children and adolescents. *Bulletin of the World Health Organization, 85*(9), 660–667. https://doi.org/10.2471/BLT.07.043497

Díaz-Morales, J. F., de, L., Ma, C. D., & Sorroche, M. G. (2007). Validity of the morningness-eveningness scale for children among Spanish adolescents. *Chronobiology International, 24*(3), 435–447. https://doi.org/10.1080/07420520701420659

Ehret, C. F. (1974). The sense of time: Evidence for its molecular basis in the eukaryotic gene-action system. *Advances in Biological and Medical Physics, 15*(0), 47–77. https://doi.org/10.1016/b978-0-12-005215-8.50009-7

Esin, K., & Ayyıldız, F. (2024). Relationship between chronotype with emotional eating, eating disorder risk and depression: A cross-sectional study. *Sage Open, 14*(1), Article 21582440231224221. https://doi.org/10.1177/21582440231224221

Garaulet, M., Vizmanos, B., Muela, T., Betancourt-Núñez, A., Bonmatí-Carrión, M.-Á., Vetter, C., Dashti, H. S., Saxena, R., & Scheer, F. A. J. L. (2023). Evening types as determined by subjective and objective measures are more emotional eaters. *Obesity (Silver Spring, Md.), 31*(5), 1192–1203. https://doi.org/10.1002/oby.23749

Gau, S. S.-F., Shang, C.-Y., Merikangas, K. R., Chiu, Y.-N., Soong, W.-T., & Cheng, A. T.-A. (2007). Association between morningness-eveningness and behavioral/emotional problems among adolescents. *Journal of Biological Rhythms, 22*(3), 268–274. https://doi.org/10.1177/0748730406298447

Gelbmann, G., Kuhn-Natriashvili, S., Pazhedath, T. J., Ardeljan, M., Wöber, C., & Wöber-Bingöl, Ç. (2012). Morningness: Protective factor for sleep-related and emotional problems in childhood and adolescence? *Chronobiology International, 29*(7), 898–910. https://doi.org/10.3109/07420528.2012.686946

Giannotti, F., Cortesi, F., Sebastiani, T., & Ottaviano, S. (2002). Circadian preference, sleep and daytime behaviour in adolescence. *Journal of Sleep Research, 11*(3), 191–199. https://doi.org/10.1046/j.1365-2869.2002.00302.x

Golombek, D. A., & Rosenstein, R. E. (2010). Physiology of Circadian Entrainment. *Physiological Reviews, 90*(3), 1063–1102. https://doi.org/10.1152/physrev.00009.2009.

Guenther, K., & Stolarski, M. (2021). Linking morningness with healthy eating behaviors: The mediating role of time perspectives. *Biological Rhythm Research, 52*(10), 1618–1630. https://doi.org/10.1080/09291016.2019.1684795.

Guerrini Usubini, A., Bottacchi, M., Caroli, D., Castelnuovo, G., & Sartorio, A. (2022). Cognitive Fusion and Emotional Eating among Adolescents with Obesity: A Preliminary Cross-Sectional Study. *International Journal of Environmental Research and Public Health, 19*(22), 14855. https://doi.org/10.3390/ijerph192214855.

Hasler, B. P., Franzen, P. L., de Zambotti, M., Prouty, D., Brown, S. A., Tapert, S. F., Pfefferbaum, A., Pohl, K. M., Sullivan, E. V., De Bellis, M. D., Nagel, B. J., Baker, F. C., Colrain, I. M., & Clark, D. B. (2017). Eveningness and later sleep timing are associated with greater risk for alcohol and marijuana use in adolescence: Initial findings from the national consortium on alcohol and neurodevelopment in adolescence study. *Alcoholism: Clinical and Experimental Research, 41*(6), 1154–1165. https://doi.org/10.1111/acer.13401

Hsu, T., & Forestell, C. A. (2021). Mindfulness, depression, and emotional eating: The moderating role of nonjudging of inner experience. *Appetite, 160*, Article 105089. https://doi.org/10.1016/j.appet.2020.105089

