Anger-Related Characteristics According to Chronotypes in Bipolar or Depressive Disorders

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Objective   Though anger was highly associated with eveningness in general population, there is no study on the relationship between chronotype and anger-related characteristics in bipolar or depressive disorders. This study aimed to investigate the difference of anger-related characteristics according to chronotypes in bipolar or depressive disorders.

Methods   Patients with bipolar or depressive disorders (n=238) were included in this study. Their chronotypes and anger-related characteristics were assessed with a self-evaluation of the Composite Scale of Morningness (CSM), the State Trait Anger Expression Inventory (STAXI) and the Anger Coping Scale (ACS).

Results   The eveningness group in patients with mood disorders showed the highest scores of anger-trait (p<0.001), anger-expression (p=0.002) and anger-in (p<0.001) in STAXI subscales, verbal aggression (p=0.010) in ACS subscales among three groups, but the morningess group showed the lowest scores of these subscales among three groups. However, there were no significant differences in all subscales of the STAXI and ACS according to diagnostic subtypes in the Friedman test.

Conclusion   The results of this study suggested that eveningness in patients with mood disorders might be related to anger proneness and maladaptive anger coping. To manage anger emotion in the patients with mood disorders, therapeutic interventions to modulate eveningness might be helpful.   **Psychiatry Investig 2020;17(9):880-888**

Key Words   Chronotype, Anger, Coping, Bipolar disorder, Depressive disorder.

INTRODUCTION

Chronotype is a type of behavioral manifestation of circadian rhythm that refers to the personal propensity of timing for activity and sleep. There are numerous studies that show chronotype is closely related to emotional dysregulation. In particular, individuals with eveningness have tendency to represent more mood-related symptoms such as anxiety, depression, mood fluctuation and suicidal ideation than people with other chronotypes.[1-3] Eveningness is also associated with impulsivity-related disorders such as addiction,[4] eating problems[5] and impulsivity-related characteristics, such as higher sensation seeking, disinhibited trait and risk-taking behavior.[6,7]

Furthermore, previous studies suggested that eveningness was related to anger proneness and regulation. In a web survey with 6,436 subjects, the eveningness group showed higher levels of anger as well as maladaptive emotional profiles such as lower levels of control, volition, coping, and inhibition measured by the Affective and Emotional Composite Temperament Scale than the morningness group.[8] Another study examined the association between morningness-eveningness and impulsivity as well as with anger in a general population consisted of community-dwelling subjects.[9] In this study, morningness was negatively associated with the impulsivity and anger, respectively. Additionally, the impulsivity played a role as a moderator on the association between chronotype and anger. One comprehensive review with subjects of childhood and adolescent reported that behavioral and emotional problems, such as aggression or antisocial behavior were more pronounced in the eveningness group than the morningness.[10]

Similarly, study with 4,948 adolescents examined the relationship among chronotype, emotional and behavioral problems by using the Strengths and Difficulties Questionnaire including the contents related to anger.[11] This study also showed that the eveningness were associated with an increased risk of emotional and behavioral problems. Therefore, chronotypes are likely to have the close relationship with anger.

Relationships between anger-related characteristics and mood disorders such as bipolar or depressive disorders have also been studied. Approximately 62% of patients with bipolar disorders during depressive episode and 26% to 44% of patients with unipolar depressive disorders during depressive episode, such as major depression and dysthymia suffer from anger attacks.[12,13] Bipolar patients express their impulsive outbursts of anger in more aggressive ways than patients with depressive disorders.[14] Even though bipolar patients are in the phases of bipolar prodrome or bipolar depression, they are likely to become angry.[15] Irritability and anger dyscontrol were the earliest distinguishable factors in childhood bipolar patients.[12,15] In addition, patients with depressive disorders have more anger feelings than those with anxiety disorders, somatoform disorders and healthy controls.[16] Previous studies support that anger might be highly associated with both bipolar and depressive disorders.

Though previous studies have reported relationships between anger and chronotype in general population, there is no study on the relationships between chronotype and anger-related characteristics in bipolar or depressive disorders. Given that anger is one of the negative emotions that should be importantly treated in patients with bipolar or depressive disorders, it would be meaningful to investigate the relationships between anger and chronotype in bipolar or depressive disorders. We hypothesized that the eveningness chronotype might have higher anger proneness and more maladaptive anger coping than other chronotypes. In addition, the patients with bipolar disorders might have higher anger proneness and more dysfunctional anger coping in the eveningness groups than those with depressive disorders. Therefore, this study aimed to investigate the anger-related characteristics, including anger coping strategies, according to the chronotypes in patients with bipolar or depressive disorders, respectively.

