

# **The impact of chronotype on mental health and subjective well-being: the mediating role of emotion regulation strategies**

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## **Statements and Declarations**

The authors have no competing interests to declare that are relevant to the content of this article.

## **Author Contribution**

JGW: conceptualization, methodology, formal analysis, investigation, resources, data curation, writing – original draft, writing – review & editing, visualization, project administration, supervision

## **Abstract**

Multiple studies have shown that individuals with an evening chronotype tend to report greater mental health problems, such as higher levels of depression and reduced well-being, compared to those with a morning chronotype. The adverse outcomes associated with eveningness appear to be linked to a combination of biological, social, and psychological factors. In the present study, we investigated the relationship between chronotype and two emotion regulation strategies: cognitive reappraisal and expressive suppression. Furthermore, we explored whether these strategies mediate the association between chronotype and indicators of mental health and well-being. Participants completed the Composite Scale of Morningness (CSM), and based on the established chronotype cut-off criteria, 76 individuals were classified as morning types and 81 as evening types. The total sample consisted of 157 participants (107 women, 50 men; aged 19-42 years,  $M \pm SD$ :  $25.12 \pm 4.53$  years). All participants completed questionnaires assessing emotion regulation strategies, depressive symptoms, life satisfaction, and positive and negative affect. Evening types scored lower in cognitive reappraisal and well-being, and higher in expressive suppression and depressive symptoms. Controlling for age and gender, we found significant mediation effects, showing that the relationship between chronotype and depressive symptoms and between chronotype and subjective well-being might stem from lower cognitive reappraisal and higher expressive suppression among evening types. These findings suggest that adaptive emotion regulation strategies can positively impact well-being and reduce depressive symptoms, especially among evening types. These findings highlight the importance of targeted interventions to improve emotion regulation strategies in this population.

**Keywords:** chronotype, emotion regulation, mental health, subjective well-being, depressive symptoms

## 1. Introduction

Chronotype – commonly referred to as morningness-eveningness – reflects individual differences in preferred timing for sleep and wakefulness, as well as the peak daily functioning. While some people naturally prefer going to bed and waking up early (*morning types*), others prefer a later daily schedule (*evening types*). However, the majority of people are somewhere in between these two extremes and do not display distinct circadian preferences (*intermediate types*) (Adan et al. 2012). Importantly, chronotype can be conceptualized in two ways: as a categorical variable, where individuals are classified into distinct types (morning, evening, or intermediate), or as a continuous variable, which reflects a position on the morningness-eveningness continuum. Both conceptualizations are commonly used in chronobiological research, depending on the study design and analytical goals (Natale et al. 2006).

Chronotype is generally considered a stable individual trait, although it can shift across the lifespan due to developmental and environmental influences (Fischer et al. 2017). Besides the clear differences in the sleep-wake patterns between morning and evening types, these chronotypes also differ in several physiological characteristics such as body temperature, melatonin secretion (Lack et al. 2009), and cortisol secretion (Oginska et al. 2010). In addition to physiological distinctions, chronotype is associated with several psychological characteristics, such as mood (Bauducco et al. 2020), personality (Tonetti et al. 2009), impulsivity (McCarthy et al. 2023), emotion regulation (Wang & Hu, 2016; Watts & Norbury 2017), life satisfaction (Randler 2008), and general affective functioning (Gao et al. 2019). Most studies investigating these differences consistently indicate that individuals with an evening chronotype tend to report lower mood, reduced well-being, and poorer mental health outcomes compared to morning types, suggesting they face a disadvantageous situation.

## **1.1. Eveningness, well-being, and mental health**

Multiple studies suggest that the evening chronotype is a significant predictor of reduced well-being (Polańska et al. 2024) and increased vulnerability to mental health problems (Gao et al. 2019). The current literature offers various possible explanations for these links. Results show a common genetic basis between eveningness and depression or anxiety symptoms (Toomey et al. 2015). Moreover, evening types are exposed to less natural daylight, which may affect their mood via neurobiological pathways (Goulet et al. 2007; Blume et al. 2019). Importantly, social factors also contribute significantly to these dynamics, for example, the morning orientation of the social clock (related to school and work schedules) often compels evening-type individuals to function at times that are misaligned with their natural rhythms (Wittmann et al. 2006). Additionally, Taylor and Hasler (2018) proposed a conceptual model linking mechanisms underlying the association between eveningness and mental health problems. They point to shared genetic, neural/psychological, and environmental factors as contributors to circadian disturbances. While these mechanisms are undoubtedly important, they appear to explain only part of the relationship between eveningness, well-being, and mental health outcomes (Hasler, 2023). Notably, these explanations often overlook a key dimension that may further distinguish evening and morning types: the role of individual differences.

