Can morning affect protect us from suicide? The mediating role of general mental health in the relationship between chronotype and suicidal behavior among students

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ABSTRACT

Although chronotype has been associated with suicidal behavior, current research suggest that this relationship may be mediated by other factors. The aim of this study was to assess whether chronotype, specifically morningness, may predict suicidal behavior and whether this relationship may be mediated by general mental health, depressive and anxiety symptoms, and/or social functioning among young adults.

The study group comprised 306 students: 204 (65.8%) women, 101 (32.6%) men and one who chose not to identify with either option (0.3%). The participants completed The Composite Scale of Morningness, The General Health Questionnaire, 30-item version, Suicide Acceptance Questionnaire and The Suicidal Behaviors Questionnaire-Revised. Correlations between the continuous variables of interest revealed a weak, but significant, negative association between morning affect (CSM) and suicidal behavior (SBQ-R); a moderate positive association was found between suicidal behavior (SBQ-R) and depression/anxiety, and a weak one between suicidal behavior (SBQ-R) and interpersonal relations (GHQ-30). The models predicting suicidal behavior, and chronotype-related variables as predictors of suicidal behavior, were then tested. Although the morning affect predicted suicidal behavior, this effect became irrelevant when combined with mental health characteristics: psychopathological symptoms of depression and anxiety and the quality of interpersonal relations.

Our findings imply that the role of chronotype is secondary to general mental health: mental disorder symptoms should be considered as the core risk factors for suicide and serve as the focus for suicide risk assessments.

1. Introduction

Many studies have examined the differences in preferred sleep and activity schedule between individuals. These findings gave rise to the concept of chronotype, which typically classifies preferences regarding the optimal time of the day for activity using a morningness-eveningness spectrum (Horne and Ostberg, 1976; Montaruli et al., 2021). More recent studies have focused on its associations with changes in alertness, mood, or cognition (Bauducco et al., 2020; Díaz-Morales et al., 2015), and have initiated a discussion on the impact of chronotype on mental health.

When viewed in terms of morningness and eveningness, the evening chronotype tends to be linked to a less healthy lifestyle (Rhee et al., 2012), lower life satisfaction (Jankowski, 2012), poorer sleep quality (Goelema et al., 2019) as well as poorer mental health, for example depressive symptoms (Bauducco et al., 2020). Among psychiatric diseases, depression is considered to be one of the most relevant risk factors for suicide (Bachmann, 2018; Orsolini et al., 2020) including suicide ideation, planning suicide, attempting suicide and completed suicide, which accounts for 1.4% of premature deaths worldwide (Bachmann,

2018).

Since eveningness has been associated with more suicidal ideation in patients with MDD (Bahk et al., 2014) and more severe depressive symptoms (Müller et al., 2016; van den Berg et al., 2018) when compared to morningness, it has been hypothesized that a morning chronotype could be considered a protective factor against both depression and anxiety, as well as other disorders and possibly even suicide (Gaspar-Barba et al., 2009). Morningness has been shown to act as a potential protective factor against sleep-related problems in childhood, sleep-related problems and psychological problems, including both externalizing and internalizing problem behavior (Gelbmann et al., 2012); it has also been proposed to protect against smoking, alcohol use and physical inactivity in adolescents (Urbán et al., 2011), as well as against poor sleep quality (Sun et al., 2019), food addiction and ADHD symptoms (Yilbas et al., 2022) in students, among others.

The influence of chronotype on suicidal thoughts and behaviors has been examined to a limited extent. However, existing research suggests that morningness could also play an important part as a protective factor – not only against depression but also against suicide (Park et al., 2018). Eveningness has been associated with greater risk of suicidal thoughts and behaviors among both adults and adolescents (Rumble et al., 2022). Evening types not only report more suicidal thoughts and a higher prevalence of lifetime suicide attempts (Rumble et al., 2022) but also more frequently choose violent methods of suicide (Selvi et al., 2011). While these findings point to the significance of chronotype as a risk factor, the most consistent conclusion deriving from the subject literature is that the majority of suicides worldwide are related to psychiatric diseases, such as depression, substance use and psychosis (Bachmann, 2018).