Joseph, P. L., Gonçalves, C., & Fleary, S. A. (2023). Psychosocial correlates in patterns of adolescent emotional eating and dietary consumption. *PLoS One, 18*(5), Article e0285446. https://doi.org/10.1371/journal.pone.0285446

Julian, V., Haschke, F., Fearnbach, N., Gomahr, J., Pixner, T., Furthner, D., Weghuber, D., & Thivel, D. (2022). Effects of movement behaviors on overall health

and appetite control: Current evidence and perspectives in children and adolescents. *Current Obesity Reports, 11*(1), 10–22. https://doi.org/10.1007/s13679-021-00467-5
Konttinen, H., Kronholm, E., Partonen, T., Kanerva, N., Männistö, S., & Haukkala, A. (2014). Morningness–eveningness, depressive symptoms, and emotional eating: A population-based study. *Chronobiology International, 31*(4), 554–563. https://doi.org/10.3109/07420528.2013.877922
Kunset, P., Punsawad, C., Petsirasan, R., Suwanbamrung, C., Shohaimi, S., Narkkul, U., & Noonil, N. (2023). Unhealthy dietary patterns and their associations with sociodemographic factors as predictors among underweight and overweight adolescents in southern Thailand. *International Journal of Environmental Research and Public Health, 20*(17), 6703. https://doi.org/10.3390/ijerph20176703
Lang, C., Richardson, C., Micic, G., & Gradisar, M. (2022). Understanding sleep-wake behavior in late chronotype adolescents: The role of circadian phase, sleep timing, and sleep propensity. *Frontiers in Psychiatry, 13*, Article 785079. https://doi.org/10.3389/fpsyt.2022.785079
Lazarevich, I., Irigoyen Camacho, M. E., Velázquez-Alva, M. del C., & Zepeda Zepeda, M. (2016). Relationship among obesity, depression, and emotional eating in young adults. *Appetite, 107*, 639–644. https://doi.org/10.1016/j.appet.2016.09.011
Limbers, C. A., Greenwood, E., Shea, K., & Fergus, T. A. (2021). Metacognitive beliefs and emotional eating in adolescents. *Eating and Weight Disorders: EWD, 26*(7), 2281–2286. https://doi.org/10.1007/s40519-020-01078-0
Limbers, C. A., & Summers, E. (2021). Emotional eating and weight status in adolescents: A systematic review. *International Journal of Environmental Research and Public Health, 18*(3), 991. https://doi.org/10.3390/ijerph18030991
López-Gil, J. F. (2022). The eating healthy and daily life activities (EHDLA) study. *Children, 9*(3). https://doi.org/10.3390/children9030370. Article 3.
López-Gil, J. F., Moreno-Galarraga, L., Mesas, A. E., Gutiérrez-Espinoza, H., López-Bueno, R., & Gaffin, J. M. (2023). Is chronotype linked with adherence to the mediterranean diet among adolescents? The EHDLA study. *Pediatric Research, 94*(6), 2070–2076. https://doi.org/10.1038/s41390-023-02703-1
López-Gil, J. F., Oriol-Granado, X., Izquierdo, M., Ramírez-Vélez, R., Fernández-Vergara, O., Olloquequi, J., & García-Hermoso, A. (2020). Healthy Lifestyle Behaviors and Their Association with Self-Regulation in Chilean Children. *International Journal of Environmental Research and Public Health, 17*(16), 5676. https://doi.org/10.3390/ijerph17165676.
Lu, Q., Tao, F., Hou, F., Zhang, Z., & Ren, L. (2016). Emotion regulation, emotional eating and the energy-rich dietary pattern. A population-based study in Chinese adolescents. *Appetite, 99*, 149–156. https://doi.org/10.1016/j.appet.2016.01.011
Lundahl, A., & Nelson, T. D. (2015). Sleep and food intake: A multisystem review of mechanisms in children and adults. *Journal of Health Psychology, 20*(6), 794–805. https://doi.org/10.1177/1359105315573427