## **1.2. Eveningness and individual differences**

Recent research highlights the important role of individual differences in shaping the link between eveningness, well-being, and mental health – factors that can either attenuate or amplify these associations. Protective factors against elevated depressive symptoms and reduced well-being among evening types may include personality traits such as higher conscientiousness and lower neuroticism (Gorgol et al. 2022a), temperamental traits like higher briskness and lower emotional reactivity (Gorgol et al. 2022b), lower rumination

(Antypa et al. 2017), stronger perceived social support (Gorgol et al. 2022c), or higher self-esteem (Gorgol et al. 2024). Moreover, effective coping strategies may also play an extremely important role in the formation of these relationships. Specifically, skills such as problem-solving and adaptive emotion regulation have been shown to mitigate the intensity and duration of negative emotional states and rumination, while simultaneously enhancing positive affect (Watts & Norbury 2017; Zawadzki 2015). Conversely, difficulties in managing emotional responses may lead to psychological distress, anxiety, and depression, as well as diminished well-being (Kraiss et al. 2020).

### **1.3. Emotion regulation**

One widely used and extensively researched concept of emotion regulation strategies is the one proposed by Gross and John (2003). It identifies two types of emotion regulation: cognitive reappraisal and expressive suppression. Cognitive reappraisal refers to reframing a situation or reinterpreting the meaning of stimuli and events to alter their emotional impact and is considered beneficial. For example, when faced with a stressful situation, such as giving a presentation at work, using cognitive reappraisal might help you stay calm by considering how the situation may have positive outcomes. You might think, 'This presentation will showcase my skills and possibly lead to a promotion,' rather than thinking, 'I might fail and feel embarrassed'. Importantly, research suggests that high cognitive reappraisal ability may reduce depressive symptoms (Troy et al. 2010) and improve well-being (Dawel et al. 2023). At the same time, expressive suppression refers to inhibiting the emotional expression or experience and is considered maladaptive (Gross 2002). For example, when you are angry and dissatisfied with something, you might use expressive suppression to speak in a calm voice and keep a cheerful facial expression instead of raising your voice - this way, you suppress your emotions to avoid conflict. Results indicate that higher expressive suppression is associated with increased emotional exhaustion and stress

because it requires constant effort to inhibit emotional expression. This, in turn, may lead to lower life satisfaction and higher levels of depression, anxiety, and greater negative emotions (Moore et al. 2008). However, it is worth noting that in some contexts, suppression may serve adaptive functions - for example, helping to maintain social harmony or avoid escalation in situations where expressing emotions could be risky or inappropriate (Butler et al., 2007). Cultural factors may also shape whether suppression is experienced as maladaptive or adaptive, as studies suggest it is perceived more positively in collectivist contexts compared to individualistic ones (Klein et al. 2024) Thus, the impact of expressive suppression on well-being may depend on situational and cultural circumstances.

#### **1.4. Emotion regulation and chronotype**

These two emotion regulation strategies – cognitive reappraisal and expressive suppression – have also been linked to chronotype and sleep parameters. Specifically, eveningness has been associated with a greater tendency to use expressive suppression, while morningness correlates with more frequent use of cognitive reappraisal (Watts & Norbury 2017; Keenan et al. 2025). Moreover, expressive suppression is positively related to worse sleep quality (Latif et al. 2019). Other studies suggest that morning chronotype may influence well-being through greater use of cognitive reappraisal strategies (Antúnez 2020). Considering that cognitive reappraisal has adaptive properties (Troy et al. 2010), it seems that it may be a factor protecting against the development of depressive symptoms and may enhance well-being among evening types. This strategy could be especially beneficial for evening types, who often face stress due to circadian misalignment and reduced daylight exposure (Wittmann et al., 2006). In contrast, expressive suppression is considered maladaptive (Gross 2002) and may increase vulnerability to depressive symptoms and lower well-being in evening types. Because reappraisal relies on executive resources (Gross & Thompson 2007), which are depleted by poor sleep, eveningness may further constrain

individuals' ability to use this adaptive strategy, explaining why suppression often predominates in this group.