METHODS

Subjects

We collected and analyzed data from patients who had consecutively visited the Mood Disorders Clinic (MDC) at Pusan National University Hospital between January 1, 2012 and January 31, 2019. The study protocol was approved by the Institutional Review Board of Pusan National University Hospital (H-1611-003-048). All procedures in the study were carried out in accordance with the principles of the Declaration of Helsinki. The inclusion criteria were: 1) Outpatients with bipolar or depressive disorders clinically assessed by psychiatrist according to the Diagnostic and Statistical Manual for Axis I disorder fourth edition (DSM-IV) criteria; 2) Patients aged 18−65 years; 3) Patients who were in full or partial remission states at the assessment visit in order to avoid the distorting influence on self-rating assessment by acute mood episodes. This full or partial remission was determined by a psychiatrist, based on the definition as the states that do not meet the sufficient durations and numbers of symptoms for major mood episodes according to the DSM-IV criteria. The criteria for exclusion were: 1) Patients who have a personality disorder as a principle diagnosis clinically assessed by psychiatrist according to the DSM-IV criteria; 2) Patients with severe medical diseases; 3) Patients with an organic mental disorder and/or mental retardation, and 4) Patients who cannot read and/or write. Finally, data from 238 patients were included in the analysis, which consisted of 148 bipolar disorders (62.2%), and 90 depressive disorders (37.8%); 57 bipolar I disorder (23.8%), 34 bipolar II disorder (15.0%), 57 bipolar disorder not otherwise specified (23.8%), 47 major depressive disorder (19.6%), 37 depressive disorder not otherwise specified (15.4%) and 6 dysthymic disorder (2.5%). In case of missing data on some sections, the missing data were imputed through reassessments during following visits.

Design and assessment

This study is a cross-sectional study for exploring the difference of anger experience and anger coping style according to chronotypes in bipolar or depressive disorders. Age, sex, job, marital status, education, age of onset, chronotype, anger-related characteristics, depressive symptoms and anxiety symptoms were additionally assessed.

Assessment of chronotypes

Chronotypes were measured with the Composite Scale of Morningness (CSM). The CSM is a thirteen-item self-report questionnaire for assessing a person's circadian preferences judging with various activities that allows to classify individuals accordingly. The CSM demonstrated good test-retest reliability and acceptable validity in previous studies.[17,18] Ten items of the CSM are scored 1 to 4 each, while the other three items can be 1 to 5, thus a total score range would be from 13 to 55, and higher scores indicate greater morning preference. The Korean version of the CSM has shown test-retest reliability of 0.91 and Cronbach's alpha of 0.82. The chronotypes of the Korean version of the CSM are supposed to be classi-

fied as eveningness type (range from 13 to 26), intermediate type (range from 27 to 40) and morningness type (range from 41 to 55).[19] The Cronbach's alpha for CSM in this study was 0.839.

Assessment of anger-related characteristics

The anger-related characteristics were assessed using the State Trait Anger Expression Inventory (STAXI) and the Anger Coping Scale (ACS). The STAXI is a self-report inventory with 44 items to measure the components of anger.[20] It has five main subscales as following: State Anger (current feelings of anger), Trait Anger (anger temperament and anger reactions), Anger-In (holding in or suppressing anger), Anger-Out (the outward expression of anger) and Anger-Control (attempts to control the expression of anger). All items can be rated between 1 and 4. Higher scores on the State Anger and Trait anger represent higher level of anger. Total score of anger expression is calculated by 'Anger-In + Anger-Out – Anger Control + 16' with a score range between 0 and 72. Higher anger expression can be translated as more incompetent anger coping. The Korean version of the STAXI questionnaire has been reported that it is acceptable for psychometric properties.[21]