Maechler, M., Rousseeuw, P., Croux, C., Todorov, V., Ruckstuhl, A., Salibian-Barrera, M., Verbeke, T., Koller, M., Conceicao, E. L., & di Palma, A. (2024). *robustbase: Basic robust statistics* [Computer software].
Manchón, J., Quiles, M. J., Quiles, Y., & López-Roig, S. (2021). Positive and negative emotional eating are not the same-the Spanish version of the positive-negative emotional eating scale (PNEES). *Frontiers in Psychology, 12*, Article 709570. https://doi.org/10.3389/fpsyg.2021.709570
Mao, B., Xie, Z., Liu, M., Gong, Y., Wang, H., Yang, S., Liao, M., Xiao, T., Tang, S., Wang, Y., & Yang, Y.-D. (2024). Associations of chronotype with anxiety, depression and insomnia among general adult population: A cross-sectional study in hubei, China. *Journal of Affective Disorders, 351*, 250–258. https://doi.org/10.1016/j.jad.2024.01.188
Merikanto, I., Lahti, T., Kronholm, E., Peltonen, M., Laatikainen, T., Vartiainen, E., Salomaa, V., & Partonen, T. (2013). Evening types are prone to depression. *Chronobiology International, 30*(5), 719–725. https://doi.org/10.3109/07420528.2013.784770
Merrill, R. M. (2022). Mental health conditions according to stress and sleep disorders. *International Journal of Environmental Research and Public Health, 19*(13), 7957. https://doi.org/10.3390/ijerph19137957
Montaruli, A., Castelli, L., Mulè, A., Scurati, R., Esposito, F., Galasso, L., & Roveda, E. (2021). Biological rhythm and chronotype: New perspectives in health. *Biomolecules, 11*(4), 487. https://doi.org/10.3390/biom11040487
Montaruli, A., Galasso, L., Caumo, A., Cè, E., Pesenti, C., Roveda, E., & Esposito, F. (2017). The circadian typology: The role of physical activity and melatonin. *Sport Sciences for Health, 13*(3), 469–476. https://doi.org/10.1007/s11332-017-0389-y
Muha, J., Schumacher, A., Campisi, S. C., & Korczak, D. J. (2024). Depression and emotional eating in children and adolescents: A systematic review and meta-analysis. *Appetite, 200*, Article 107511. https://doi.org/10.1016/j.appet.2024.107511
Nguyen-Rodriguez, S., Unger, J. B., & Spruijt-Metz, D. (2009). Psychological determinants of emotional eating in adolescence. *Eating Disorders, 17*(3), 211–224. https://doi.org/10.1080/10640260902848543
Nolan, L. J., Barnhart, W. R., Diorio, G., Gallo, V., & Geliebter, A. (2025). A systematic review and meta-analysis of cross-sectional questionnaire studies of the relationship between negative and positive emotional eating and body mass index: Valence matters. *Appetite, 209*, Article 107966. https://doi.org/10.1016/j.appet.2025.107966
Ottoni, G. L., Antoniolli, E., & Lara, D. R. (2012). Circadian Preference Is Associated With Emotional and Affective Temperaments. *Chronobiology International, 29*(6), 786–793. https://doi.org/10.3109/07420528.2012.679329.
Perpiñá, C., Cebolla, A., Botella, C., Lurbe, E., & Torró, M.-I. (2011). Emotional Eating Scale for children and adolescents: Psychometric characteristics in a Spanish sample. *Journal of Clinical Child and Adolescent Psychology, 40*(3), 424–433. https://doi.org/10.1080/15374416.2011.563468. *The Official Journal for the Society of Clinical Child and Adolescent Psychology, American Psychological Association, Division 53*.