## **1.5. Current study**

Given the undesirable emotional consequences often associated with eveningness, this study aimed to investigate whether different emotion regulation strategies may underpin the association between chronotype and depressive symptoms as well as between chronotype and subjective well-being. Two hypotheses were formulated: 1) individuals with an evening chronotype would report higher levels of depressive symptoms and expressive suppression, along with lower levels of subjective well-being and cognitive reappraisal, and 2) cognitive reappraisal and expressive suppression would mediate the relationships between chronotype and both depressive symptoms and subjective well-being. Specifically, it was expected that higher eveningness would be indirectly associated with greater depressive symptoms and lower well-being through more frequent use of expressive suppression and less frequent use of cognitive reappraisal.

## **2. Method**

### **2.1. Participants and procedure**

In the first part of the study, participants ( $N = 1036$ ) were asked to complete a 3-minute online survey measuring their chronotype and simple demographic data. Participants were recruited through announcements on social media, the University website, and the University newsletter. They registered by email and then received a short screening survey, which included questions about demographic information and self-reported diagnoses of depression or sleep disorders. Only those who confirmed the absence of such conditions, indicated Poland as their country of origin, and scored within the range of extreme morning or evening chronotypes were invited to take part in the second stage of the study. This stage involved completing a set of online questionnaires described below.

In line with the cut-off criteria recommended for the chronotype scale (described in detail in the *Main measures* section below), the final sample consisted of 81 evening types and 76 morning types (107 women and 50 men), aged 19-42 years ( $M = 25.12$ ,  $SD = 4.53$ ). Approximately 45% of participants had university degrees, 53% had secondary education, 1% vocational education, and 1% lower secondary education.

All participants provided informed consent before participating in each phase of the study. The research was conducted in line with the ethical standards of the Declaration of Helsinki, and the procedure was accepted by the institutional ethics committee.

An a priori power analysis using G\*Power (Faul et al. 2009), assuming medium effects size at 80% power, yielded a sample size of 64 ( $d = 0.5$ ,  $\alpha = .05$ , power = .80). Thus, our sample size is large enough to detect effects reported on previous publications (Gorgol et al. 2022a).

## **2.2. Main measures**

*Chronotype* was assessed using the Composite Scale of Morningness (CSM) in its Polish adaptation by Jankowski (2015a). The CSM comprises 13 items that assess various aspects of circadian functioning, including preferred times for waking and sleeping, optimal periods for physical and mental activity, and subjective levels of alertness. Each item of the CSM is rated on a 4- or 5-point scale. The total CSM score is calculated as the sum of responses to all its items, with scores ranging from 13 to 55, where higher scores indicate greater morningness. According to Jankowski's (2015a) recommendations, the cut-off points for evening types were 24 and below, while for morning types they were 43 and above. The internal consistency of the CSM in our study was  $\alpha = 0.97$ .

*Satisfaction with life* was assessed using the Satisfaction with Life Scale (SWLS) in its Polish adaptation by Jankowski (2015b). The SWLS includes 5 items relating to overall cognitive assessments of one's life satisfaction. Each item of the SWLS is rated on a 7-point

scale. The total SWLS score is calculated as the sum of the responses to all its items, with scores ranging from 5 to 35, where higher scores indicate greater life satisfaction. The internal consistency of the CSM in our study was  $\alpha = 0.85$ .

*Positive and negative affect* were assessed using the Positive and Negative Affect Schedule (PANAS; Watson et al. 1988) in its Polish adaptation. The PANAS comprises 20 items that measure the extent to which participants experienced specific feelings or emotions over the past week, assessing both positive affect (PA) and negative affect (NA). Each item of PANAS is rated on a 5-point scale. The total scores for PA and NA are calculated as the sum of the responses to their respective items (10 items for PA and 10 for NA), with scores ranging from 10 to 50. The internal consistency of the PA in our study was  $\alpha = 0.86$ , and for NA was  $\alpha = 0.89$ .