The ACS developed by Koh and Park in 2005 is a self-report inventory with 19 items to assess the coping style in anger situations.[22] It consists of five subscales, which are behavioral aggression, verbal aggression, problem-solving, tension-releasing and anger suppression. Behavioral aggression is about venting his/her anger by beating or having physical quarrel with the other side while verbal aggression refers venting his/her anger by cussing or having verbal quarrel when one is in anger state. Problem-solving coping is an attempt to understand a problem situation objectively and look for solutions. Tension-releasing coping refers calming one's anger by such as exercise, humor, taking bath, mediating and so on. Anger suppression is avoiding outbursts of anger and holding in when someone is faced with anger situations. All items of the ACS were rated by a 5-point Likert scale, from 'never' to 'very likely.' The inventory has been found to have acceptable internal consistency. (Cronbach's alpha values varied between 0.73 to 0.86).[23]

Assessment of severity of depressive and anxiety symptoms

The severity of depressive symptoms was measured using the Beck Depression Inventory (BDI), whereas the severity of anxiety symptoms was evaluated with the Beck Anxiety Inventory (BAI). The BDI is a self-report scale that is composed of 21 items for assessing affective, cognitive, motivational and physiological depression symptoms. All items can be rated between 0 and 3, thus the total scores range from 0 to 63. In this study, we used the Korean version of BDI with acceptable internal consistency (Cronbach's alpha, values varied between 0.80 and 0.90).[24] The BAI is also a self-report scale of 21 items to assess the severity of anxiety symptoms on cognitive, affective and physical domains. It has a 4-point Likert scale from 0 to 3 with total score range of 0−63. The Korean version of the BAI with a reliable Cronbach's coefficient (0.93) and a test-retest reliability (0.84) was used in this study.[25] We obtained a license to use the Korean version of BDI and BAI from Korea Psychology Co., LTD.

Statistical analysis

The scores of each scale and demographic data were compared according to chronotypes and diagnosis. The subjects were divided into two groups as bipolar group (BD; including bipolar I disorder, bipolar II disorder and bipolar disorder not otherwise specified) and depressive group (DD; including major depressive disorder, dysthymic disorder and depressive disorder not otherwise specified) according to the diagnosis. All variables of scales used in this study (all subscales, $p<0.05$) did not show normal distribution by the Shapiro-Wilks test. Therefore, nonparametric statistics were used in this study. In order to explore the correlations between clinical variables and CSM score, Spearman's correlations were performed. The chi-square test or Fischer's exact test was used to compare categorical variables. In the case of continuous variables, the Mann Whitney U test, which is a nonparametric test of independent t-test was used for comparison of two groups. For comparison of three groups, the Kruskall-Wallis test, which is a nonparametric test of analysis of variance (ANOVA) was used. When the Kruskall-Wallis test yielded a significant outcome, the Jonckheere trend test for post-hoc test was performed. In order to explore the effects of chronotypes and diagnostic groups, the Friedman two-way analysis of variance by ranks was performed.[26,27] Furthermore, the anger-related characteristics among the chronotypes were analyzed by rank analysis of covariance (rank ANCOVA) in order to adjust the influence of covariates, such as age, age at onset, BDI score and BAI score.[28] The data analysis was conducted using R statistical software, version 3.6.0. In all analysis, the level of significance was set at $p<0.05$, 2-tailed probability.

RESULTS

Sociodemographic and clinical variables of participants

Patients with bipolar disorders were 32.6 (±11.4) years old on average and 58.8% of them were female while patients with depressive disorders were 35.3 (±13.0) years old on average