Thus, it has been proposed that depressive symptoms may act as a mediator for the relationship between chronotype and suicide (Park et al., 2018). Since anxiety disorders, including social anxiety and symptoms such as social dysfunction, have also been associated with suicide risk (Buckner et al., 2017; Porcelli et al., 2020), their symptoms could also influence this relationship. Nevertheless, there are many additional factors worth considering when analyzing suicide. One such factor is age: the 15–24 year age group is characterized by the highest suicide rate of any age group, where it is also the second most common cause of death, in both sexes (Patton et al., 2009). Concerning chronotype, social jetlag and its possible influences on mental health should also be accounted for (Taillard et al., 2021). Substance use has also been linked to a significant risk of suicide mortality, especially for those experiencing multiple substance use disorders (Lynch et al., 2020). It is also believed that one's belief system, especially beliefs regarding suicide and its acceptability can also influence the chance of suicide: Joe et al. (2007) indicate that adolescents and young adults who most strongly believe that suicide is an acceptable way of ending one's life are more than fourteen times more likely to make a plan to kill themselves in comparison to those who do not have such beliefs.

This study focuses on the possible protective effect of morningness against suicidal behavior, including mental health factors - depressive and anxiety symptoms as well as social functioning as possible mediators (see Fig. 1). The main purpose is to assess (1) whether chronotype, specifically morningness, may in fact predict suicidal behavior and (2) whether general mental health, i.e. depressive and anxiety symptoms and/or social functioning, may mediate this relationship among young adults. The analysis includes a number of significant factors such as age,
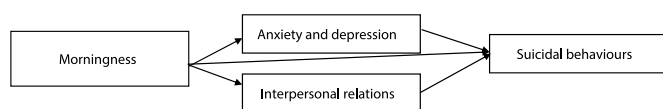
substance use, suicide acceptance and social jetlag.

2. Methods

2.1. Study sample and design

The study group comprised 313 students aged 18–48 (*M = 21.99; SD = 3.213*), including 208 women (66.5%), 104 (33.2%) men and one participant (0.3%) who chose not to identify with either option. Based on the exclusion criteria, i.e. age under 30 and no diagnosed mental illness, 306 participants were included in the study: 204 (65.8%) women, 101 (32.6%) men and one participant who chose not to identify with either option (0.3%). Out of all the included participants, 76.1% (N = 236) declared that they are not using any substances while 22.6% (N = 70) admitted to some substance use. Other characteristics of the sample are presented in Table 1 as continuous variables. The data was collected from December 2021 to May 2022 using different Facebook groups visited by students. The participants were recruited via snowball sampling by the researcher and, after giving their informed consent, were asked to complete the set of questionnaires described below. As the study aimed to focus on a non-psychiatric sample, the exclusion criteria comprised a diagnosis of mental illness.

The Composite Scale of Morningness (CSM) was developed by Smith et al. (1989) and adapted to Polish by Jankowski (2015). Despite the discrepancy regarding its factor structure (di Milia and Bohle, 2009), this tool presents good psychometric properties. The questionnaire consists of two scales: morning affect, sometimes described as the general morning factor, and a second, more controversial, and not easily-labeled factor, which will be defined as clock time in this study (di Milia and Bohle, 2009). These factors serve as indicators of morningness and the preferred times of activity, respectively, with higher scores representing stronger morningness and a later preferred time of activity. Cronbach's alpha values were 0.828 for the Morning Affect scale and 0.784 for the Clock Time scale in the current study.

Suicidal behavior was assessed by The Suicidal Behaviors Questionnaire-Revised (SBQ-R) devised by Osman et al. (2001) and adapted to Polish by Chodkiewicz and Gruszczynska (2020). This tool comprises four questions, three of a retrospective character and one of the prospective character, which correlates with other methods measuring depression and suicidal tendencies. Its structure is unidimensional, with satisfactory internal consistency and overall good psychometric proprieties (Chodkiewicz and Gruszczynska, 2020). Cronbach's alpha value was 0.819 in the current study.

The General Health Questionnaire, 30-item version (GHQ-30) was incorporated into this study as a screening tool designed to assess general mental health issues in non-psychiatric samples. GHQ was originally created by Goldberg (1972) and has been widely used ever since, expanding into numerous versions and adaptations such as the Polish adaptation of GHQ-30 (Małyszczak, 2003; Małyszczak and Pawłowski, 2003). The questionnaire comprises three factors: depression and

Table 1
Descriptive statistics of the sample.