*Subjective well-being* is conceptualized as comprising life satisfaction, and the experience of more positive and less negative emotions (see Diener et al. 1999). Following this definition, subjective well-being was calculated using the SWLS and PANAS scales (Doğan et al. 2012). As the two instruments use different response formats, all variables were standardized (*z*-scores) prior to computing the composite score. The overall subjective well-being score was calculated using the formula: Subjective well-being =  $z\text{SWLS} + z(\text{PA} - \text{NA})$ .

*Depressive symptomatology* was measured using the Patient Health Questionnaire-9 (PHQ-9) in its Polish adaptation by Gorgol-Waleriańczyk (2025). The PHQ-9 consists of 9 items referring to the frequency of depressive symptoms described in the DSM-IV diagnostic criteria over the past two-week period. Each item of PHQ-9 is rated on a 4-point scale. The total PHQ-9 score is calculated as the sum of the responses to all its items, with scores ranging from 0 to 27 points. The internal consistency of the PHQ-9 in our study was  $\alpha = .88$ .

*Emotion regulation* was assessed using the Polish adaptation of the Emotion Regulation Questionnaire (ERQ; Gross & John 2003). The ERQ consists of 10 items that

measure the individuals' tendency to regulate their emotions in two ways: cognitive reappraisal and expressive suppression. Each item on the ERQ is rated on a 7-point scale. The total ERQ score is calculated as the sum of the responses to all items, with scores ranging from 10 to 70 points. The internal consistency of the ERQ in our study was  $\alpha = .72$ .

### **2.3. Analytical strategy**

In all the analyses, the morning-type category was coded as "1", whereas the evening-type category was coded as "2". Data distribution was assessed using the Shapiro-Wilk test and through visual inspection of relevant plots. Chi-square tests were conducted to compare chronotype with gender distribution and with the clinical threshold for depression. Additionally, an independent-samples t-test was used to examine age differences between chronotype groups. Spearman's rank-order correlations were calculated to examine associations between chronotype, subjective well-being components, depressive symptoms, and the two types of emotion regulation strategies. Group differences in cognitive reappraisal, expressive suppression, subjective well-being, and depressive symptoms between morning and evening types were assessed using the Mann–Whitney U test. Standard mediation analyses were then conducted to determine whether the associations between chronotype and subjective well-being, as well as between chronotype and depressive symptoms, were mediated by cognitive reappraisal and expressive suppression. In the mediation models, age and gender were included as covariates. All statistical analyses were conducted using IBM SPSS for Windows and PROCESS macro (Hayes 2013). Figures were created using RStudio.

## **3. Results**

### **3.1. Descriptive statistics**

The present sample showed a gender imbalance, with women being significantly overrepresented compared to men ( $\chi^2(1, N = 171) = 21.76, p < .001$ ). Moreover, morning types were on average older ( $M = 25.80, SD = 5.03$ ) than evening types ( $M = 24.48, SD =$

3.93), but this difference did not reach statistical significance,  $t(141.85) = 1.83, p = .070, d = 0.29$ . The effect size indicated a small-to-moderate trend suggesting that morning types may be somewhat older, consistent with the general tendency for chronotype to shift toward morningness with age (Adan et al. 2012), though this was not robust in our sample.

A chi-square test was also conducted to examine whether morning and evening chronotypes differed in the proportion of participants scoring above the clinical cut-off for depression (PHQ-9  $\geq 10$ ; Kroenke et al. 2001). The analysis revealed a significant association between chronotype and depression diagnosis,  $\chi^2(1, N = 157) = 6.37, p = .012$ . Among morning types ( $n = 76$ ), 15 participants (19.7%) scored above the clinical threshold for depression, whereas among evening types ( $n = 81$ ), 36 participants (44.4%) met the criteria. Thus, evening types were more than twice as likely as morning types to report clinically relevant levels of depressive symptoms.