Table 1. Sociodemographic and clinical variables of participants

	BD (N=148)	DD (N=90)	Total MD (N=238)	U or χ^2	p-value
Age, mean year (±SD)	32.6 (±11.4)	35.3 (±13.0)	33.7 (±12.0)	6,008.500	0.206
Female, N (%)	87 (58.8)	45 (50.0)	132 (55.5)	1.748	0.186
Job, N (%)				1.045	0.903
No	39 (26.4)	21 (23.3)	60 (25.2)		
Part-time job	14 (9.5)	6 (6.7)	20 (8.4)		
Full-time job	42 (28.4)	27 (30.0)	69 (29.0)		
Housewife/-husband	23 (15.5)	16 (17.8)	39 (16.4)		
Student	30 (20.3)	20 (22.2)	50 (21.0)		
Marital status, N (%)				3.480	0.176
Unmarried	97 (65.5)	49 (54.4)	146 (61.3)		
Married/cohabited	35 (23.6)	31 (34.4)	66 (27.7)		
Divorced/separated	16 (10.8)	10 (11.1)	26 (10.9)		
Education, mean year (±SD)	14.0 (±1.9)	13.4 (±2.3)	13.8 (±2.1)	5,898.000	0.122
Diagnosis, N (%)†				1.748	0.186
BP-I	57 (38.5)	-	57 (23.8)		
BP-II	34 (23.0)	-	34 (15.0)		
BD-NOS	57 (38.5)	-	57 (23.8)		
MDD	-	47 (52.2)	47 (19.6)		
DD-NOS	-	37 (41.1)	37 (15.4)		
Dysthymic disorder	-	6 (2.5)	6 (2.5)		
Age of onset, mean year (±SD)	25.2 (±9.7)	30.1 (±12.8)	27.3 (±11.3)	5,031.500	0.002*
BDI, mean (±SD)	23.5 (±15.2)	26.8 (±12.3)	24.8 (±14.2)	5,666.000	0.054
BAI, mean (±SD)	21.0 (±15.9)	22.6 (±13.5)	21.5 (±15.0)	6,052.000	0.238
Chronotypes, N (%)				0.539	0.764
Morningness	17 (11.5)	9 (10.0)	26 (10.9)		
Intermediate	99 (66.9)	58 (64.4)	157 (66.0)		
Eveningness	32 (21.6)	23 (25.6)	55 (23.1)		

Statistics was tested by chi-Square test or Mann-Whitney U test. Data show mean (±SD) and number (%). *p<0.01, †Fisher's exact test was done. MD: total group of mood disorder, BD: group of bipolar disorders, DD: group of depressive disorders, BP-I: bipolar I disorder, BP-II: bipolar II disorder, BP-NOS: bipolar disorder not otherwised specified, MDD: major depressive disorder, DD-NOS: depressive disorder not otherwised specified, BDI: Beck Depression Inventor, BAI: Beck Anxiety Inventory

and 50.0% of them were female. As shown in the Table 1, there were no significant differences in age, sex, job, marital status, education, BDI scores, BAI scores and chronotypes between bipolar and depressive patients (age U=6008.5, p=0.206; sex χ^2=1.748, p=0.186; Job χ^2=1.045, p=0.903; marital status χ^2=3.480, p=0.176; education U=5898.0, p=0.122; BDI U=5666.0, p=0.054; BAI U=6052.0, p=0.238; chronotype χ^2=0.539, p=0.764). However, patients with bipolar disorders showed earlier age of onset than patients with depressive disorders (p=0.002).

Spearman correlation between clinical variables and CSM score

In the patients with mood disorders, clinical variables, such as age (p<0.001), age of onset (p=0.001), BDI scores (p<0.001) and BAI scores (p<0.001) were significantly correlated to CSM score (Table 2). Meanwhile, in the patients with bipolar disorders, several clinical variables, such as age (p=0.011), BDI scores (p<0.001), and BAI scores (p=0.001) were significantly correlated to CSM score. In patients with depressive disorders, clinical variables, such as age (p=0.002), age of onset (p=0.001), BDI scores (p=0.033) and BAI scores (p=0.005) were significantly correlated to CSM score.

There were significant correlations between anger-related characteristics and CSM score. In the patients with mood disorders, anger-related characteristics, such as anger-state (p=0.012), anger-trait (p<0.001), anger-expression (p<0.001), anger-in (p<0.001), anger-out (p=0.003), verbal aggression (p=

Table 2. Spearman correlations between composite scale of morningness score and anger-related clinical variables

	BD (N=148)	DD (N=90)	Total MD (N=238)
Age	0.209 (0.011)*	0.318 (0.002)**	0.249 (<0.001)**
Age of onset	0.142 (0.086)	0.349 (0.001)**	0.220 (0.001)**
BDI	-0.418 (<0.001)**	-0.226 (0.033)*	-0.349 (<0.001)**
BAI	-0.275 (0.001)**	-0.292 (0.005)**	-0.276 (<0.001)**
STAXI			
S	-0.222 (0.007)**	-0.056 (0.601)	-0.163 (0.012)*
T	-0.248 (0.002)**	-0.279 (0.008)**	-0.253 (<0.001)**
E	-0.319 (<0.001)**	-0.283 (0.007)**	-0.303 (<0.001)**
C	0.133 (0.108)	-0.105 (0.324)	0.119 (0.068)
AI	-0.347 (<0.001)**	-0.266 (0.011)*	-0.319 (<0.001)**
AO	-0.184 (0.025)*	-0.206 (0.052)	-0.189 (0.003)**
ACS			
VA	-0.207 (0.011)*	-0.193 (0.069)	-0.197 (0.002)**
BA	-0.022 (0.792)	-0.198 (0.061)	-0.079 (0.227)
TR	0.289 (<0.001)**	0.064 (0.548)	0.206 (0.001)**
AS	-0.075 (0.367)	-0.169 (0.111)	-0.114 (0.080)
PS	0.112 (0.176)	-0.004 (0.972)	0.072 (0.267)