Variable	M	Min	Max	SD
Age	21.65	18.00	29.00	2.145
GHQ-30 (anxiety/depression)	23.06	11.00	40.00	6.83
GHQ-30 (interpersonal relations)	8.78	4	16	2.25
Morning Affect (CSM)	14.34	6	24	4.00
Clock time (CSM)	18.06	7	29	4.14
Suicide acceptance (SAQ)	27.79	10	46	7.787
Suicidal behavior (SBQ-R)	7.23	3	18	3.89
SJLsc	1.14	0	24	2.18

GHQ-30 - The General Health Questionnaire, 30-item version; CSM - The Composite Scale of Morningness; SAQ - Suicide Acceptance Questionnaire; SBQ-R - The Suicidal Behaviors Questionnaire-Revised; SJLsc – social jetlag calculated with the sleep corrected formula.

Fig. 1. The hypothesized model of the mediating role of depression and anxiety and interpersonal relations in the association between morningness and suicidal ideation among students.

anxiety, interpersonal relations and general functioning (Frydecka et al., 2010). For current study, two factors were essential: depression and anxiety and interpersonal relations. The Cronbach's alpha values for these scales were 0.901 and 0.713 respectively.

The acceptance of suicide act was measured using Suicide Acceptance Questionnaire (SAQ) developed by Stecz et al. (2020). This Polish tool consists of 10 items and demonstrates appropriate reliability and concurrent validity for measuring suicide acceptance. The Cronbach's alpha value was 0.810 in the current study.

Social jetlag was calculated using the sleep corrected formula developed by Jankowski (2017).

The study was conducted according to institutional and national ethical standards and in accordance with the guidelines of the Declaration of Helsinki. Ethical review and approval were waived for this study, due to observational character of the study and involvement of non-invasive measures (self-reported questionnaires).

3. Statistical analysis

Statistical analysis was conducted in IBM Statistics SPSS. For the binominal variables, their prevalence in the sample was presented as both absolute (number of observations, N) and relative scores (percentage, %). Continuous variables were presented as mean with standard deviation.

For continuous variables, the distribution was assessed with the Shapiro-Wilk W-test and the analysis of the Q-Q plots of the residuals. The association between two continuous variables was initially assessed with Pearson's correlation coefficient. Linear regression models were constructed to further assess the predictive value of chronotype and possible mediation. A global Fisher-Snedecor test was used to assess the goodness of fit of the model. An analysis of residuals was performed to assess the validity of assumptions of normality, homoscedasticity, and independence between observations (with the Durbin–Watson test). Tolerance indices were analyzed to track possible multicollinearities – a lack of significant collinearity was adopted for a tolerance index greater than 0.1.

A mediation model, with GHQ-30 depression/anxiety and interpersonal relations scales as mediators, was created and analyzed using Hayes Process Macro. A post hoc analysis was performed to verify the statistical power. Bootstrapping, with sampling set at n = 5000. was performed to empower the results and account for possible non-parametric distribution. Statistical significance was defined as p < 0.05 or a confidence interval not encompassing 0.

4. Results

Correlations between the continuous variables of interest revealed a statistically significant weak and negative association between morning affect (CSM) and suicidal behavior (SBQ-R), as well as positive associations between suicidal behavior (SBQ-R) and depression/anxiety and interpersonal relations (GHQ-30), the latter two being moderate and weak, respectively. Correlations between all the continuous variables considered in this study are presented in Table 2. Subsequently, the

model predicting suicidal behavior, as well as the model focusing specifically on chronotype-related variables as predictors of suicidal behavior were both analyzed. Their proprieties are presented in Table 3. In order to analyze the possible mediation effect, the direct and indirect effects are presented Table 4.

5. Discussion

This aim of the study was to assess the protective effect of morning affect against suicidal behavior, thus exploring the link between chronotype and suicidality. The analysis included depressive and anxiety symptoms, as well as social functioning, as mental health factors possibly mediating this relationship. The proposed mediation model revealed that these mental health factors can in fact explain the relationship.

While morningness has been presented as a potential protective factor buffering against risk of suicidal behavior (Gaspar-Barba et al., 2009; Park et al., 2018; Selvi et al., 2010; 2011), our findings indicate that this effect becomes irrelevant when taking into consideration other mental health characteristics, *viz.* psychopathological symptoms of depression and anxiety and the quality of interpersonal relations. Although it suggests that the role of the chronotype itself is rather secondary to general mental health, the results are in line with subject literature. A similar model suggesting that the predictive value of

Table 3
A summary of the hierarchical linear regression analyses predicting suicidal behavior among students. Presented as unstandardized parameter (B) and bias-corrected accelerated 95% confidence intervals (BCa95% CI); results derived by Bootstrapping with N = 5000 sampling.