### **3.2. Correlations**

Spearman's correlations are presented in Table 1. Eveningness showed negative correlations with cognitive reappraisal and subjective well-being, and positive correlations with expressive suppression and depressive symptoms. Moreover, cognitive reappraisal was negatively related to depressive symptoms and positively associated with subjective well-being, whereas expressive suppression was positively associated with depressive symptoms, and negatively related to subjective well-being. Finally, depressive symptoms were negatively correlated with subjective well-being. According to established guidelines (see Cohen, 1992), the observed relationships ranged from small-to-moderate ( $r = .10$  to  $.30$ ) to moderate-to-large ( $r = .30$  to  $.50$ ).

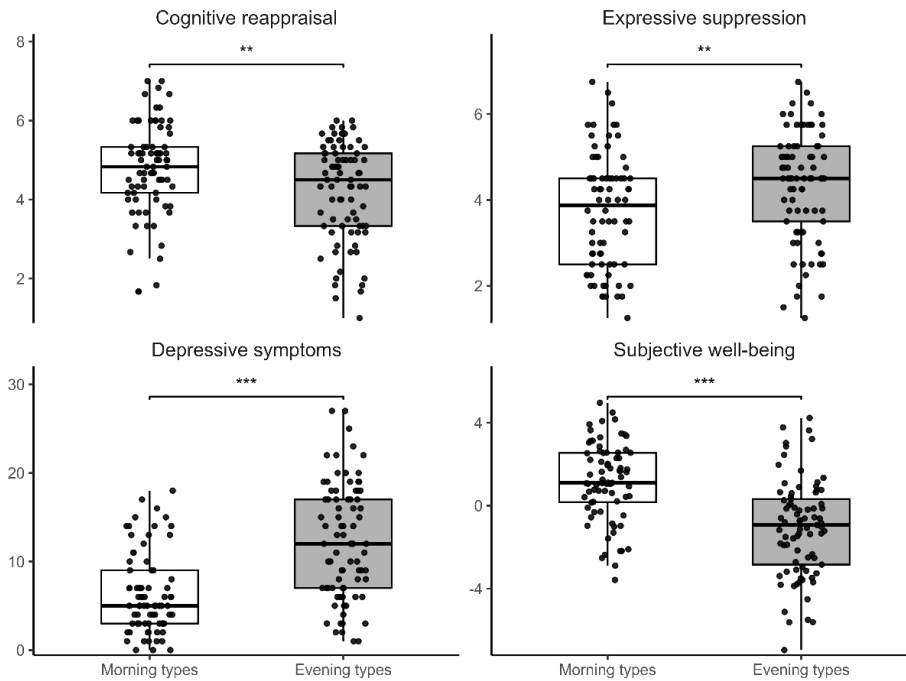
**Table 1.***Correlations between variables included in the present study.*

Variable	1.	2.	3.	4.	5.
1. Chronotype	-				
2. Cognitive reappraisal	-.20*	-			
3. Expressive suppression	.23*	-.09	-		
4. Depressive symptoms	.47**	-.36**	.34**	-	
5. Subjective well-being	-.49**	.42**	-.34**	-.74**	-

\*  $p < .05$ , \*\*  $p < .001$

### 3.3. Difference between morning and evening types

The score distributions for cognitive reappraisal, expressive suppression, depressive symptoms, and subjective well-being between morning and evening types are depicted in Figure 1. Additionally, Table 2 summarizes the differences between the two chronotypes groups. As shown, morning types scored significantly higher in cognitive reappraisal and subjective well-being, and lower in expressive suppression, and depressive symptoms than evening types. Following Cohen's (1992) recommendations, the observed differences between morning and evening types indicate moderate to high effect sizes.



**Figure 1.** Boxplots illustrating differences in cognitive reappraisal, expressive suppression, depressive symptoms, and subjective well-being between morning and evening chronotypes.

\*\*\* $p < .001$ , \*\* $p < .01$ .