Statistics were tested by nonparametric Spearman correlation analysis. Data are displayed as Speaman coefficient and p-values within parentheses. *p<0.05, **p<0.01. MD: total group of mood disorder, BD: group of bipolar disorders, DD: group of depressive disorders, BDI: Beck Depression Inventory, BAI: Beck Anxiety Inventory, STAXI: State Trait Anger Expression Inventory, S: anger-state, T: anger-trait, E: anger-expression, C: anger-control, AI: anger-in, AO: anger-out, ACS: anger coping scale, VA: verbal aggression, BA: behavioral aggression, TR: tension-releasing, AS: anger suppression, PS: problem-solving

0.002) and tension-releasing (p=0.001) were significantly correlated to CSM score. Meanwhile, in the patients with bipolar disorders, anger-related characteristics, such as anger-state (p=0.007), anger-trait (p=0.002), anger-expression (p<0.001), anger-in (p<0.001), anger-out (p=0.025), verbal aggression (p=0.011) and tension-releasing (p<0.001) were significantly correlated to CSM score. In the patients with depressive disorders, anger-related characteristics, such as anger-trait (p=0.008), anger-expression (p=0.007) and anger-in (p=0.011) were significantly correlated to CSM score.

Comparison of anger-related characteristics among three chronotypes in patients with bipolar or depressive disorders

In the Kruskall-Wallis analysis, there were significant differences in anger-trait (p<0.001), anger-expression (p=0.002), and anger-in (p<0.001) scores of the STAXI and verbal aggression (p=0.022), tension-releasing (p=0.005) scores of the ACS among three chronotype groups in the patients with mood dis-

orders (Table 3). Meanwhile, there were significant differences in anger-state (p=0.042), anger-trait (p=0.001), anger-expression (p=0.005), and anger-in (p<0.001) scores of the STAXI and verbal aggression (p=0.042), tension-releasing (p<0.001) scores of the ACS among three chronotype groups in patients with bipolar disorders. However, there were no significant differences of STAXI subscales and ACS subscales among three chronotypes in the patients with depressive disorders.

In the Jonckheere trend test, the eveningness group in the patients with mood disorders showed the highest scores of anger-trait (p<0.001), anger-expression (p=0.002) and anger-in (p<0.001) in STAXI subscales, verbal aggression (p=0.010) in ACS subscales among three groups, but the morningess group showed the lowest scores of these subscales among three groups. By contrast, the tension-releasing anger coping was the lowest in the eveningness group and the highest in the morningness group. (p=0.005). Meanwhile, the eveningness group in the patients with bipolar disorder showed the highest scores of anger-state (p=0.038), anger-trait (p=0.002), anger-expression (p=0.004) and anger-in (p<0.001) in STAXI subscales, verbal aggression (p=0.017) in ACS subscales among three groups, but the morningess group showed the lowest scores of these subscales among three groups. By contrast, the tension-releasing anger coping was the lowest in the eveningness group and the highest in the morningness group (p=0.001).

In order to explore the effects of chronotypes and diagnostic groups on anger-related characteristics, the Friedman two-way analysis of variance by ranks was performed. However, no significance was shown in STAXI and ACS subscales according to both the groups of chronotypes and diagnostic subtypes in total 238 patients (anger-state, p=0.867; anger-trait, p=0.135; anger-expression, p=0.135; anger-control, p=0.368; anger-in, p=0.135; anger-out, p=0.223; verbal aggression, p=0.135; behavioral aggression, p=0.223; tension-releasing, p=0.156; anger-suppression, p=0.368; problem-solving, p=0.368).