Poínhos, R., Oliveira, B. M. P. M., & Correia, F. (2018). Psychopathological correlates of eating behavior among Portuguese undergraduate students. *Nutrition (Burbank, Los Angeles County, Calif.), 48*, 33–39. https://doi.org/10.1016/j.nut.2017.10.009
Reichenberger, J., Schnepper, R., Arend, A.-K., & Blechert, J. (2020). Emotional eating in healthy individuals and patients with an eating disorder: Evidence from psychometric, experimental and naturalistic studies. *Proceedings of the Nutrition Society, 79*(3), 290–299. https://doi.org/10.1017/S0029665120007004
Rodríguez, I. T., Ballart, J. F., Pastor, G. C., Jordà, E. B., & Val, V. A. (2008). [Validation of a short questionnaire on frequency of dietary intake: Reproducibility and validity]. *Nutricion Hospitalaria, 23*(3), 242–252.
Roenneberg, T., Pilz, L. K., Zerbini, G., & Winnebeck, E. C. (2019). Chronotype and social jetlag: A (self-) critical review. *Biology (Basel), 8*(3), 54. https://doi.org/10.3390/biology8030054
Rothman, K. J. (1990). No adjustments are needed for multiple comparisons. *Epidemiology (Cambridge, Mass.), 1*(1), 43–46.
Roßbach, S., Diederichs, T., Nöthlings, U., Buyken, A. E., & Alexy, U. (2018). Relevance of chronotype for eating patterns in adolescents. *Chronobiology International, 35*(3), 336–347. https://doi.org/10.1080/07420528.2017.1406493
Saleh-Ghadimi, S., Dehghan, P., Abbasalizad Farhangi, M., Asghari-Jafarabadi, M., & Jafari-Vayghan, H. (2019). Could emotional eating act as a mediator between sleep quality and food intake in female students? *BioPsychoSocial Medicine, 13*(1), 15. https://doi.org/10.1186/s13030-019-0154-3
Sampige, R., Kuno, C. B., & Frankel, L. A. (2023). Mental health matters: Parent mental health and children's emotional eating. *Appetite, 180*, Article 106317. https://doi.org/10.1016/j.appet.2022.106317
Schneider, J., Fárková, E., & Bakštein, E. (2022). Human chronotype: Comparison of questionnaires and wrist-worn actigraphy. *Chronobiology International, 39*(2), 205–220. https://doi.org/10.1080/07420528.2021.1992418
Segura-Díaz, J. M., Barranco-Ruiz, Y., Saucedo-Araujo, R. G., Aranda-Balboa, M. J., Cadenas-Sanchez, C., Migueles, J. H., Saint-Maurice, P. F., Ortega, F. B., Welk, G. J., Herrador-Colmenero, M., Chillón, P., & Villa-González, E. (2021). Feasibility and reliability of the Spanish version of the Youth Activity Profile questionnaire (YAP-Spain) in children and adolescents. *Journal of Sports Sciences, 39*(7), 801–807. https://doi.org/10.1080/02640414.2020.1847488
Sempere-Rubio, N., Aguas, M., & Faubel, R. (2022). Association between chronotype, physical activity and sedentary behaviour: A systematic review. *International Journal of Environmental Research and Public Health, 19*(15), 9646. https://doi.org/10.3390/ijerph19159646
Serra-Majem, L., Ribas, L., Ngo, J., Ortega, R. M., García, A., Pérez-Rodrigo, C., & Aranceta, J. (2004). Food, youth and the mediterranean diet in Spain. Development of KIDMED, mediterranean diet quality index in children and adolescents. *Public Health Nutrition, 7*(7), 931–935. https://doi.org/10.1079/phn2004556
Shriver, L. H., Dollar, J. M., Calkins, S. D., Keane, S. P., Shanahan, L., & Wideman, L. (2020). Emotional eating in adolescence: Effects of emotion regulation, weight status and negative body image. *Nutrients, 13*(1), 79. https://doi.org/10.3390/nu13010079