**Table 2.**

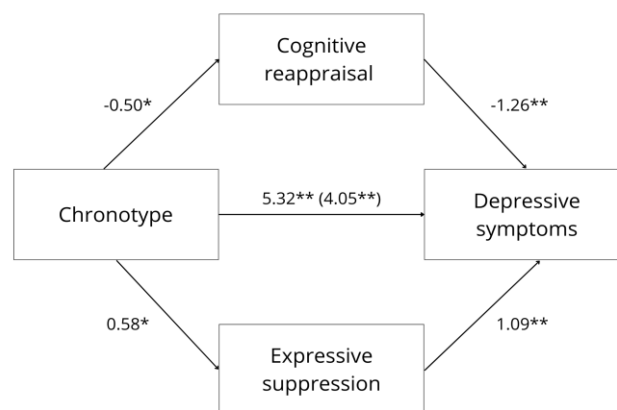
*Descriptive statistics and Mann-Whitney U test results for differences between morning (MT) and evening type (ET) chronotype groups.*

Variable	Mean $\pm$ standard deviation		Mann-Whitney U	$p$ -value	Cohen's $d$
	MT	ET			
Cognitive reappraisal	4.77 $\pm$ 1.17	4.22 $\pm$ 1.24	2373.50	.013	0.46
Expressive suppression	3.73 $\pm$ 1.34	4.32 $\pm$ 1.27	2251.50	.004	-0.45
Depressive symptoms	6.38 $\pm$ 4.51	12.30 $\pm$ 6.47	4749.00	<.001	-1.06
Subjective well-being	1.15 $\pm$ 1.86	-1.08 $\pm$ 2.31	1353.50	<.001	1.06

### 3.4. Mediation analyses

To examine the primary hypothesis regarding the mediating effects of two emotion regulation strategies in the relationship between chronotype and both depressive symptoms and subjective well-being, two multiple mediation analyses were performed, with age and gender included as covariates.

In the first model, chronotype served as the independent variable, with cognitive reappraisal and expressive suppression included as mediators, and depressive symptoms as the outcome variable. As illustrated in Figure 2, both cognitive reappraisal and expressive suppression partially mediated the association between chronotype and depressive symptoms. The total indirect effect was 1.27 (95% CI [0.52 – 2.24]), accounting for approximately 24% of the total effect. Specifically, the indirect effect through cognitive reappraisal was 0.63 (95% CI [0.12 – 1.41]) and through expressive suppression was 0.64 (95% CI [0.12 – 1.37]), each explaining about 12% of the total effect. These findings support our hypothesis about the mediating role of emotion regulation in the relationship between chronotype and depressive symptoms.

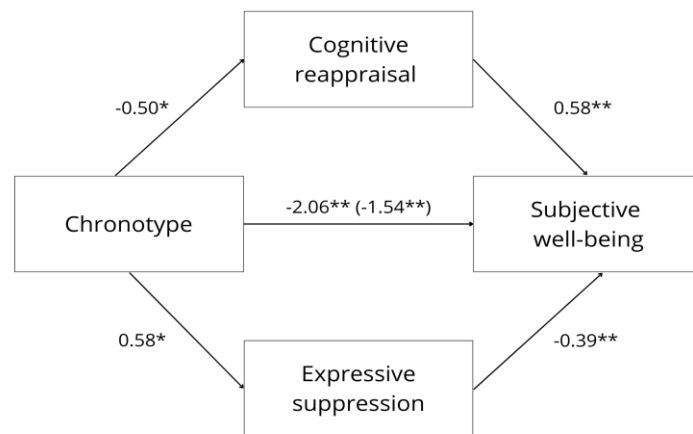


**Figure 2.** Mediation model illustrating the indirect effects of cognitive reappraisal and expressive suppression on the relationship between chronotype and depressive symptoms.

Age and gender were included as covariates.

\*  $p < .05$ , \*\*  $p < .001$

In the second model, chronotype was a direct predictor, cognitive reappraisal and expressive suppression were introduced as mediators, and subjective well-being constituted the outcome variable. As presented in Figure 3, both cognitive reappraisal and expressive suppression mediated the studied relationship. The total indirect effect was  $-0.52$  (95% CI  $[-0.88, -0.20]$ ), indicating that approximately 25% of the effect of chronotype on subjective well-being was accounted for by these two emotion regulation strategies. Specifically, the indirect effect via cognitive reappraisal was  $-0.29$  (95% CI  $[-0.59, -0.06]$ ), and via expressive suppression was  $-0.23$  (95% CI  $[-0.47, -0.05]$ ), corresponding to indirect-to-total effect ratios of 0.14 and 0.11, respectively. These findings support our hypothesis about the mediating role of emotion regulation in the relationship between chronotype and subjective well-being.