Comparison of anger-related characteristics among three chronotypes after covariate adjustment

After adjusting the effects of age, age at onset, BDI and BAI, anger-related characteristics were compared among three chronotypes in total 238 patients with mood disorders (Table 4). After the adjustment of age, still significant differences existed in anger-trait (p=0.003), anger-expression (p=0.002), anger-control (p= 0.016), anger-in (p=0.026) of the STAXI and verbal aggression (p=0.005), tension releasing (p=0.005) of the ACS. After the adjustment of age of onset, there were still significant differences in anger-expression (p=0.021) of the STAXI and tension releasing (p=0.033) of the ACS. After the adjustment of BDI scores, there were still significant differences in anger-trait (p=0.044) of the STAXI and verbal aggression (p=0.044)

Table 3. Comparison of anger-related subscales according to chronotypes in patients with bipolar or depressive disorders

	Bipolar disorders (N=148)						Depressive disorders (N=90)						Total mood disorders (N=238)					
	Morningness (N=17)	Intermediate (N=99)	Eveningness (N=32)	χ^2	p	JT	Morningness (N=9)	Intermediate (N=58)	Eveningness (N=23)	χ^2	p	JT	Morningness (N=26)	Intermediate (N=157)	Eveningness (N=55)	χ^2	p	JT
STAXI																		
S	12.3 (±5.0)	15.3 (±7.7)	15.1 (±5.7)	6.335	0.042*	M<I<E (0.038)*	16.6 (±7.1)	14.4 (±5.5)	15.3 (±6.8)	0.864	0.649	-	13.8 (±6.0)	15.0 (±7.0)	15.2 (±6.1)	4.010	0.135	-
T	19.6 (±8.1)	20.1 (±7.3)	26.2 (±7.9)	14.496	0.001**	M<I<E (0.002)**	18.4 (±7.1)	19.6 (±6.7)	22.6 (±6.2)	4.659	0.097	-	19.2 (±7.6)	20.0 (±7.1)	24.7 (±7.4)	17.877	<0.001**	M<I<E (<0.001)**
E	28.2 (±12.7)	32.4 (±12.3)	38.6 (±11.4)	10.699	0.005**	M<I<E (0.004)**	29.4 (±9.9)	32.6 (±10.1)	35.6 (±12.0)	2.425	0.297	-	28.6 (±11.6)	32.5 (±11.5)	37.3 (±11.6)	12.522	0.002**	M<I<E (0.002)**
C	20.1 (±4.7)	18.0 (±5.8)	17.3 (±6.4)	3.644	0.162	-	18.6 (±3.8)	18.2 (±4.5)	18.0 (±5.0)	0.033	0.983	-	19.5 (±4.4)	18.1 (±5.3)	17.6 (±5.8)	2.703	0.259	-
AI	16.9 (±6.5)	18.2 (±5.5)	22.3 (±4.8)	16.242	<0.001**	M<I<E (<0.001)**	18.3 (±5.8)	19.7 (±5.3)	21.3 (±5.2)	2.022	0.364	-	17.4 (±6.2)	18.7 (±5.5)	21.9 (±4.9)	16.917	<0.001**	M<I<E (<0.001)**
AO	15.3 (±5.6)	16.2 (±5.9)	17.5 (±5.5)	2.585	0.275	-	13.7 (±4.8)	15.2 (±4.3)	16.4 (±5.6)	1.855	0.396	-	14.7 (±5.3)	15.9 (±5.4)	17.0 (±5.6)	3.918	0.141	-
ACS																		
VA	3.5 (±3.1)	4.7 (±3.4)	6.0 (±3.7)	6.352	0.042*	M<I<E (0.017)*	3.3 (±2.7)	4.3 (±3.2)	5.0 (±3.3)	1.855	0.396	-	3.5 (±2.9)	4.6 (±3.4)	5.6 (±3.5)	7.674	0.022*	M<I<E (0.010)*
BA	1.4 (±1.7)	1.5 (±2.4)	1.6 (±2.2)	0.525	0.769	-	0.6 (±1.0)	0.7 (±1.2)	1.5 (±1.8)	3.091	0.213	-	1.1 (±1.5)	1.2 (±2.1)	1.5 (±2.0)	1.777	0.411	-
TR	6.8 (±3.7)	4.3 (±3.8)	2.6 (±2.4)	15.316	<0.001**	M>I>E (0.001)**	3.0 (±2.4)	3.3 (±2.8)	3.1 (±2.5)	0.034	0.983	-	5.5 (±3.8)	3.9 (±3.5)	2.8 (±2.4)	10.519	0.005**	M>I>E (0.005)**
AS	4.9 (±2.5)	4.7 (±2.6)	5.9 (±2.8)	4.079	0.130	-	4.9 (±2.6)	5.8 (±2.5)	6.0 (±2.7)	0.864	0.649	-	4.9 (±2.5)	5.1 (±2.6)	5.9 (±2.7)	3.665	0.160	-
PS	11.6 (±4.3)	9.2 (±4.2)	9.0 (±5.0)	4.199	0.123	-	8.8 (±3.8)	8.2 (±3.5)	9.5 (±4.6)	1.716	0.424	-	10.6 (±4.3)	8.8 (±3.9)	9.2 (±4.8)	3.293	0.193	-