Chronotype and social jetlag as SBQ-R predictors (R2 = 0.056; F = 5987; df = 3; p < 0.001)				
Predictor	β	βCa95%CI	t	p
Morning Affect (CSM)	−0.203	[-0.320; −0.075]	−3176	0.002
Clock time (CSM)	−0.027	[-0.144; 0.093]	−0.417	0.677
SJLsc	−0.089	[-0.355; 0.039]	−1.582	0.115
Full model (R2=0.406; df=8; F=25,345; p<0.001)				
Predictor	**β**	**βCa95%CI**	**t**	**p**
GHQ-30 (depression/anxiety)	0.419	[0.172; 0.306]	7049	**<0.001**
GHQ-30 (interpersonal relations)	0.111	[0.006; 0.378]	2032	**0.043**
Morning Affect (CSM)	0.032	[-0.075; 0.137]	0.578	0.564
Clock time (CSM)	−0.056	[-0.148; 0.043]	−1081	0.281
Suicide acceptance (SAQ)	0.295	[0.101; 0.193]	6289	**<0.001**
SJLsc	−0.017	[-0.189; 0.129]	−0.374	0.709
Substance use	0.060	[-0.268; 1.383]	1.329	0.185
Age	0.067	[-0.042; 0.284]	1485	0.146

R^2 – coefficient of determination; F – Fisher-Snedecor test statistics; df – degrees of freedom; p – probability in the test; GHQ-30 - The General Health Questionnaire, 30-item version; CSM - The Composite Scale of Morningness; SAQ - Suicide Acceptance Questionnaire; SBQ-R - The Suicidal Behaviors Questionnaire-Revised; SJLsc – social jetlag calculated with the sleep corrected formula.

Table 2
Pearson's correlation quotients of the association between pairs of the variables of interest in the studied group.

	Morning Affect	Clock time	GHQ-30 depression/anxiety	GHQ-30 interpersonal relations	SJLsc	SAQ	SBQ-R
Morning Affect	–	0.484**	−0.377**	−0.207**	−0.025	−0.158**	−0.218**
Clock time	0.484**	–	−0.105	−0.097	0.062	−0.113	−0.130
GHQ-30 depression/anxiety	−0.377**	−0.105	–	0.559**	−0.130*	0.249**	0.542**
GHQ-30 interpersonal relations	−0.207**	−0.097	0.559**	–	−0.079	0.205**	0.399**
SJLsc	−0.025	0.062	−0.130*	−0.079	–	−0.035	−0.095
SAQ	−0.158**	−0.113*	0.249**	0.205**	−0.035	-	0.430**
SBQ-R	−0.218**	−0.130*	0.542**	0.399**	−0.095	0.430**	-

** - p < 0.01, * - p < 0.05; GHQ-30 - The General Health Questionnaire, 30-item version; CSM - The Composite Scale of Morningness; SAQ - Suicide Acceptance Questionnaire; SBQ-R - The Suicidal Behaviors Questionnaire-Revised; SJLsc – social jetlag calculated with the sleep corrected formula.

Table 4
The direct and indirect (i.e., mediated by anxiety/depression and interpersonal relations) effect of morningness (assessed with the CSM) on suicidal behavior (SBQ-R). The data is presented as standardized estimates from linear regression models, with 95% Confidence Intervals (CI), derived by bootstrapping with N = 5000 sampling.

Direct effect of X on Y	Estimate	95% CI
Morning Affect (CSM)	−0.016	[-0.115; 0.083]
Indirect effects of X on Y (completely standardized)	**Estimate**	**95% CI**
Total indirect effects	−0.201	[-0.269; −0.135]
GHQ-30 (depression/anxiety)	−0.173	[-0.239; −0.111]
GHQ-30 (interpersonal relations)	−0.029	[-0.064; 0.004]

GHQ-30 - The General Health Questionnaire, 30-item version; CSM - The Composite Scale of Morningness.

chronotype regarding suicidal behavior is mediated by general health indices such as somatic symptoms, anxiety, insomnia, and depressive symptoms has been proposed by Mokros et al. (2021).