**Figure 3.** Mediation model illustrating the indirect effects of cognitive reappraisal and expressive suppression on the relationship between chronotype subjective well-being. Age and gender were introduced to the analysis as control variables. \*

$p < .05$ ,  $** p < .001$

#### 4. Discussion

The present study investigated the associations between chronotype, subjective well-being, depressive symptoms, and both cognitive reappraisal and expressive suppression.

Additionally, the study examined whether these emotion regulation strategies mediate the relationship between chronotype and both subjective well-being and depressive symptoms. As expected, and consistent with previous studies (Watts & Norbury, 2017), eveningness was associated with higher depressive symptoms and expressive suppression as well as with lower subjective well-being, and cognitive reappraisal. Furthermore, both cognitive reappraisal and expressive suppression partially mediated the link between chronotype and depressive symptoms as well as between chronotype and subjective well-being.

Several implications follow from these results. First, they suggest that evening types may be more susceptible to elevated depressive symptoms and reduced well-being due, in part, to a greater reliance on expressive suppression and a lower tendency to employ cognitive reappraisal as an emotion regulation strategy. Cognitive reappraisal, an adaptive emotion regulation strategy, is known to positively influence mood and enhance psychological well-being (Troy et al. 2010). A diminished use of this strategy among evening types may therefore increase their vulnerability to emotional difficulties. In contrast, expressive suppression – more maladaptive form of emotion regulation strategy – has been linked to adverse outcomes such as emotional exhaustion and heightened stress (Moore et al. 2008). Therefore, evening types who use this strategy more often might experience higher levels of emotional exhaustion, potentially leading to lower mental health and well-being. However, it is important to note that suppression may not always be harmful. In some contexts, such as when maintaining social harmony or avoiding conflict escalation, suppression can serve adaptive functions (Butler et al., 2007). Thus, while our findings highlight its generally detrimental associations, future studies should also consider situational and cultural factors that may determine when suppression is harmful and when it may play a protective role.

Our findings also indicate that the differences in depressive symptoms between morning and evening chronotypes may be of clinical concern. Using the established PHQ-9 cut-off ( $\geq 10$ ; Kroenke et al. 2001), evening types were more than twice as likely as morning types to report clinically relevant levels of depressive symptoms (44.4% vs. 19.7%). This suggests that the elevated vulnerability observed in evening types is not limited to subclinical mood variation but extends into ranges that may indicate a probable depressive disorder. Such a pattern highlights the practical significance of chronotype in mental health research and underlines the need for tailored preventive and intervention strategies. In particular, evening types might benefit from programs that target emotion regulation skills, sleep hygiene, and alignment of social and biological rhythms, which could help mitigate their heightened risk of clinically significant depressive symptoms.

It is important to understand why evening types use expressive suppression more often. This tendency may stem from the necessity to function during socially imposed schedules that do not align with their natural circadian rhythms (see Wittmann et al. 2006). Such misalignment can be associated with difficulties in managing emotions, especially during early morning hours when evening types are typically not at their optimal level of functioning. As a result, they may resort to suppressing emotional expressions as a coping mechanism to meet daily demands. Moreover, evening types often experience lower mood in the morning or are less productive, which may contribute to more negative social evaluations (Stolarski & Gorgol 2022). In this context, suppressing the outward expression of negative emotions may serve as a strategy to navigate interpersonal expectations and reduce the risk of unfavourable social judgments. At the same time, chronotype reflects a relatively stable preference for activity and alertness at certain times of the day. Thus, evening types not only face external pressures but also bring with them a dispositional tendency toward later activity, which can exacerbate the mismatch between their biological and social clocks. This enduring

preference may partly explain why suppression emerges as a common regulatory strategy in this group, as they regularly encounter situations where their natural rhythms are at odds with societal expectations.

Understanding the relationship between emotion regulation strategies and their influence on the relationship between chronotype and mental health suggests new possibilities for designing targeted interventions to support evening types. Training, interventions, or courses (e.g., cognitive-behavioral interventions; Plate & Aldao, 2017) on effective emotion regulation techniques can alleviate the negative emotional consequences they experience daily, leading to better mental health. In particular, cognitive reappraisal plays a beneficial role in the studied relationships and may potentially buffer against lower well-being and higher depressiveness. Importantly, this study indicates that mental health professionals should consider an individual's chronotype in their diagnosis, prevention, and treatment plans, and focus on strengthening adaptive strategies for regulating emotions.