Data are shown as mean (±SD). Kruskal-Wallis test and Jonckheere test (JT) were used. *p<0.05, **p<0.01. STAXI: State Trait Anger Expression Inventory, S: anger-state, T: anger-trait, E: anger-expression, C: anger-control, AI: anger-in, AO: anger-out, ACS: anger coping scale, VA: verbal aggression, BA: behavioral aggression, TR: tension-releasing, AS: anger suppression, PS: problem-solving

Table 4. Comparison of anger-related subscales according to chronotypes after adjustment of covariates in 238 patients with mood disorders

	Rank ANCOVA									
	Age		Age of onset		BDI		BAI		Age of onset+BDI	
	F	p	F	p	F	p	F	p	F	p
STAXI										
S	0.982	0.396	0.030	0.970	1.159	0.339	1.652	0.219	1.226	0.320
T	8.545	0.003**	3.377	0.086	3.817	0.044*	2.659	0.097	4.959	0.021*
E	10.080	0.002**	6.576	0.021*	2.305	0.132	0.694	0.512	3.772	0.046*
C	5.399	0.016*	1.046	0.395	0.668	0.527	0.386	0.685	0.048	0.953
AI	13.655	<0.001**	1.733	0.237	1.704	0.213	5.068	0.018*	3.738	0.047*
AO	1.887	0.184	2.531	0.141	0.683	0.541	0.443	0.649	3.889	0.042*
ACS										
VA	7.428	0.005**	3.938	0.065	3.839	0.044*	1.592	0.231	2.165	0.147
BA	3.107	0.072	0.428	0.666	1.558	0.241	0.793	0.468	1.120	0.351
TR	7.364	0.005**	5.356	0.033*	1.682	0.217	9.992	0.001*	1.256	0.312
AS	0.933	0.414	0.737	0.509	0.745	0.491	0.364	0.700	0.754	0.486
PS	1.199	0.327	1.058	0.391	0.096	0.909	1.525	0.245	0.149	0.863

Effects of age of onset, Beck Depression Inventory (BDI) scores are adjusted by rank analysis of covariance (rank ANCOVA). *p<0.05, **p<0.01. STAXI: State Trait Anger Expression Inventory, S: anger-state, T: anger-trait, E: anger-expression, C: anger-control, AI: anger-in, AO: anger-out, ACS: anger coping scale, VA: verbal aggression, BA: behavioral aggression, TR: tension-releasing, AS: anger suppression, PS: problem-solving

of the ACS. After the adjustment of BAI scores, there were still significant differences in anger-in (p=0.018) of the STAXI and tension releasing (p=0.001) of the ACS. Considering the multicolinealities between age and age of onset and between BDI and BAI scores, the adjustment of age of onset and BDI scores was performed. As results, there were still significant differences in anger-trait (p=0.021), anger-expression (p=0.046), anger-in (p=0.047) and anger-out (p=0.042) of the STAXI.