Depression and its symptoms are the most widely acknowledged risk factors of suicide (Beghi et al., 2021; Chiang et al., 2022; Valdés-García et al., 2021). Both the DSM-5 and ICD-11 recognize recurrent thoughts of death or suicide, suicide ideation and suicide attempts as features of depressive disorders included in the diagnostic criteria (American Psychiatric Association, 2013; World Health Organization, 2022). The association between anxiety and suicide is admittedly less pronounced but nonetheless substantial (Fisher et al., 2022; Nepon et al., 2010). Taken together, depressive and anxiety symptoms are strongly correlated with suicidal behavior, further mediating the relationship between morning affect and suicide. Social support has been shown to reduce the risk of suicidal ideation (Coppersmith et al., 2019; Kusumastuti et al., 2021; Miller et al., 2015; Na et al., 2022; Otten et al., 2022), making interpersonal relations a possible target of interventions aimed at preventing suicide. Relatedly, its importance was reflected by our findings, *viz.* the identified correlations between interpersonal relationships and suicidal behavior, their predictive value regarding suicidal behavior and their mediating role in the relationship between morning affect and suicidal behavior.

Due to the severity of suicide, being not only a mental health-related issue, but also one of the leading global causes of death and disability (Klonsky et al., 2016), it is urgent to identify and investigate both risk factors and protective factors. Grounding the knowledge in such research will facilitate further development of effective suicide prevention interventions and programs. Similarly to existing research (Manoel Bertolote and Fleischmann, 2002; Valdés-García et al., 2021), our findings implicate mental disorder symptoms as core risk factors for suicide, and this should be taken into account by the suicide risk assessment process.

Concerning chronotype, the results presented in this study encourage further discussion about the nature of relationship between chronotype and mental health. On the one hand, such discussion should address the aspect of circadian rhythm disruptions induced by mental disorder. Many reports indicating chronotype as a risk factor of sorts stem from research based on clinical samples. Consequently, it can be easily overlooked that a certain chronotype might actually emerge as a symptom of specific mental health disorders. It should therefore be explored whether these relationships are relevant in both a clinical and non-clinical context. On the other hand, a growing body of research explores the dimensions of chronotype exceeding morningness and eveningness. It seems that characteristics such as distinctness (i.e., the strength or rigidity of circadian preference) should be considered as proper risk factors, rather than the morningness-eveningness component of chronotype (Carciofo, 2020; Mokros et al., 2017;

Nowakowska-Domagała et al., 2022).

As this study focused on young adults – a population particularly vulnerable to suicide (Patton et al., 2009) – the results should be especially valuable to the practitioners involved in the process of suicide risk assessment and suicide prevention aimed at this group. While chronotype's role turned out to be secondary to general mental health, the associations between morning affect, eveningness and mental health symptoms, regardless of its nature, should be acknowledged (Bauducco et al., 2020; Díaz-Morales et al., 2015). Based on this study's results, psychopathological symptoms as well as social functioning and social support should be the primary targets of suicide prevention programs. However the interventions targeting chronotype could also be applicable in some cases. Such interventions as well as their sleep, circadian and health outcomes have already been studied among adolescents (Harvey et al., 2018), albeit not in the context of suicide prevention. Nevertheless, a treatment addressing the importance of chronotype could potentially reduce the severity of experienced mental health symptoms and consequently reduce suicide risk.

6. Limitations

Although most research evaluating chronotype includes mainly self-reported techniques, this approach can reflect convictions and beliefs of participants and not necessarily their true behaviors, distorting the perception of research subject (Bauducco et al., 2020). Nevertheless, its accessibility and ease of use makes it common practice in scientific research. While acknowledging its flaws, this study nevertheless includes validated and recognized psychometric tools, allowing the results to be replicated or compared. While the CSM is one such tool, it does not assess the distinctness of chronotype which, as it was already discussed, is an emerging, important factor.

Furthermore, the study did not control for the additional work and its schedule, which could impose certain hours of activity and rest, affecting the severity of psychopathological symptoms experienced by students, depending on the chronotype. Future research should aim to address the role of work schedule as a factor related to both chronotype and general mental health.

It should also be noted that the sample exclusively consisted of young adults. This could heavily influence the results, as some effects of chronotype are believed to cumulate over the years, manifesting themselves only later in life (Haraden et al., 2017).

CRediT authorship contribution statement

KND: conceptualisation, data curation, funding acquisition, formal analysis, investigation, methodology, writing –original draft, writing –review and editing, MJD: data curation, investigation, writing and editing MP: investigation, writing and editing, AL: data curation, investigation, writing –review and editing, TP: writing –review and editing, supervision, ŁM: formal analysis, investigation, writing –original draft writing –review and editing, supervision; All authors have read and approved the final version of the manuscript.

Data availability statement

The data that support the findings of this study are available from the corresponding author, [KND], upon reasonable request.

Declaration of competing interest

All authors confirm no conflicts of interest associated with this

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