This study adds to the growing body of evidence suggesting that the relationship between chronotype and mental health depends not only on biological (Toomey et al. 2015) and social (Wittmann et al. 2006) factors but also on individual differences. These findings encourage a more holistic approach to enhance understanding of the chronotype-mental health relationship indicating that factors such as the impact of biological rhythms, social influences, and psychological processes should be considered together. Integrating these dimensions may provide a more nuanced understanding of the mechanisms underlying this relationship and promote more comprehensive and effective approaches to mental health care.

#### **4.1. Limitations and future research**

Our study shares the limitations typical of cross-sectional research designs based on self-report measures. Therefore, they should be interpreted cautiously, especially considering

the various biases associated with self-report questionnaires. Furthermore, due to the cross-sectional nature of the study, any conclusions about the direction of causality regarding the associations discussed here are speculative. Future longitudinal studies could provide a stronger test of our hypotheses, confirm the stability of the obtained effects, and explore the underlying mechanisms linking chronotype, emotion regulation strategies, and mental health. Moreover, in this study, we used the CSM questionnaire to assess chronotype. Despite its strengths, such as high internal consistency and strong correlations with other diurnal preference measures, it has limitations. Moreover, CSM assesses chronotype preference rather than actual behavioral patterns. This means that while we interpret the findings in terms of circadian misalignment, the study does not directly capture whether participants' preferred rhythms were indeed out of sync with their daily obligations. Future research incorporating objective measures of sleep-wake behavior could provide stronger evidence for how misalignment contributes to emotion regulation strategies among evening types. Furthermore, replicating our study using more sophisticated scales, such as the Munich Chronotype Questionnaire (MCTQ; Roenneberg et al. 2003) or the Morningness-Eveningness-Stability Scale improved (MESSi, Randler et al. 2016), is important. Another limitation concerns the studied population, which consisted mainly of young adults, predominantly female, recruited in Poland. Although this relative homogeneity helped minimize potential confounding variables, it also restricts the generalizability of the findings. Age distribution may have influenced the results, as chronotype tends to shift across the lifespan (Adan et al. 2012). Likewise, the gender imbalance may have shaped the observed associations, given that women may differ from men in both chronotype (Adan et al. 2012) and emotion regulation strategies (Gross & John 2003), which could affect the links between chronotype, emotion regulation, and well-being. Cultural context is also important to consider: strong morning-oriented social schedules may exacerbate the disadvantages of

eveningness, whereas in cultures with more flexible daily rhythms these effects might be less pronounced. Moreover, cultural norms regarding the acceptability of emotion regulation strategies (e.g., suppression being more adaptive in collectivist contexts) may moderate the associations between chronotype, emotion regulation, and mental health problems (Klein et al. 2024). Therefore, future research should aim to include more gender-balanced, culturally diverse, and age-heterogeneous samples to verify the robustness and universality of these findings. Finally, the present study included only participants with extreme chronotypes (morning and evening types). Although this approach allowed to maximize between-group differences and provide clearer contrasts, it reduced the representativeness of the sample, since most individuals in the general population are intermediate types. Future research should address this issue by including all chronotype categories and testing both categorical and dimensional approaches.

## **5. Conclusion**

In summary, the present study demonstrated that evening types report higher expressive suppression and lower cognitive reappraisal than morning types. These two emotion regulation strategies were found to mediate the link between chronotype and both depressive symptoms and subjective well-being. Higher levels of cognitive reappraisal appear to be crucial for a more adaptive way of dealing with emotions, helping to protect against depressive symptoms and increase well-being. In contrast, higher expressive suppression may increase depression and decrease well-being, especially among evening types. Based on these findings, the development of targeted interventions or training programs aimed at enhancing adaptive emotion regulation strategies in evening types is recommended, as a means of mitigating vulnerability to affective disorders and promoting psychological well-being.

## Data availability statements

The data that support the findings of this study are openly available in RepOD at <https://doi.org/10.18150/FMYPKU>

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