DISCUSSION

This study has shown that mood disorder patients with eveningness especially who have bipolar disorders, might be related to anger proneness, such as anger-state, anger-trait, anger-expression and anger-in. They failed to response to their anger appropriately and were likely to use maladaptive anger coping, including higher verbal aggression and lower tension-releasing. As in the studies of general population,[8,9] eveningness might be highly associated with anger proneness and maladaptive anger coping in the patients with mood disorders. Based on our findings in the patients with mood disorders and the results of previous studies in general population, the eveningness group can be inferred to be more likely to hold their anger inward and less likely to use tension-releasing than other chronotypes. 'Anger-in' might be a compensatory response to avoid interpersonal conflicts due to an anger expression. However, keeping anger inside cannot be an effective strategy to

deal with anger emotion and to solve anger situation.[29] Unsolved anger can progress into expressed aggressive behavior or other behavioral problems.[30,31] In patients with impulsivity, the process leading to the maladaptive anger expression could occur easier and faster.[9] Given that anger is associated with negative consequences, such as familial conflict and violent behavior,[32,33] the issue of anger control needs to be considered with importance in the patients with mood disorders.

The best way to deal with the anger situation is solving the problem that caused anger.[22] When the anger situation cannot be solved immediately, a tension-releasing coping is needed to endure the anger emotion.[22] However, our findings suggest that the mood disorder patients with the eveningness were likely to cope with anger maladaptively. Several studies reported that individuals with the eveningness had lower executive function and higher impulsivity and emotionality than those with the morningness.[34] The characteristics related to the eveningness may have caused the patients to get angry easily and respond to the anger situation inappropriately. Most of anger management interventions include techniques to deal with anger emotion efficiently and strategies to enhance problem-solving skills.[35,36] In the case of the mood disorder patients with eveningness, therapeutic interventions to modulate the chronotype, for example, social rhythm therapy,[37] might be helpful to reduce anger proneness and improve anger coping adaptively.

The relationship between chronotype and anger charac-

teristics could be influenced by a number of factors. Initially, we expected the differential effects of the chronotype on anger-related characteristics according to diagnostic subtypes in mood disorders, because previous studies suggested that bipolar disorder might be more related to anger than unipolar depression.[12,14,15] However, we were not able to get significant results on the diagnostic effect on the relationship between the chronotype and anger-related characteristics in this study. This insignificant results might be caused by small sample sizes corresponding to the groups of chronotype, as morningness or eveningess among chronotypes was defined by the subjects within a range of upper or lower 10% of CSM scores, respectively.[19] Whether the relevance of chronotype on anger-related characteristics differs or not between bipolar disorders and depressive disorders needs to be reanalyzed in a future study with a large number of samples.

Besides, this study examined the effects of several factors that might be potentially related to chronotype and anger. Factors such as age, age of onset, BDI scores and BAI scores were correlated to the chronotype in this study. After adjusting these factors, some of anger-related characteristics were still significant even though the results were different according to factors. These results imply that the eveningness might be related to anger proneness independent of these covariates, though several factors might have differential influences on each component of anger-related characteristics. In this study, due to the restriction of the sample size, we were not able to analyze the interactions of these factors on the relationship between chronotypes and anger-related characteristics. In order to understand the process that eveningness has an impact on anger proneness and anger coping strategy, a path analysis considering these mediating factors needs to be performed.

There were several limitations in this study. First, this study is a cross-sectional design. Since the influence of chronotypes and other variables associated with anger could be different over time, a prospective longitudinal study would give us more detailed information on this topic. Moreover, this study only used self-report scales for measuring chronotypes and anger-related characteristics. A study using objective measurement such as actigraphy and circadian rhythm hormones beyond chronotypes could reflect the effect of circadian rhythm change on anger state. In the future, a prospective longitudinal study using objective measurement is needed to detect detailed findings on the relationship between anger and circadian rhythms in mood disorders. Furthermore, this study did not consider other mediating factors, such as cognition, insight, symptom severity, numbers of mood episodes, insomnia or other sleep problems. With regards to symptom severity, we excluded patients with major mood episodes. Additionally, statistical adjustments were performed to avoid the influence of depres-

sive symptoms in patients with subsyndromal depression or brief depression that was included inevitably. However, because the statistical adjustments were not perfect, the interpretation of these results should be done cautiously. Lastly, this study was performed at a single university hospital in Korea. Future study needs to be multi-centered and transcultural in order to generalize these results.

Despite these limitations, this study has firstly reported that there might be a relevance of chronotype on anger-related characteristics in patients with mood disorders. Considering that the eveningness might be related to anger proneness and maladaptive anger coping, there is a need to pay more attention to the eveningness in the anger management program. That is, the therapeutic intervention for alleviating excessive eveningness such as the social rhythm therapy might be useful to regulate anger emotions.

Author Contributions

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