Tanofsky-Kraff, M., Theim, K. R., Yanovski, S. Z., Bassett, A. M., Burns, N. P., Ranzenhofer, L. M., Glasofer, D. R., & Yanovski, J. A. (2007). Validation of the emotional eating scale adapted for use in children and adolescents (EES-C). *International Journal of Eating Disorders, 40*(3), 232–240. https://doi.org/10.1002/eat.20362
Tarokh, L., Short, M., Crowley, S. J., Fontanellaz-Castiglione, C. E. G., & Carskadon, M. A. (2019). Sleep and circadian rhythms in adolescence. *Current Sleep Medicine Reports, 5*(4), 181–192. https://doi.org/10.1007/s40675-019-00155-w
van Buuren, S., & Groothuis-Oudshoorn, K. (2011). mice: Multivariate imputation by chained equations in *R*. *Journal of Statistical Software, 45*(3). https://doi.org/10.18637/jss.v045.i03
Van den Berg, J. F., Kivelä, L., & Antypa, N. (2018). Chronotype and depressive symptoms in students: An investigation of possible mechanisms. *Chronobiology International, 35*(9), 1248–1261. https://doi.org/10.1080/07420528.2018.1470531
van Strien, T. (2000). Ice-cream consumption, tendency toward overeating, and personality. *International Journal of Eating Disorders, 28*(4), 460–464. https://doi.org/10.1002/1098-108x(200012)28:4<460::aid-eat16>3.0.co;2-a
van Strien, T. (2018). Causes of emotional eating and matched treatment of obesity. *Current Diabetes Reports, 18*(6), 35. https://doi.org/10.1007/s11892-018-1000-x
van Strien, T., Konttinen, H., Homberg, J. R., Engels, R. C. M. E., & Winkens, L. H. H. (2016). Emotional eating as a mediator between depression and weight gain. *Appetite, 100*, 216–224. https://doi.org/10.1016/j.appet.2016.02.034
van Strien, T., & Oosterveld, P. (2008). The children's DEBQ for assessment of restrained, emotional, and external eating in 7- to 12-year-old children. *International Journal of Eating Disorders, 41*(1), 72–81. https://doi.org/10.1002/eat.20424
van Strien, T., van der Zwaluw, C. S., & Engels, R. C. M. E. (2010). Emotional eating in adolescents: A gene (*SLC6A4/5-HTT*) – depressive feelings interaction analysis. *Journal of Psychiatric Research, 44*(15), 1035–1042. https://doi.org/10.1016/j.jpsychires.2010.03.012
Vera, B., Dashti, H. S., Gómez-Abellán, P., Hernández-Martínez, A. M., Esteban, A., Scheer, F. A. J. L., Saxena, R., & Garaulet, M. (2018). Modifiable lifestyle behaviors, but not a genetic risk score, associate with metabolic syndrome in evening chronotypes. *Scientific Reports, 8*, 945. https://doi.org/10.1038/s41598-017-18268-z
White, I. R., Royston, P., & Wood, A. M. (2011). Multiple imputation using chained equations: Issues and guidance for practice. *Statistics in Medicine, 30*(4), 377–399. https://doi.org/10.1002/sim.4067
Willem, C., Nandrino, J.-L., Doba, K., Roussel, M., Triquet, C., Verkindt, H., Pattou, F., & Gandolphe, M.-C. (2021). Interoceptive reliance as a major determinant of emotional

eating in adult obesity. *Journal of Health Psychology, 26*(12), 2118–2130. https://doi.org/10.1177/1359105320903093

Wu, J., Willner, C. J., Hill, C., Fearon, P., Mayes, L. C., & Crowley, M. J. (2018). Emotional eating and instructed food-cue processing in adolescents: An ERP study. *Biological Psychology, 132*, 27–36. https://doi.org/10.1016/j.biopsycho.2017.10.012

Zou, H., Zhou, H., Yan, R., Yao, Z., & Lu, Q. (2022). Chronotype, circadian rhythm, and psychiatric disorders: Recent evidence and potential mechanisms. *Frontiers in Neuroscience, 16*, Article 811771. https://doi.org/10.3389/fnins.2022.811771